EXHIBIT K

Hydrobiological Monitoring Plan

for the

Integrated Local Water Supply Project

Prepared for

CITY OF WICHITA

October 2004

Project Number 34256

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1.0 INTRODUCTION

1.1 PURPOSE AND NEED

The City of Wichita (City) has committed to developing and implementing a Hydrobiological Monitoring Program (HBMP) as part of the mitigation described in the 2003 Final Environmental Impact Statement (EIS) for the Integrated Local Water Supply Project (ILWSP).

The HBMP will help identify and describe a process whereby the possible environmental impacts to existing natural resources resulting from implementation and operation of the ILWSP can be monitored. The HBMP has two basic goals:

- Establish baseline environmental conditions prior to starting construction and operation of the ILWSP
- Evaluate if flows in the Little Arkansas or Arkansas rivers fluctuate to the extent that water quality parameters, or flora, fauna or threatened or endangered species communities, habitat, or populations are either adversely or beneficially impacted

The HBMP is designed to be a flexible plan, one that can be revised as necessary to address changing environmental conditions and the beneficial or adverse impacts that may be a result of the construction or operation of the ILWSP. Much of the information contained within this HBMP has been obtained directly or derived from the Final EIS that was generated for the ILWSP in 2003, or from the periodic HBMP development meetings with participating agencies in 2003 and 2004.

Many of the state and federal agencies that either have been or are currently conducting programs that collect biological or chemical data in the project area have been contacted. The objectives are to supplement the existing available data set and analyses, to avoid unnecessary duplication, and to concentrate, at least initially, on resources that are believed to be most likely impacted by the project. These programs and the data being

collected and analyzed are described in Section 6.0 of the HBMP. By being aware of what information or data is or will be available, the City is able to design a HBMP that directly focuses on specific biological or physical parameters that may be affected by the ILWSP.

As mentioned above, the environmental impacts that may be associated with ILWSP construction and operation may not always be adverse. For example, the hydrologic model used in the ILWSP to predict stream flow impacts indicated that the water surface elevations in Cheney Reservoir and downstream flow volumes in the North Fork of the Ninnescah River would not be reduced with the Project in place. In fact, water surface elevations in the reservoir may be slightly higher, thereby decreasing surface water fluctuations that are currently observed and expected to occur in the future. As indicated in the City's EIS, no adverse impacts are predicted for the reservoir or in the North Fork of the Ninnescah River; therefore, no monitoring is proposed as part of the HBMP.

The HBMP is an environmental monitoring program that is being developed in cooperation with several federal and state agencies. The agencies currently involved with developing and implementing the HBMP for the ILWSP are:

- City of Wichita
- Kansas Department of Wildlife and Parks (KDWP)
- U.S. Fish and Wildlife Service (FWS)
- U.S. Bureau of Reclamation (BOR)
- U.S. Geological Survey (USGS)

Other agencies, groups or individuals may be invited or may request to participate in future HBMP refinement, the analysis of data, and the development of recommendations for future activities as conditions warrant and interest is expressed.

1.2 PLAN OBJECTIVES

The objectives of the HBMP are as follows:

- Document the existing environmental conditions in the Little Arkansas and Arkansas rivers
- Detect if changes in the existing environmental conditions occur
- Determine if any detected environmental changes are caused by the ILWSP or other unrelated causes
- Provide a scientifically defensible means to evaluate whether the ILWSP is causing or significantly contributing to the observed beneficial or adverse environmental changes
- Recommend management actions or operational changes to mitigate adverse or enhance beneficial environmental impacts if they occur or are expected to occur

1.3 BACKGROUND

Even though no lead federal agency was identified, the City proactively developed and completed an EIS for the ILWSP in 2003 that followed the National Environmental Policy Act (NEPA) process. This EIS discloses the environmental impacts that could occur if the City develops and expands multiple local water sources to meet the increased water demands that are expected to occur within the greater metropolitan area of Wichita, Kansas by the year 2050.

The City carefully considered the public and agency comments received during the scoping process, comments received from review of the draft EIS and the NEPA process, and regulatory requirements to determine the range of water supply alternatives to be addressed in the final EIS. The alternatives considered met the following two goals:

- Provide water supply plans capable of supplying the year 2050 projected average and maximum daily demands of 112 and 223 million gallons per day (MGD), respectively, and
- Help protect the Equus Beds aquifer's water quality

With respect to the first goal, the City identified 27 water supply sources or alternatives that were evaluated using conceptual design and operating protocols, estimated project

construction and operation costs, and water quality parameters. These potential alternatives were screened using the following criteria: water supply capability, water quality, future availability, legal issues, policy and political issues, planning horizons, environmental issues, and costs. Ultimately, three alternatives were identified as best meeting the first goal: the Milford Reservoir Plan, the ILWSP with 250 MGD Diversion Option, and the ILWSP with 150 MGD Diversion Option.

These three alternatives were then evaluated to meet the second goal – the capability to protect the Equus Beds aquifer's water quality. The Milford Reservoir Plan alternative does not provide any protection to the aquifer, and was eliminated from further consideration. The remaining two alternatives were compared and refined based on more detailed engineering studies and a demonstration project. Each of the two remaining alternatives satisfied the second goal of providing protection for the Equus Beds aquifer water quality. Refinements ultimately resulted in a reduction in the water quantity each alternative would be required to provide. The result was that the two ILWSP alternatives were renamed – the ILWSP 150 MGD Diversion and the ILWSP 100 MGD Diversion. These two alternatives and the No-Action alternative are considered in detail in the EIS and are summarized below.

No-Action Alternative

Under this alternative, the City would not construct nor provide an expanded water supply to meet projected population growth needs of the Wichita metropolitan area. As with the two water supply alternatives, water conservation is included as a component of the No-Action alternative due to public and agency input received during project scoping process. The No-Action alternative reduces the net water need through self-imposed growth limitations. The City would continue water service to existing retail and wholesale customers, but would not serve any additional wholesale customers. In addition, the City would not provide a water supply for projected population increases outside of their existing service area.

ILWSP 150 MGD Diversion

The ILWSP 150 MGD Diversion alternative would capture water from the Little Arkansas River using a surface water intake and induced filtration wells adjacent to the river. In addition to the surface water intake and induced infiltration wells, facilities to transfer and recharge the captured water to the Equus Beds aquifer, and to recover the stored water (ASR system) would be included in the plan. A pre-sedimentation plant is proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment plants. As with the No-Action alternative, water conservation was an integral part of the ILWSP 150 MGD Diversion alternative. Three options for capturing 150 MGD of water were considered; each option was considered with and without diverting 60 MGD of treated surface water to the City water treatment facilities. The three options were:

- 60/90 ASR Option – Capture of 60 MGD of induced infiltration water for recharge and 90 MGD of surface water for treatment and recharge with an additional option to capture, pre-treat, and convey 60 MGD of surface water direct to the City's water treatment facilities
- 75/75 ASR Option – Capture of 75 MGD of induced infiltration water for recharge and 75 MGD of surface water for treatment and recharge with additional option to capture, pre-treat, and convey 60 MGD of surface water direct to the City's water treatment facilities, and
- 100/50 ASR Option – Capture of 100 MGD of induced infiltration water for recharge and 50 MGD of surface water for treatment and recharge with additional option to capture, pre-treat, and convey 60 MGD of surface water direct to the City's water treatment facilities

ILWSP 100 MGD Diversion

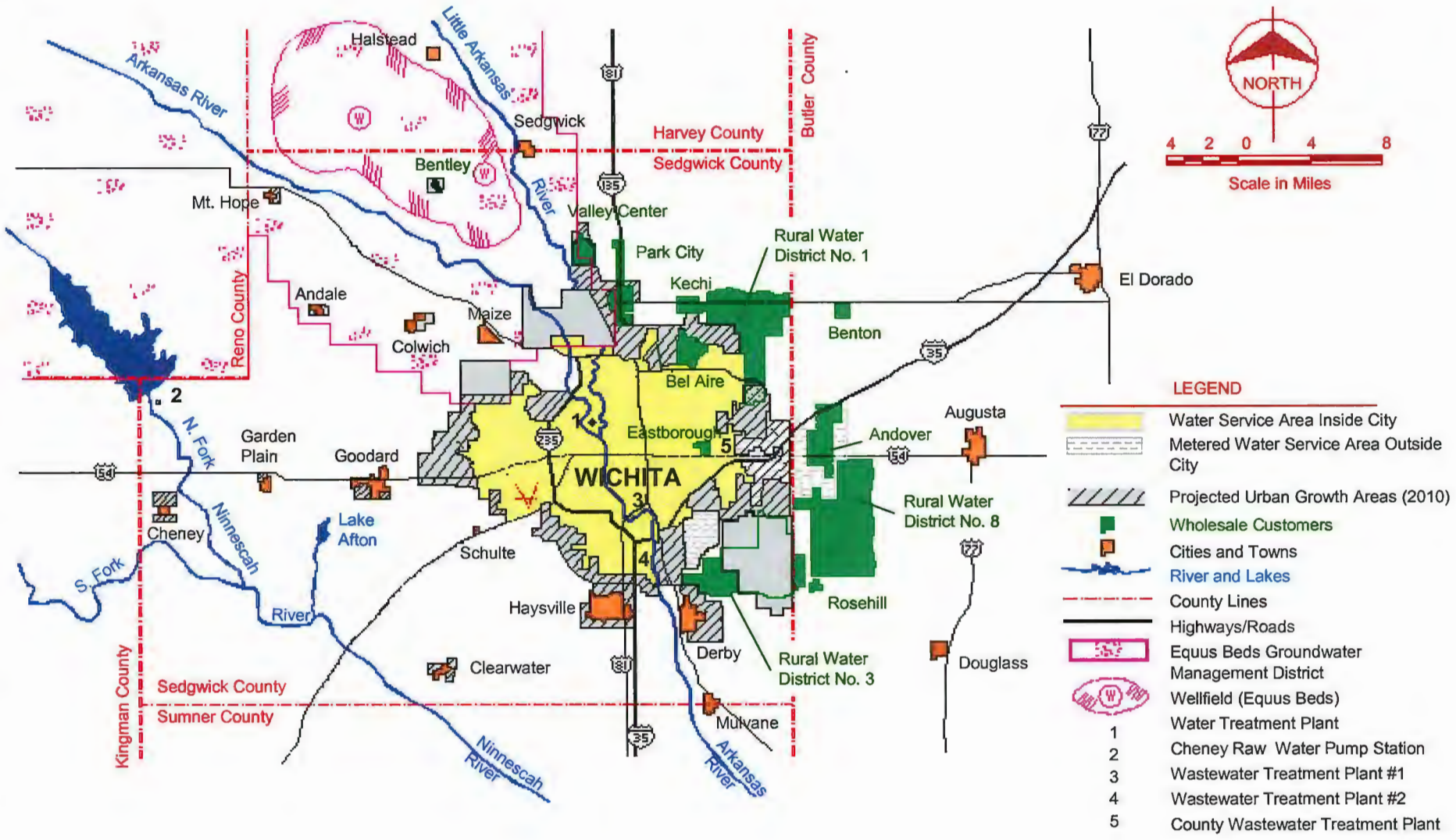
The ILWSP 100 MGD Diversion alternative would capture 100 MGD of water from the Little Arkansas River using a surface water intake and induced infiltration wells adjacent to the river. As with the preceding alternative, project facilities would include a surface water intake, induced infiltration wells, facilities to transfer and recharge the captured water to the aquifer, and an ASR system. In addition, a pre-sedimentation plant is

proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment facilities. Water conservation was again an integral part of this alternative. Once again, three options for capturing 100 MGD of water were considered; each option was considered with and without diverting 60 MGD of treated surface water to the City water treatment facilities. The three options were:

- 60/40 ASR Option – Capture of 60 MGD of induced infiltration water for recharge and 40 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities
- 75/25 ASR Option – Capture of 75 MGD of induced infiltration water for recharge and 25 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities, and
- 100/0 ASR Option – Capture of 100 MGD of induced infiltration water for recharge and no surface water; however, there is an additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City water treatment facilities; the pre-sedimentation plant with this option could be located adjacent to the City's Central Water Treatment Plant in Wichita

Following detailed alternative screening and comparison, the City selected the ILWSP 100 MGD alternative with the ASR 75/25 option as their preferred alternative. The ILWSP Project location map, as depicted in the 2003 EIS, is shown in Figure 1-1.

Figure 1–1 ILWSP Project Location Map



Note: Projected growth areas from information provided by the Wichita-Sedgwick County Metropolitan Area Planning Department
Source: EIS ILWSP for the City of Wichita 2003

2.0 EVALUATION OF ECOLOGICAL IMPACTS

The information obtained from implementing the HBMP will be used by the City of Wichita and federal and state agencies to evaluate if adverse or beneficial impacts have occurred to the environment as a result of the ILWSP implementation and operation. During the alternative comparison process and in the EIS, impacts were evaluated to a wide variety of natural resources (land, water, air, noise, wetlands, vegetation, wildlife, threatened or endangered species, socioeconomics, recreation, cultural resources, and hazardous wastes). Except for water quality, wetlands, and threatened or endangered species in and on the Little Arkansas and Arkansas rivers, implementation and operation of the ILWSP is not anticipated to significantly impact the natural environment.

As mentioned in Section 1.3 above, the ILWSP 100 MGD Diversion alternative with the 75/25 ASR Option is the City's environmentally preferred alternative. NEPA defines the environmentally preferable alternative as "*. . . the alternative that will promote the national environmental policy as expressed in NEPA. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.*" It is implicit in NEPA that the environmentally preferable alternative must be reasonable and feasible to implement.

Both of the goals established for the project will be met – providing for increased water supply needs for the Wichita metropolitan area through the year 2050 and protection of the Equus Beds aquifer's water quality. If No-Action were taken, the existing water supply sources would be unable to meet the maximum daily needs for the expected future growth of metropolitan Wichita. Without additional capacity, the City would be required to limit new customers as much as possible by not providing water to customers outside its present service area boundaries. This action would limit, but not completely stop, growth in demand because the Department is required by statute to serve new customers

within its service area boundaries. Eventually, the City would not be able to maintain system pressure during maximum use periods.

According to the 2003 EIS, with the ILWSP in place, the water levels and water stored in Cheney Reservoir will be slightly increased, compared to the No-Action alternative, maintaining and slightly improving recreation opportunities, fish habitat, and water quality. A slight increase in the flow regime and improvement in water quality is expected in the North Fork of the Ninnescah River below Cheney Reservoir, perhaps resulting in a slight improvement in fish habitat in the North Fork.

In the Little Arkansas River above Wichita, low or base flow will increase over time as aquifer recharge occurs; high flows in the river will be unchanged. With the exception of May and June, median flows in the river are expected to increase and no change in water quality is expected. Below the Local Well Field within the City, flow in the Little Arkansas River in the last mile above the confluence with the Arkansas River is expected to decrease when the ILWSP is operating. As stated in the 2003 EIS, the total dissolved solids, suspended sediment, and chloride concentration in the Arkansas River is expected to increase by six, four, and seven percent respectively below the confluence with the Little Arkansas River. A slight decrease in the Arkansas River flow is expected in June when the ILWSP is likely to be operating.

2.1 WATER LEVELS AND WATER QUALITY

Equus Beds aquifer groundwater levels within the City's well field area are expected to be higher and recover faster following dry periods. Groundwater levels along the Little Arkansas River will be lower in the immediate vicinity of each induced infiltration well during pumping periods; recovery will occur quickly once pumping ceases. Similar reductions in groundwater levels and quick recovery will occur in the Arkansas River alluvium when the Bentley Reserve Well Field is operating. Water quality in the Equus Beds aquifer will improve as infiltration and salinity content rates decrease with rising groundwater levels in the aquifer due to ILWSP operation. If no action was taken by the

City, water levels in the aquifer would decrease, with little hopes of recovering. Also, with no action, the water quality in the aquifer would become worse over time as a result of chloride migration, thus increasing salinity.

2.2 NATURAL RESOURCES

Wetland disturbance resulting from the phased construction of the ILWSP will be avoided and minimized. When avoidance is not possible, permits will be obtained from the U.S. Army Corps of Engineers, Kansas City District. Approximately 266 acres of vegetation will be permanently lost as project facilities are constructed. Of this amount, about 75 acres of row crops, hay fields, and pasture would also be lost. The agricultural use of 65 acres of prime farmland would be lost for the life of the project. Wildlife species may be temporarily displaced during construction and a slight decrease in fishery habitat in the Little Arkansas River may occur due to water diversions. Threatened and endangered species or other species of special concern could be temporarily affected by construction if they are in the area. Wildlife would be displaced at the pre-sedimentation plant site for the life of the project. Fish habitat in the Arkansas River may be slightly decreased. No known cultural resource properties will be affected; unknown sites that are discovered later will be avoided. Surveys to identify, avoid, and mitigate cultural resource properties will occur as phased project facility construction occurs; coordination with the Kansas State Historic Preservation Office to obtain needed clearances will be maintained.

2.3 SOCIOECONOMICS

Temporary increases in employment will be expected during individual construction phases for the ILWSP. The current trend of local economic expansion in the City and region will be facilitated with a dependable water supply; with the ILWSP in place, projected increases in population growth and new housing starts are expected to continue. A temporary increase in traffic density, noise and dust levels in rural areas of Sedgwick and Harvey counties would be expected during construction. Development of the ILWSP

project facilities will result in an increase in the number of industrial structures visibly present in a rural landscape for the life of the project and in the amount of night lighting. A temporary increase in traffic density on urban streets in the Local Well Field vicinity within the City would also be expected. Vehicular access to residences and businesses would be temporarily disrupted in the immediate vicinity of the pipeline construction for a short period of time.

3.0 AGENCY REVIEW AND COORDINATION

For purposes of the HBMP, the City and participating state and federal agencies attended periodic meetings to discuss and identify the following:

- specific beneficial or adverse environmental impacts that could be expected to occur
- specific natural resources that should be evaluated and how
- environmental and natural resource data that is currently available and being collected
- environmental data that should be collected
- appropriate methods for data collection
- analysis and evaluation methods to be used in data evaluation
- necessary coordination, communication, and reporting requirements

The cooperating federal and state agencies played an important role in assisting the City in developing the 2003 EIS and the HBMP, and will continue to play an important role in reviewing, altering, and implementing the HBMP as the ILWSP continues to be implemented and operation begins.

City and agency review and coordination efforts should continue after the HBMP has been implemented. HBMP participants should meet following review of a draft annual report to discuss current assessments and any need to revise any portion of the HBMP. This annual meeting should be tentatively scheduled to occur in March of each year, following the analysis of the previous year's data and distribution of the draft HBMP report.

4.0 REVISIONS TO THE HYDROBIOLOGICAL MONITORING PLAN

The City may revise the HBMP any time during the implementation and operation of the ILWSP as long as there is reasonable technical evidence that revision of the HBMP is warranted. These revisions may be necessary, for example, if data collection locations, the timing of collections, or the specific resources being monitored are not providing the ecological information necessary to make reasonable determinations regarding impacts that may be caused by the ILWSP. The HBMP may also be revised when the City and the cooperating agencies conclude that specific resources that are not being monitored are impacted. Processes within the HBMP may also be revised to provide for more efficient coordination efforts between the City and cooperating federal and state agencies. All proposed revisions or other modifications to the HBMP will be documented by the City in writing, and maintained in HBMP files.

For the assessment of environmental, natural resource, or ecological relationships relative to possible beneficial or adverse project impacts, the City may need to evaluate available information from other sources. The City may conduct these additional assessments at its discretion at any time. The cooperating agencies may request in writing that the City consider other available sources of information or data in the HBMP analysis of relationships or evaluation of impacts.

5.0 REPORT REQUIREMENTS

Reports will be submitted by the City to the cooperating agencies typically in five-year cycles as described in the following paragraphs. For reporting purposes, the data collection year extends from January 1 through December 31. Annual reports for years 1, 2 and 4 will generally be summary reports that basically document the data collected during the 12-month period only; these reports will not be submitted to the cooperating agencies as drafts. Reports for years 3 and 5 will contain much more analysis and evaluation of the data collected during the previous 3- and 5-year periods; these reports will be submitted to the cooperating agencies as drafts for review and comment. Please see additional discussion below for more detail about each report type.

Reports for years 1, 2 and 4 will be provided to the cooperating agencies within 90 days (or March 31) of the close of the data collection period. For the 3- and 5-year reports, draft reports will be provided to the cooperating agencies within 120 days (or April 30) of the conclusion of the data collection period. The cooperating agencies will have 45 days to provide written review comments to the City; the City will have 60 days to incorporate comments, make revisions, and distribute final reports. Each report will be distributed in hard copy and on digital format (CD). Each successive annual report will be added to a single CD, so that one CD contains 5 separate reports at the end of the 5-year reporting period. It is also recommended to make the final reports available on the City and/or participating agency website.

5.1 YEAR ONE REPORT

The Year One Report will be prepared by the City and provided to the cooperating agencies within 90 days (March 31) following the end of the data collection year (December 31). The Year One Report will contain all of the raw data collected during that year. The report will be mostly a tabular presentation with text limited to technical explanation of important observations, problems encountered, or other description important to the HBMP.

5.2 YEAR TWO REPORT

The Year Two Report will be a data report similar to the Year One Report. The first two years of data collection will be presented on a CD.

5.3 YEAR THREE REPORT

Following the third year of data collection, the City will prepare an expanded, mid-term data report that contains the raw data for the third year. The report will contain basic figures, tables and summaries of data for the pervious three years of data collection. Interpretative text in the Year Three Report will include a description of monitoring process and progress, any observed changes in parameters being monitored, summaries for the three years of data collection, and recommendations for either continuance of monitoring without change and/or discussions of modifications to address observed changes. At a minimum, the Year Three Report should specifically include in a preliminary fashion the following:

- analysis of current conditions
- comparison of current conditions to baseline conditions
- data collection methodologies, locations, and frequencies
- professional opinion of project induced impacts, if any exist, including beneficial or adverse impacts
- recommendations for the HBMP regarding data collection, report requirements, agency involvement, etc.

5.4 YEAR FOUR REPORT

The Year Four Report will be similar to the reports for years one and two.

5.5 YEAR FIVE REPORT

The Year Five Report will be a comprehensive, interpretative report that analyzes all continuing data collected to that point of time in the HBMP. All data including that of the preceding five year period will be included in the Year Five Report. This report will

examine the long-term trends for specific project resources and their relationship to beneficial or adverse terrestrial or aquatic impacts. The report will present analyses that document the status of monitored parameters and determine if the health and productivity of the project area resources are showing signs of improvement or stress due to the construction and operation of the ILWSP. For example, changes in freshwater flows or water elevations will be evaluated to determine if any impact to the ecological resources is observable.

The design of the HBMP will be reviewed and re-evaluated in each Year Five Report. Modifications to the HBMP can be recommended in this report, or at an interim time if approved by the City and cooperating agencies. The Year Five Reports will be the primary documents for evaluating the presence or absence of beneficial or adverse ecological impacts, the significance of such impacts, and the environmental considerations for continuing construction of additional project phases or continued project operation. The effectiveness of the specific operational criteria relative to the initiation or cessation of project operations or the mixing of surface and groundwater to maintain water quality and the original project goals will be evaluated.

6.0 DATA COLLECTION

The HBMP will be used as a repository for the assimilation of data from historic, current and future data collection programs in the Project area. This data will be used to satisfy environmental, natural resource, and ecological objectives identified in Sections 1.0 and 3.0. The City and the cooperating agencies may need to perform additional studies of limited duration to evaluate specific relationships that would be used to evaluate certain ecological parameters or revise the design or operation of the ILWSP. In this way, both the City and the cooperating agencies would be involved in the design and operation of the ILWSP, the collection and interpretation of limited duration data and studies within the HBMP framework, and in scientific peer review.

The data that has been, is or will be collected for, used in, or required for the HBMP is described in the following sections and paragraphs. The data analyses that the City is expected to perform are also described. Lastly, cooperating agencies can request reasonable additional analyses to be performed as a result of the draft report review process of the more detailed reports described in Section 5.0.

6.1 AVAILABLE HYDROLOGICAL AND BIOLOGICAL DATA

Information and data used in the HBMP report described in Section 5.0 will be collected from a variety of sources. Some of these sources will include ongoing and future monitoring programs by the City and various state and federal agencies such as the USGS, KDHE, and the Groundwater Management District No. 2 (GMD2) to address various regulatory responsibilities. Each of these entities has specific monitoring programs in place that are responsible for evaluating groundwater and/or surface water systems, using both hydrological and biological components. Some of these programs have been in operation for several years and are anticipated to remain so indefinitely. Additional data may be available from the FWS and KDWP for purposes of the HBMP; however, much of the data is limited as it is typically collected for short-term special projects when funding is available. Maps showing existing stream and groundwater data

collection and monitoring locations for the various agencies and the City are presented in Appendices A and B.

As an example, the City is currently conducting a Bio-Monitoring program administered by the Water and Sewer Department, Sewage Treatment Division. As part of the program, a water quality specialist with the City, has been extensively studying and sampling fish and benthic macro-invertebrates, where the Arkansas River is the primary concern. Physical habitat studies, a new component of the monitoring program, were added in the year 2000 for tributaries to the Arkansas River within the City of Wichita. Chemical monitoring has been an on-going program at several sites on many tributaries and the main stem of the Arkansas River. Limited data has been collected along the Little Arkansas River.

6.1.1 Groundwater Elevation Data

6.1.1.1 Available USGS Groundwater Elevation Data

The USGS has been cooperatively working with the City and GMD2 to monitor wells in the project area for several years. Data has been collected and analyzed to determine water storage capacities in the Equus Beds for the ILWSP. Some of the City and GMD2 groundwater elevation records date back to the 1940s. A map depicting wells that are currently being monitored in the ILWSP area is located in Appendix B. Groundwater elevation change data for the project area is available from the USGS and the GMD2. Much of this data can also be retrieved at the following website: http://ks.water.usgs.gov/Kansas/studies/equus/equus_gwstorage.html.

6.1.2 Stream Flow Data

6.1.2.1 Available USGS Stream Flow Monitoring Data

The USGS has operated and is currently operating stream gaging stations at several locations in the Project area. Many of these gaging stations were of vital importance in the 2003 EIS and the associated hydrologic modeling, and will likely continue to be important for the HBMP. These recommended gaging stations are listed in Table 6-1 and

were derived from the gaging station list contained in the EIS. Per HBMP discussions with the USGS, stations 07143665 Little Arkansas River at Alta Mills, Kansas and 07144200 Little Arkansas River at Valley Center, Kansas should be maintained, as water quality consistently varies between the two stations. A summary of available USGS stream flow and water quality data from 1973 to 2003 has been compiled by HDR Engineering, Inc.; a compact disk (CD) containing this information is included in the HBMP in Appendix E. At the present time, the USGS plans to continue stream flow and water quality data collection at these stations, and will make the data available to the City for use in the HBMP.

Table 6-1. Recommended USGS Stream Gages

Station Number & Name	Location (Latitude/ Longitude)	Drainage Area (miles^2)	Period of Record
07143330 Arkansas R near Hutchinson, KS	37° 56' 47" 97° 45' 29"	38,910	10/01/59–present
07143375 Arkansas R near Maize, KS	37° 46' 53" 97° 23' 33"	39,110	03/01/87–present
07143665 Little Arkansas R at Alta Mills, KS	38° 06' 44" 97° 35' 30"	736	06/06/73–present
07143672 Little Arkansas R at Halstead, KS*	38° 01' 43" 97° 32' 25"	759	05/95 - present
07144100 Little Arkansas R near Sedgwick, KS*	37° 52' 59" 97° 25' 27"	1,239	10/01/93–present
07144200 Little Arkansas R at Valley Center, KS	37° 49' 56" 97° 23' 16"	1,327	06/10/22–present
07144550 Arkansas R at Derby, KS	37° 32' 34" 97° 16' 31"	40,830	10/01/68–present
07144300 Arkansas R at Wichita, KS	37° 38' 41" 97° 20' 06"	40,490	10/01/34–present

Source: EIS for the ILWSP Wichita, KS 2003 and USGS website 2003 (http://water.usgs.gov).
* These sites are only monitored for water quality.

6.1.3 Stream Quality Data

6.1.3.1 Available KDHE Stream Chemistry Data

Beginning in 1990, bimonthly samples were taken at all of KDHE's routine permanent (every year) and rotational (every fourth year) stream chemistry monitoring stations. The parameters that are sampled include a wide spectrum of physical, inorganic, organic (every quarter) and bacteriological water quality constituents. The physiochemical

parameters that are monitored are listed in Table 6-2, as provided by KDHE in January 2004. Per KDHE, the monitoring schedule for all routine stations is fixed and scheduled one year in advance of the sampling event.

The ambient stream chemistry data is tentatively available two months following sampling and is electronically available in spreadsheet or database formats. The data is recorded with remark codes, where the "<" value is the Method Reporting Limit (MRL). The MRL is the "less than" value reported when a specific analyte either is not detected or is detected at a concentration less than the MRL. Per KDHE, all of the monitoring stations included in Table 6-3 will be monitored on a bimonthly basis for the foreseeable future.

Table 6-2. KDHE Stream Chemistry Program Monitored Physiochemical Parameters

Routine Inorganic Parameters	Routine Organic Parameters
Alkalinity, total (as CaCO3)	2,4-D as acid (phenoxychlorine herbicide)
Aluminum, total recoverable	2,4, 5-T as acid (phenoxychlorine herbicide)
Ammonia, total (as N)	2,4,5-TP as acid - Silvex (phenoxypropionic herbicide)
Antimony, total recoverable	Acetochlor (chloroacetanilide herbicide)
Arsenic, total recoverable	Alachlor (chloroacetanilide herbicide)
Barium, total recoverable	Aldrin (cyclodiene insecticide)
Beryllium, total recoverable	Atrazine (chlorotriazine herbicide)
Biochemical oxygen demand (Ended Y2000)	Butachlor (chloracetanilide herbicide)
Boron, total recoverable	Carbofuron – Furadan (cabamate insecticide)
Bromide	Chlordane (cyclodiene insecticide)
Cadmium, total recoverable	Cyanazine - Bladex (chlorotriazine herbicide)
Calcium, total recoverable	DCPA - Dacthal (phthalic acid herbicide)
Chloride	p,p'-DDD (organochlorine insecticide)
Chromium, total recoverable	p,p'-DDE (organochlorine insecticide)
Cobalt, total recoverable	p,p'-DDT (organochlorine insecticide)
Copper, total recoverable	Dieldrin (cyclodiene insecticide)
Dissolved oxygen	Endosulfan I (organochlorine acaricide, cyclodiene insecticide)
Fluoride	Endosulfan II (organochlorine acaricide, cyclodiene insecticide)
Hardness, total (as CaCO3)	Endosulfan Sulfate (organochlorine acaricide, cyclodiene insecticide)
Iron, total recoverable	Endrin (cyclodiene insecticide)
Kjeldahl nitrogen, total (Began Y2000)	alpha-BHC isomer (organochlorine acaraicide, insecticide, rodenticide)
Lead, total recoverable	beta-BHC isomer (organochlorine acaraicide,

Routine Inorganic Parameters	Routine Organic Parameters
	insecticide, rodenticide)
Magnesium, total recoverable	delta-BHC isomer (organochlorine acaraicide, insecticide, rodenticide)
Manganese, total recoverable	gamma-BHC- Lindane (organochlorine acaraicide, insecticide, rodent)
Mercury, total	Heptachlor (cyclodiene insecticide)
Molybdenum, total recoverable	Heptachlor epoxide - oxidation prod of heptachlor (cyclodiene insect)
Nickel, total recoverable	Hexachlorobenzene (aromatic fungicide)
Nitrate (as N) (Began Y1968-1977) (1995-current)	Hexachlorocyclopentadiene
Nitrite (as N) (Began Y1995)	Methoxychlor (organochlorine insecticide)
Nitrate-Nitrite (as N) (June 1977 through 1994)	Metolachlor - Dual (chloroacetanilide herbicide)
pH (field)	Metribuzin - Sencor (triazinone herbicide)
Phosphate, ortho- (as P)	PCB-1016 Polychlorinated Biphenyls (containing 41.5% chlorine)
Phosphorus, total (as P)	PCB-1221 Polychlorinated Biphenyls (containing 21% chlorine)
Potassium, total recoverable	PCB-1232 Polychlorinated Biphenyls (containing 32% chlorine)
Selenium, total recoverable	PCB-1242 Polychlorinated Biphenyls (containing 42% chlorine)
Silica, total recoverable (as SiO2)	PCB-1248 Polychlorinated Biphenyls (containing 48% chlorine)
Silver, total recoverable	PCB-1254 Polychlorinated Biphenyls (containing 54% chlorine)
Sodium, total recoverable	PCB-1260 Polychlorinated Biphenyls (containing 60% chlorine)
Specific conductance	Picloram - Tordon (picolinic acid herbicide)
Sulfate	Propachlor – Ramrod (chloracetanilide herbicide)
Strontium, total recoverable (Began Y2002)	Propazine - Milogard (chloracetanilide herbicide)
Thallium, total recoverable	Simazine (chlorotriazine herbicide)
Total dissolved solids	Toxaphene (organochlorine acaricide,insecticide)
Total organic carbon (Began Nov.Y2000)	
Total suspended solids	**Non-Routine Reported Organic Parameters**
Turbidity	Diazinon (organophosphate insecticide)
Vanadium, total recoverable	Deethylatrazine (chlorotriazine herbicide) atrazine metabolite
Zinc, total recoverable	Deisopropylatrazine (chlorotriazine herbicide) atrazine metabolite
Temperature (field)	Prometon - Pramitol (triazine herbicide)
	Dursban – Chlorpyrifos
Routine Microbiological Parameters	
Fecal coliform bacteria (Ended Y2003)	
Fecal streptococcus bacteria (Ended Y1999)	
E. Coli (Began July 2003)	

Source: KDHE Correspondence January 2004

KDHE's ambient stream chemistry monitoring program has a quality assurance management plan that defines the agency's standard operating procedures for the collection, preservation, transport and analysis of environmental samples. This plan also provides information regarding water quality monitoring and assessment of the surface waters in the State of Kansas. This document can be found at the KDHE website, http://www.kdhe.state.ks.us/environment/qmp_2000/download/SCMP_QAMP.pdf.

Table 6-3 KDHE Stream Chemistry Sampling Locations

Site Number	General Location/Name	Latitude/Longitude	Period of Record
SC281	Arkansas R at Derby	NA	Active – 1973
SC524	Arkansas R near Yoder	37.98468 97.86682	Active – 1990
SC536	Arkansas R near Maize	37.81035 97.42687	Active – 1990
SC729	Arkansas R in Wichita	NA	Active – 2000
SC246	Little Arkansas R at Alta Mills	38.11244 97.59198	Active – 1975
SC282	Little Arkansas R at Valley Center	37.81035 97.38802	Active – 1973
SC728	Little Arkansas R in Wichita	NA	Active – 2000

Source: KDHE Correspondence January 2004

6.1.3.2 Available Stream Chemistry Data from the City's Bio-Monitoring Program

The chemical monitoring being conducted as part of the Bio-Monitoring Program includes stations on several tributaries to and the main stem of the Arkansas River. These locations, along with sampling frequencies, are listed in Table 6-4. The chemical monitoring locations are as far north as the Harvey-Sedgwick county line on the Little Arkansas River and north of Mt. Hope on the Arkansas River. According to the City, monitoring sites were established to assess the waters entering the county and the City, and waters exiting the City. Sampling is set up on a monthly collection schedule with 11 sites on the Arkansas River and five sites on the Little Arkansas River. Samples are analyzed for:

- pH
- temperature
- dissolved oxygen
- conductivity

- ammonia
- nitrates
- phosphates
- bacteria

Additional analyses are performed at specific locations for:

- chlorophyll A
- chlorides
- metals
- cyanide
- total suspended solids (TSS)
- nitrites
- total kjeldahl nitrogen (TKN)
- hardness

Please refer to Appendix D for more detail on the Bio-Monitoring Program. Bacteria source tracking and hydrographic assessment are also part of the program.

Table 6-4. Wichita's Current Bio-Monitoring Schedule

General Location	River	Type	Frequency
Mt. Hope	Arkansas R	Chemical	Monthly and Field Visit
Bentley	Arkansas R	Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
53rd St. N.	Arkansas R	Chemical	Monthly and Field Visit
		Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
Harvey/Sedgwick	Little Arkansas R	Chemical	Monthly and Field Visit
109th St. N.	Little Arkansas R	Chemical	Monthly and Field Visit
85th St. N.	Little Arkansas R	Chemical	Monthly and Field Visit
53rd St. N.	Little Arkansas R	Chemical	Monthly and Field Visit
		Benthic	Biannually
Seneca	Arkansas R	Chemical	Monthly and Field Visit
Central	Little Ark. River	Chemical	Monthly and Field Visit
Twin Lakes	Arkansas R	Fish	Annually
		Benthic	Biannually
Lincoln Street	Arkansas R	Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
Herman Hill Park	Arkansas R	Fish	Annually
		Chemical	Field Visit
Lewis	Arkansas R	Chemical	Monthly and Field Visit
Hydraulic	Arkansas R	Chemical	Monthly and Field Visit
47th St. South	Arkansas R	Chemical	Monthly

General Location	River	Type	Frequency
		Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
63rd St. South	Arkansas R	Chemical	Monthly
		Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
Pawnee	Arkansas R	Chemical	Monthly
Derby	Arkansas R	Chemical	Monthly and Field Visit
		Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
Mulvane	Arkansas R	Chemical	Monthly and Field Visit
		Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
55 HWY	Arkansas R	Chemical	Monthly and Field Visit
		Fish	Annually
		Benthic	Biannually
		Phy-Hab	Biannually
K-96	Arkansas R	Chemical	Monthly and Field Visit
		Fish	Annually
		Benthic	Biannually

Source: City of Wichita, HBMP Meetings 2003/2004

6.1.3.3 Available USGS Stream Chemistry Monitoring Data

As reported, the USGS conducts routine monitoring of fecal coliform bacteria (FCB) at specific locations along the Arkansas and Little Arkansas rivers. The summary of USGS data that was compiled by HDR Engineering, Inc. as part of the Phase II Report includes bacterial mass loading probability curves from 1990-2003 historical data by sampling location. KDHE ceased routine monitoring of fecal streptococcus bacteria and fecal coliform bacteria in 1999 and 2003, respectively (KDHE website, http://www.kdhe.state.ks.us). The USGS expects to continue monitoring for FCB since portions of the Arkansas and Little Arkansas rivers have exceeded established FCB water quality standards and have been placed on the KDHE 303 (d) impairment list. The CD containing the USGS data can be found in Appendix E of this report.

6.1.3.4 Available KDHE Fish Tissue Sampling Data

As shown in their correspondence, KDHE has collected annual composite samples for fish tissue analysis at three locations in the ILWSP project area. Additional sample locations were established for screening purposes or as special project sites that were sampled for a period of one to three years. Some of the tissue samples were analyzed as whole fish while others were analyzed as fillets with the skin removed. All fish tissue samples were analyzed for a suite of long-lived organochlorine pesticides, a group of selected toxic metals and other organic contaminants. As provided by the agency, KDHE's monitoring locations and the types of samples obtained are summarized in Table 6-5. In addition, a summary of KDHE's stream chemistry monitoring program can be found at their website, http://www.kdhe.state.ks.us/environment/qmp_2000/qmp_2000.htm#BEFS.

Table 6-5. KDHE Fish Tissue Monitoring Locations

Site Number	General Location/Name	Latitude/Longitude	Whole Fish	Fillet
SB281	Arkansas River at Derby (Washington St.)	37.54292 97.27561	82-94,96,98,02	88,90-96, 98, 99,02
SB282	Little Arkansas River 0.5 West of Valley Center	37.83215 97.38802	82	NA
SB283	Arkansas River near Haven (3 Mi. North)	37.94641 97.77510	82-87	NA
No ID	Little Arkansas River near 13th St. in Wichita	NA	NA	94,96-98
No ID	Arkansas River at Wichita near US54/Kellog St. (upstream of the Lincoln St. dam)	NA	86	90,91,96,97,00, 01
No ID	Arkansas River upstream of Wichita (2 Mi. East and 2 Mi.North of Maize)	NA	92,93	NA
No ID	Arkansas River near Belle Plaine (East of Belle Plaine)	NA	92,93	NA

Source: KDHE Correspondence January 2004

6.1.4 Stream Macroinvertebrate/Benthic Data

6.1.4.1 Available KDHE Stream Macroinvertebrate Sampling Data

KDHE has also collected annual samples of macroinvertebrates from approximately 1980 to 2003. The locations used for macroinvertebrate data collection are considered to be long-term and will likely be sampled into the future. A list of these sample locations along with their sample history is provided in Table 6-6. The KDHE stream biological monitoring program is summarized on the following website, http://www.kdhe.state.ks.us/environment/qmp_2000/qmp_2000.htm#BEFS.

Table 6-6. KDHE Stream Macroinvertabrate Monitoring Locations

Site Number	General Location/Name	Latitude/Longitude	Period of Record
SB281	Arkansas River at Derby (Washington St.)	37.54292 97.27561	1980 – 2003
SB282	Little Arkansas River 0.5 West of Valley Center	37.83215 97.38802	1981 – 2003
SB283	Arkansas River near Haven (3 Mi. North)	37.94641 97.77510	1982 – 2003

Source: KDHE Correspondence January 2004

6.1.4.2 Available Benthic Data from the City's Bio-Monitoring Program

According to the City, benthic data has been collected as part of the Bio-Monitoring Program implemented by the Water and Sewer Department, Sewage Treatment Division. Sample locations along major tributaries to the Arkansas River were initially established for the biannual collections. Locations along the Little Arkansas River have not been sampled for benthics for the last six years. Please refer to Table 6-4 for the City's sampling locations and collection frequencies. Sampling typically consists of scavenging and D-net sweeps through all possible habitat niches at a given location. A standardized collection time of three hours per location has been established.

6.1.5 Fish Sampling

6.1.5.1 Available Fish Sampling Data from the City's Bio-Monitoring Program

The City conducts fish collections annually through their existing Bio-Monitoring Program. Currently, 11 locations along the Arkansas River are sampled, primarily to assess pollutant effects and concerns relative to the effluent discharge from the City's Sewage Treatment Plant #2. One new sample location has been added at the request of the City's Environmental Health Department to assess the effluent from the new ground water treatment facility. Sampling methods used for collection include electroshocking and seining. Sampling locations and collection frequencies as provided by the City are presented in Table 6-4.

6.1.6 Physical Habitat Data

6.1.6.1 Available Physical Habitat Data from the City's Bio-Monitoring Program

According to the City, nine of the established locations along the Arkansas River were sampled in 2003 using a physical habitat measurement system similar to that recommended by the EPA's Environmental Monitoring and Assessment Program protocols. As of 2004, no physical habitat measurements have been made at any location along the Little Arkansas River. Physical habitat sampling was proposed in order to help determine if benthic and fish population differences among sample locations were associated with habitat availability and site heterogeneity. Physical habitat data has been collected for some tributaries of the Arkansas River, such as Gypsum and Cowskin creeks. Data collected at established sample locations along the Arkansas River are scheduled to be analyzed and summarized in 2004. As mentioned earlier, established sampling locations and collection frequencies are shown in Table 6-4 in Section 6.1.3.2.

6.2 BASELINE ECOLOGICAL CONDITIONS

6.2.1 Data Obtained from Current Agency and City Monitoring Programs

Data obtained from past and present monitoring programs, investigations, and studies will be used to help determine baseline ecological conditions for the ILWSP. The only studies that are needed at this time, besides those that are currently being conducted by federal and state agencies or the City, are those that are necessary to determine baseline conditions for fisheries, benthics, and physical habitats along the Little Arkansas River. Details of these additional studies proposed at five sample locations on the Little Arkansas River are provided below in Section 6.2.1.4. Biological Conditions, of this HBMP.

6.2.1.1 Groundwater Elevation

As previously described in Section 6.1.1, the USGS has cooperatively worked with the City and GMD2 to monitor existing groundwater wells and elevations in the ILWSP project area (specifically, the Equus Beds). This groundwater data has been used to model and evaluate the water storage capacities available in the Equus Beds aquifer for recharge with implementation of the ILWSP. Groundwater elevation records date back from the 1940s; groundwater wells that are being monitored are shown graphically in Appendix B. An adequate baseline for groundwater conditions for the Equus Beds aquifer can be derived from the existing data, which can be obtained directly from the USGS and/or GMD2. A limited amount of this data can also be retrieved at the following website: http://ks.water.usgs.gov/Kansas/studies/equus/equus_gwstorage.html.

6.2.1.2 Stream Flow

As mentioned earlier in the HBMP, the USGS maintains and operates several established stream gage stations in the ILWSP project area (Table 6-7). This stream flow data was used to develop a historic record from 1923 to1996 as a basis for evaluating the ILWSP. As shown in the 2003 EIS, monthly median flow data (Table 6-8) at specific stream gage locations (Figure 6-1) provide a good representation of the seasonal variability of stream discharge in the ILWSP project area. Since median flows are those that fall in the

statistical middle of the historic range, actual daily stream flow discharges will be higher than the median flow half the time and less half of the time.

The Kansas Water Office (KWO), Division of Water Resources, KDWP, and the KDHE, established minimum desirable stream flows (MDS) for many of the streams and rivers in Kansas. Several of these streams and rivers were located in the Little Arkansas and Ninnescah river basins.

Table 6-7. Project Vicinity USGS Stream Gages

Station Number & Name	Location (Lat/Long)	Drainage Area (miles^2)	Period of Record
07143330 Arkansas R near Hutchinson, KS	37° 56' 47" 97° 45' 29"	38,910	10/01/59–present
07143375 Arkansas R near Maize, KS	37° 46' 53" 97° 23' 33"	39,110	03/01/87–present
07143400 Arkansas R near Wichita, KS	37° 42' 30" 97° 21' 50"	39,072	10/01/21–03/31/35
07143665 Little Arkansas R at Alta Mills, KS	38° 06' 44" 97° 35' 30"	736	06/06/73–present
07143672 Little Arkansas R at Halstead, KS*	38° 01' 43" 97° 32' 25"	759	05/95 - present
07144100 Little Arkansas R near Sedgwick, KS*	37° 52' 59" 97° 25' 27"	1,239	10/01/93–present
07144200 Little Arkansas R at Valley Center, KS	37° 49' 56" 97° 23' 16"	1,327	06/10/22–present
07144300 Arkansas R at Wichita, KS	37° 38' 41" 97° 20' 06"	40,490	10/01/34–present
07144550 Arkansas R at Derby, KS	37° 32' 34" 97° 16' 31"	40,830	10/01/68–present
07144780 NF Ninnescah R above Cheney R, KS	37° 43' 17" 97° 47' 39"	787	07/01/65–present
07144800 NF Ninnescah R near Cheney, KS	37° 40' 00" 97° 46' 00"	930	10/01/50–09/30/64
07145500 Ninnescah R near Peck, KS	37° 27' 26" 97° 25' 20"	2,129	04/01/38–present
07146500 Arkansas R at Arkansas City, KS	37° 03' 23" 97° 03' 32"	43,713	10/01/21–present

Source: EIS for the ILWSP, Wichita, KS, 2003 and USGS website (http://water.usgs.gov).
* These sites are only monitored for water quality.

Table 6-8. Median Flow by Month for Project Area Streams (cfs)

Month	Arkansas River			Little Arkansas River	
	Hutchinson	Wichita	Arkansas City	Alta Mills	Valley Center
Jan	124.9	249.9	571.1	23.3	53.8
Feb	169.4	327.1	645.5	26.0	61.1
Mar	207.2	387.7	801.0	31.0	70.4
Apr	216.8	459.7	947.1	35.0	76.4
May	273.5	573.4	1,198.2	45.5	107.6
Jun	405.1	825.1	1,515.8	57.0	129.4
Jul	248.4	504.5	959.6	31.5	75.6
Aug	166.5	321.6	659.7	22.7	54.7
Sep	150.0	293.2	555.5	21.6	53.5
Oct	117.6	226.9	520.6	18.7	49.6
Nov	149.6	306.0	634.2	26.0	58.8
Dec	142.3	287.8	595.8	24.5	58.4

Source: EIS for the ILWSP, Wichita, KS, 2003 and USGS website (http://water.usgs.gov).

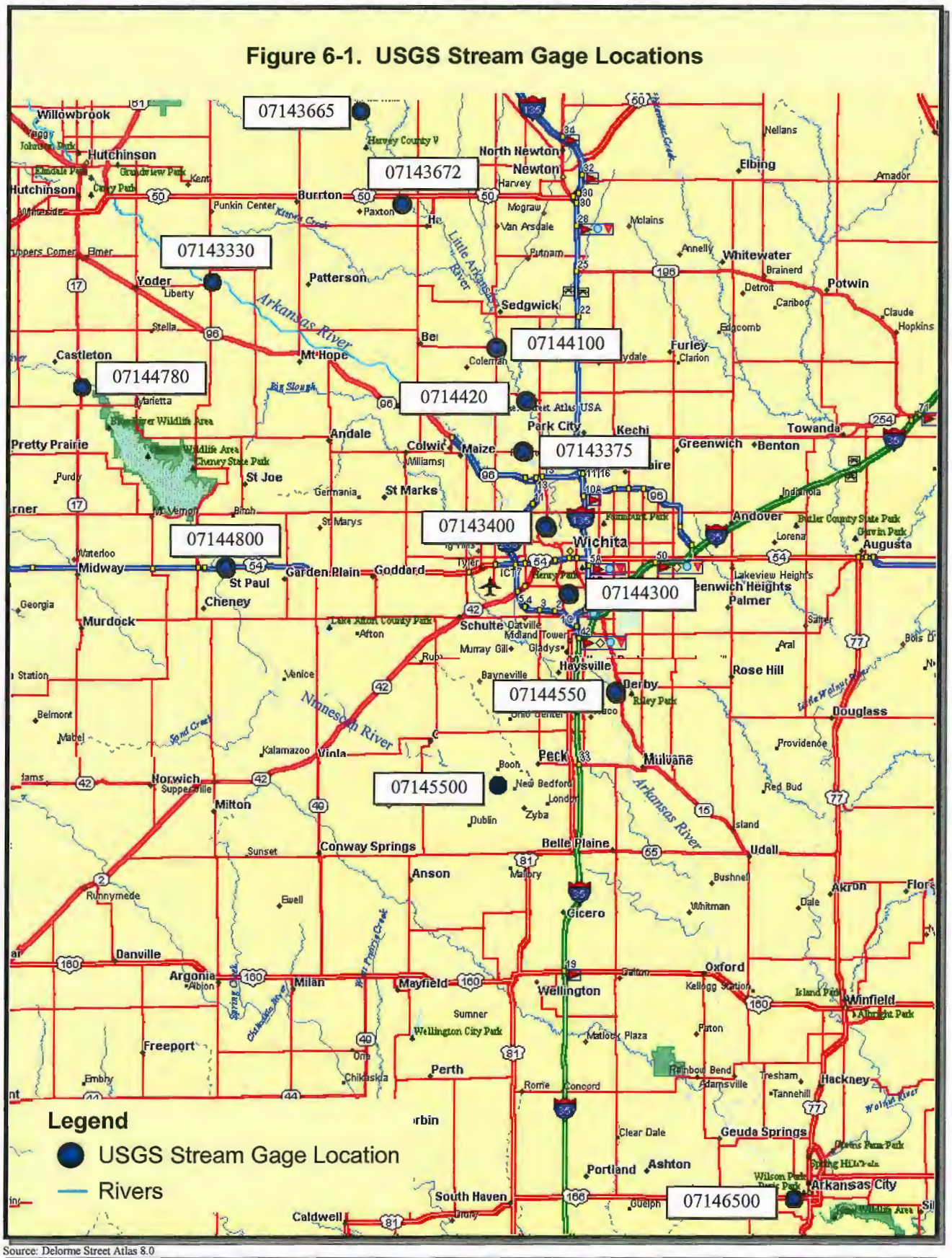
Table 6-9. Minimum Desirable Streamflow Values (cfs)

Month	Little Arkansas River	
	at Alta Mills	at Valley Center
Jan	8	20 (34)
Feb	8	20 (34)
Mar	8	20 (34)
Apr	8	20 (60)
May	8	20 (60)
Jun	8	20 (60)
Jul	8	20 (34)
Aug	8	20 (34)
Sep	8	20 (34)
Oct	8	20 (34)
Nov	8	20 (34)
Dec	8	20 (34)

Source: EIS for the ILWSP City of Wichita, KS, 2003 and Kansas Water Office, 1983 and 1985. Values in parentheses are values recommended by Kansas Department of Wildlife and Parks

The MDS values established by the State of Kansas for streams and rivers in the ILWSP project area, as presented in the 2003 EIS, are listed in Table 6–9. As an example, the official MDS at Valley Center is a flow of 20 cubic feet per second (cfs) year-round. However, KDWP originally recommended a stream flow of 60 cfs during April, May and June at Valley Center, and a 34 cfs stream flow for the remainder of the year (KWO 1983, 1985).

Figure 6-1. USGS Stream Gage Locations



Source: Delorme Street Atlas 8.0

6.2.1.3 Stream Quality

Surface water quality in streams and rivers in the ILWSP project area can vary significantly with time and location. A summary of surface water quality data used for the ILWSP that has been collected by the USGS is presented in Table 6-10. Although the number of samples and their respective collection periods vary, the surface water quality data shown in Table 6-10 is considered representative of conditions in the ILWSP area (EIS 2003).

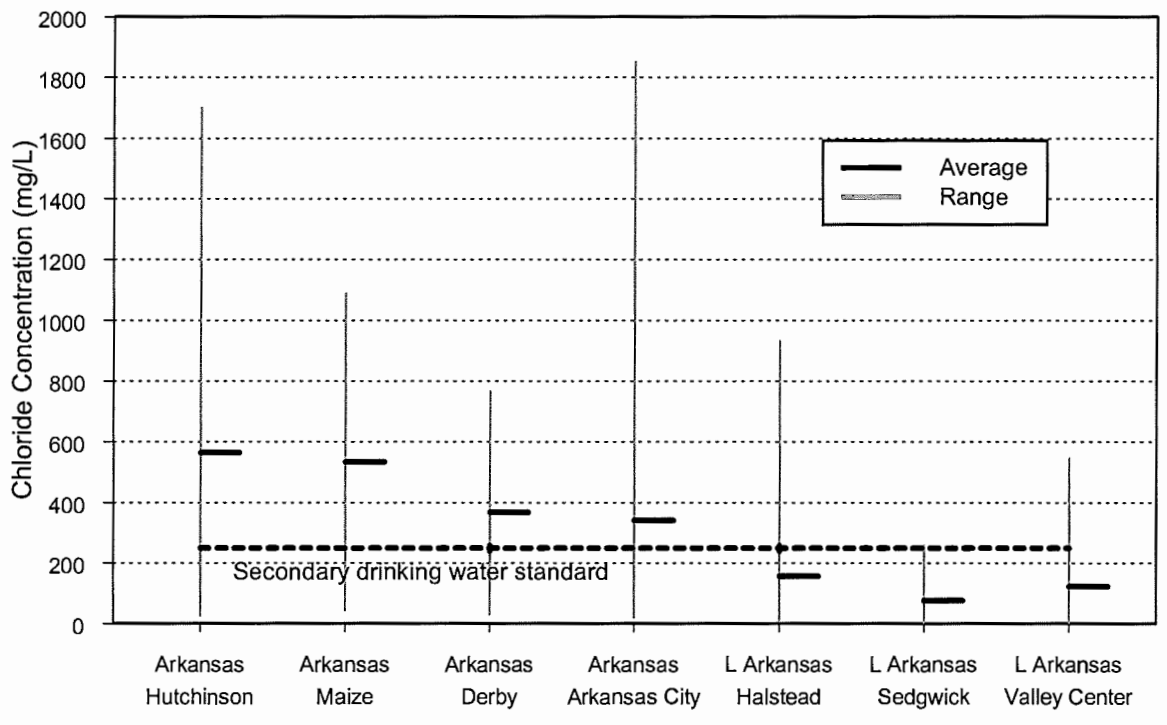
Though moderately hard, the quality of the water from these streams meets established standards for domestic and municipal use. The only exception to this condition is the elevated salinity levels that are historically found in the Arkansas River. Several natural and man-made saline sources upstream of Wichita contribute to these observed elevated levels in the Arkansas River in the ILWSP project area.

The concentration of chloride ions in the Arkansas River, which is a measure of salinity, can range up to 1,700 milligrams per liter (mg/L) upstream of Wichita (see Table 6-10). The U.S. Environmental Protection Agency (EPA) has established secondary drinking water standards that recommend limiting chloride concentrations to 250 mg/L (40 CFR 143). The contaminants that are included in the secondary drinking water standards, like chloride, are those that primarily affect the aesthetic qualities of drinking water, such as taste, odor and color.

As in the 2003 EIS, Figure 6-2 in the HBMP illustrates the range and average of chloride concentrations for those stations listed in Table 6-10 that have at least 50 data points. The data in Figure 6-2 also illustrates that surface water in the Little Arkansas River has significantly lower chloride concentrations than that of the Arkansas River. A comparison of average chloride concentrations in the Arkansas River surface water just above Wichita near Maize, and just below Wichita near Derby, provides evidence of a distinct water quality improvement.

Other compounds and chemicals such as herbicides and pesticides often affect surface water quality in streams and rivers, especially in areas where agricultural crops are concentrated. In the ILWSP project area, the herbicide atrazine is typically applied to agricultural crops in the spring and fall months. Coincidentally, this application occurs when precipitation is most intense and surface runoff can be the greatest. Atrazine concentrations and loading in the Little Arkansas River is typically greatest during the spring and early summer months (May through July).

Figure 6-2. Surface Water Chloride Concentrations



Source: Final EIS for the ILWSP, Wichita, KS 2003 and USGS website (http://water.usgs.gov).

6.2.1.4 Biological Conditions

The City has collected fisheries, benthic, and physical habitat data on both the Arkansas and Little Arkansas rivers for several years. In addition, KDHE has also collected stream macroinvertebrate data on both of these rivers. The data collected by both the City and

Table 6-10. Surface Water Quality Data

Station	Conductivity	Dissolved Oxygen	pH	Dissolved Concentrations										Sample Dates
				Hardness	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Fluoride	Dissolved Solids	Suspended Solids	
	μseimens	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	
Arkansas River														
07143330 near Hutchinson, KS	300 - 5900	1.3 - 13.6	6.9 - 9.1	0 - 805	22 - 214	3.5 - 72	23 - 1110	6.2 - 23	27 - 1700	18 - 918	0.2 - 1.2	208 - 3470	5 - 6120	1961-2002
07143375 near Maize, KS	235 - 4150		7.1 - 9.4		19 - 160	3.9 - 70	26 - 500	6.5 - 13	45 - 1088	11 - 800		162 - 1750		1987-2002
07144300 at Wichita, KS	200 - 2620		6.8 - 9.2										76 - 2500	1958-2002
07144550 at Derby, KS	185 - 3560	5.8 - 13.4	6.8 - 8.9	80 - 717	25 - 187	3.4 - 64	22 - 536	4 - 16	33 - 765	20 - 738	0.3 - 1	193 - 2150	1340 - 1560	1961-2002
07146500 at Arkansas City, KS	213 - 6540	1 - 17.1	6.6 - 10	24 - 760	17 - 216	3.5 - 56	18 - 1180	0.6 - 28	20 - 1850	15 - 630	0 - 1.1	132 - 4090	0.8 - 74	1943-2002
Little Arkansas River														
07143665 at Alta Mills, KS	105 - 3200		7 - 8.7	330 - 452	105 - 142	17 - 24	152 - 258	5.3 - 6	274 - 532	54 - 125	0.4	820 - 1380	9 - 2130	1959-2002
07144100 near Sedgwick, KS	40 - 1580	3.6 - 18.7	6.1 - 8.7	180 - 320	9.63 - 128	1.67 - 23.9	2.54 - 132	4.43 - 10.6	<5 - 258	<5 - 211	0.10 - 0.82	233-1630	<4-1600	1995-2003
07143672 near Halstead, KS	99 - 3550	2.5 - 16.2	6.2 - 8.5	210 - 460	8.19 - 174	1.54 - 36.2	4.38 - 498	4.4 - 18.1	8 - 932	<5 - 312	0.05 - 2.74	308-2970	<4-2240	1994-2003
07144200 at Valley Center, KS	79 - 7300	5.7 - 14.6	6.6 - 8.7	1 - 474	9.6 - 142	0.2 - 32	3 - 260	3.3 - 10	5 - 545	5 - 110	0.1 - 0.8	64 - 1250	9 - 9990	1944-2002
North Fork of the Ninnescah River														
07144780 above Cheney Reservoir, KS	152 - 1560	7.5 - 10.4	7.2 - 9.1	188 - 266	54 - 83	9.1 - 16	137 - 190	3.6 - 8.2	196 - 282	49 - 88	0.4 - 0.5	628 - 776	1 - 2460	1967-2002
07144800 near Cheney, KS	260 - 1770		7.2 - 8.3	84 - 307	26 - 87	4.6 - 30	16 - 265	1.6 - 8	23 - 402	11 - 85	0.2 - 0.5	158 - 967	27 - 1740	1958-1965
Ninnescah River														
07145500 near Peck, KS	15 - 4020		6.8 - 8.8	48 - 320	14 - 99	3.2 - 23	7.5 - 273	1.4 - 8.2	12 - 421	6 - 82	0 - 0.7	95 - 936	11 - 4000	1940-2002

Source: http://nwis.waterdata.usgs.gov

KDHE should be combined and used as an initial baseline for the HBMP of the ILWSP. The five locations along the Little Arkansas River that were previously sampled by the City for fisheries, macroinvertebrate, and physical habitat from 1995 through 1997 should be the starting point for collecting baseline data and to monitor if changes as a result of ILWSP operation appear to be occurring. Since the ILWSP will be constructed in phases and will take several years to be fully operational, ample time should be available to collect and analyze supplemental data for the intervening period between 1997 and 2004. It is recommended that the five sites be in addition to the City's existing program and be sampled at least twice per year beginning in the year 2005. The collected data should be analyzed, compared, and reported in the third year and fifth year reports, beginning in 2008 and continuing until five years after project implementation.

Since stream flow and conditions can be extremely variable from year to year, sampling should be conducted in the summer or winter on a consistent basis when flow parameters are likely to be most similar. Prior to determining sampling times, it is highly recommended to take advantage of "sametime" data or hourly flow data from the USGS to determine existing stream conditions.

The combination of the previously collected data and additional sampling at the five locations, along with the City's and KDHE's current data collection on the Little Arkansas River, should provide sufficient data for an accurate baseline and for comparative analyses. These five sample locations are graphically illustrated on the HBMP Monitoring Location Map in Appendix B.

This routine monitoring should be continued as part of the HBMP for five years after ILWSP implementation is completed or until a specific project impact as a result of ILWSP operation has been detected. Once all cooperating parties and the City agree that an impact appears to be occurring, the monitoring schedule can be modified and conducted as agreed by the cooperating agencies and the City.

Table 6-11. Recommended Biological Monitoring Locations Along the Little Arkansas River

Site Name	General Location Description
AQM-1	Near NW 12 Rd. in Halstead Township
AQM-6	Near NW 48 Rd. in Lakin Township
AQM-9	Near S Emma Creek Rd. in Sedgwick Township
AQM-12	Near 55th St West in Valley Center Township
AQM-13	Near 24th St W and 69th St N in Park Township

Source: Aquatic Monitoring Report - Little Arkansas River, Equus Beds Groundwater Recharge Project for the City of Wichita, 1995-1997.

6.2.2 Available Studies and Reports for Reference

Existing studies and reports should be used as references for the development and implementation of the HBMP. A partial list of these available documents is provided in Table 6-12. Additional reports and materials that were provided for reference material by the KDWP are located in the reference section of the HBMP and are listed under Additional References Provided by KDWP.

Table 6-12. Available Studies and Reports

Title	Organization	Year
Water Supply Study	Burns & McDonnell	1993
Environmental Assessment for the Equus Beds Groundwater Recharge Demonstration Project	Burns & McDonnell	1994
Annual Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1995
Annual Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1996
Local Well Field Feasibility Study Data Review and Initial Work Plan	Burns & McDonnell	1996
Equus Beds Groundwater Recharge Demonstration Project, Summary of Activities for Calendar Year 1996	Burns & McDonnell	1997
Annual Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1997
Customer and Water Demand Projection Reevaluation	Burns & McDonnell	1997
Quality Assurance Plan for Water Quality Sampling Analysis, Equus Beds Groundwater Recharge Demonstration Project	Burns & McDonnell	1997
State and Federal and Agency Update Meeting, Raw Water Supply Projects, City of Wichita, Kansas	Burns & McDonnell	1997
Local Well Field Expansion Test Well Project, Final Environmental Assessment	Burns & McDonnell	1997
Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1995-97
Annual Aquatic Monitoring Report for the North Fork of the Ninnescah	Burns & McDonnell	1997
Equus Beds Groundwater Recharge Demonstration Project,	Burns & McDonnell	1998

Title	Organization	Year
Summary of Activities for Calendar Year 1997		
Annual Aquatic Monitoring Report for the North Fork of the Ninnescah and the Ninnescah Rivers	Burns & McDonnell	1998
Aquatic Monitoring Report for the North Fork of the Ninnescah and the Ninnescah Rivers	Burns & McDonnell	1997-98
Report on Pipeline Improvements at Key Locations Along City's 48-Inch Well Field Supply Main	Burns & McDonnell	1998
Operation and Testing Manual for the Equus Beds Groundwater recharge Demonstration Project	Burns & McDonnell	1998
Equus Beds Groundwater Recharge Demonstration Project, Summary of Activities for Calendar Year 1998	Burns & McDonnell	1998
Cheney Reservoir Field Study	Burns & McDonnell	1998
Atrazine in Source Water Intended for Artificial Groundwater Recharge, South-Central Kansas	US Geological Survey	1998
Changes in Groundwater Levels and Storage in the Wichita Well Field Area, South-Central Kansas	US Geological Survey	1998
Status of Groundwater Levels and Storage in the Wichita Well Field Area, South-Central Kansas	US Geological Survey	1998
Report on Raw Water Delivery With 48-Inch Pipeline Replacement	Burns & McDonnell	1999
Local Well Field Concept Development Study	Burns & McDonnell	1999
Baseline Water Quality and Preliminary Effects of Artificial Recharge on Groundwater, South-Central KS	US Geological Survey	1999
Aquatic Monitoring Report for the Little Arkansas River	Burns & McDonnell	2000
Aquatic Monitoring Report for the North Fork of the Ninnescah and the Ninnescah Rivers	Burns & McDonnell	2000
Concept Design Study of the Equus Beds Aquifer Recharge, Storage and Recovery	Burns & McDonnell	2000
Instream Flow Incremental Modeling Report – Little Arkansas River	Burns & McDonnell	2000
080-LARB-00 Cowskin Creek, Sedgwick County	Kansas Department of Wildlife & Parks	2000
081-LARB-00 Ninnescah River, Sedgwick County	Kansas Department of Wildlife & Parks	2000
086-LARB-00 Little Arkansas River, Sedgwick County	Kansas Department of Wildlife & Parks	2000
088-LARB-00 Arkansas River, Sedgwick County	Kansas Department of Wildlife & Parks	2000
089-LARB-00 Arkansas River, Sumner County	Kansas Department of Wildlife & Parks	2000
090-LARB-00 Arkansas River, Cowley County	Kansas Department of Wildlife & Parks	2000
Instream Flow Incremental Modeling Report – North Fork of the Ninnescah River	Burns & McDonnell	2001
Effects of Artificial Recharge on Water Quality in the Equus Beds Aquifer, South-Central Kansas, 1995-2000	U.S. Geologic Survey	2001
Significant Findings of Water-Quality Studies and Implications for Cheney reservoir Watershed, South-Central Kansas, 1996-2001	U.S. Geologic Survey	2002
HDR Water Quality Report Summary – Phase II	HDR Engineering, Inc	2003
Status of Groundwater Levels and Storage Volume in the Equus Beds Aquifer Near Wichita, KS, Jan. 2000 – Jan. 2003	U.S. Geologic Survey	2003

6.3 PROJECT IMPLEMENTATION CONCERNS

Several potential issues and concerns have been identified by cooperating agencies and the public either during the NEPA EIS process or during the HBMP development meetings in 2003 and 2004. The basic objective of the HBMP is to be able to recognize and address beneficial or adverse project impacts (or issues and concerns) early-on. General issues and concerns expressed during the NEPA and HBMP processes have been related to stream flows, water quality, and the overall condition of the aquatic biological community. A brief discussion of each of these items follows.

6.3.1 Stream Flows

As mentioned in the 2003 EIS, the median stream flows of the Little Arkansas River have historically been near 60 cubic feet second (cfs) April through June and near 35 cfs the remaining time of the year. With implementation of the preferred ILWSP 100 MGD Diversion Alternative, base flows in the Little Arkansas River above Wichita are expected to increase over a period of about 15 years, while high stream flows are expected to remain relatively unchanged.

Median stream flows are expected to increase, except in the months of May and June when the median stream flow is expected to decrease slightly. Median stream flow in the Arkansas River is expected to remain essentially the same, except during June when stream flows would decrease slightly as a result of ILWSP operation increasing the upstream diversion of water for aquifer recharge in the Little Arkansas drainage. Stream flow is not expected to change significantly downstream of Cheney Reservoir in the Ninnescah River basin as a result of ILWSP implementation. A slight increase in the water surface elevation of Cheney Reservoir is expected.

The FWS and KDWP would prefer that stream flows remain within 80 percent of the historical median flows instead of the MDS of 20 cfs that was adopted by the State of Kansas for the Little Arkansas River. Both agencies believe that it is more important to monitor median flows than flows during more infrequent or rare wet or dry years. In

addition, lower stream flows appear to create a more significant stressful situation to the existing biological community than would be expected to occur with higher stream flows.

6.3.2 Surface Water Quality

In 1998, EPA approved the Section 303(d) list that identified 129 river segments, as well as 24 lakes, in the lower Arkansas River basin as "water quality impaired" (KDHE website: http://www.kdhe.state.ks.us), which includes portions of the Arkansas and Little Arkansas rivers.

High levels of FCB were the most common reason for stream water quality impairment. However, eutrophic conditions were the primary reason for lake impairment. Additional pollutants that are limiting the use of the stream or river segments include:

- Chlordane
- Selenium
- Chloride
- Fluoride
- Ammonia
- Sulfate
- Nutrient oxide demand
- Sediment
- Dissolved oxygen depletion

Additional impairments to lakes occurred as a result of:

- Chloride
- Sulfate
- Dissolved oxygen depletion
- Selenium
- Siltation
- pH
- Excessive aquatic plants

A Total Daily Maximum Load (TMDL) has been developed by KDHE for each pollutant or parameter causing impairment to a stream or lake and has been given a high, medium, or low priority ranking. As of 2004, the TMDL's with a high priority implementation ranking for portions of the Arkansas and Little Arkansas rivers in the HBMP area of interest include FCB, sediment, nutrients, and chloride. The watershed above Cheney Reservoir is on the high priority list for TMDL's for siltation and eutrophication

(nutrients); however, plans to include Cheney Reservoir or the Ninnescah River are not part of the HBMP, since ILWSP impacts are not anticipated to occur. It is also unlikely that the ILWSP would have significant impacts on water quality in either the Arkansas or Little Arkansas rivers as project operation is not expected to introduce additional or remove existing pollutants.

6.3.3 Aquatic Biological Community

During the development of the HBMP, cooperating agencies discussed their concerns that significant alteration to existing stream flow and water quality could result in adverse impacts to the aquatic biological community including fisheries, macroinvertebrates, and physical habitats. These impacts could adversely affect sensitive species populations, as well as general species populations. The two species of concern mentioned were the Arkansas River shiner (*Notropis girardi*) and the speckled chub (*Macrhybopsis aestivalis tetranemus*).

As indicated by FWS, critical habitat for the Arkansas River shiner (shiner) is no longer designated at the Federal level in the Arkansas and Ninnescah rivers in the State of Kansas. However, KDWP recognizes critical habitat for the shiner from Great Bend, Kansas to the Kansas – Oklahoma stateline. FWS indicated that a final determination to redesignate critical habitat for the Arkansas River shiner has not been completed. The Arkansas River shiner has not been found in the Arkansas or Little Arkansas river basins in Kansas since the late 1980s; however, the species is on the Kansas endangered list and on the Federal threatened list. KDWP indicated that the State of Kansas threatened and endangered species list is up for review in 2004.

The BOR and FWS are expecting a final report from Texas Tech University regarding Arkansas River shiner studies on the North Canadian River in Texas. Previously, it was believed that the Arkansas River shiner populations would remain stable in a river system if the speckled chub (*Macrhybopsis aestivalis tetranemus*) and silver chub (*Macrhybopsis storeiana*) populations remained stable. Changes to this concept have occurred, for it is now believed that length of contiguous unobstructed river segments is extremely

important for the well-being of the Arkansas River shiner according to the unpublished results of the Texas Tech study. The reasoning for this need is that the Arkansas River shiner eggs float downstream and must have time to develop for successful reproduction. The Arkansas River shiner's breeding period typically commences in May when stream flow is relatively high or near its seasonal peak.

A second species, the speckled chub, is a state-listed endangered species where critical habitat has been designated; the species is known to occur in both the Arkansas and Ninnescah river basins. This species prefers currents over clean, fine sand, avoiding calm water and silt bottoms (from KDWP County T&E List and Species Data Sheets).

6.4 SUMMARY

In summary, both hydrological and biological data will be collected by the City of Wichita and by and with assistance from federal, state, and local cooperating agencies. Historic resource data, along with that data currently being collected, can be easily used to establish adequate baseline conditions that are representative of the ILWSP prior to operation. Continuing these existing programs using the recommended schedule and reporting requirements will provide the avenue to determine if ILWSP operation will potentially create either beneficial or adverse environmental impacts or effects that will need to be recognized and addressed in the future.

Table 6-13. Data Collection by Entity

Data Type	USGS	KDHE	GMD2	City
Groundwater	X		X	X
Stream Flow	X			
Stream Quality	X	X		X
Benthic or Macroinvertebrate		X		X
Fisheries				X
Physical Habitat				X

7.0 HBMP RESPONSIBILITIES FOR DATA COLLECTION

To address the concerns of groundwater, stream flow, quality, and biological community, the HBMP recommends continuation of on-going data collection programs. The data collection procedures, responsibilities, and reporting requirements in the HBMP were agreed upon by the City and the participating agencies. The subsequent sections will summarize in detail the data collection procedures and responsibilities associated with the HBMP.

7.1 GROUNDWATER ELEVATION DATA COLLECTION

The City currently works with the USGS and GMD2 to collect groundwater data; however, it will be the City's responsibility for gathering the data from the necessary entities and including it in the HBMP annual reports. As described in Section 5.0, the data will be tabulated and briefly analyzed in the three-year reports, while the detailed analysis results and recommendations will be provided within the five-year HBMP reports. Recommended sampling locations are identified on the HBMP Groundwater Monitoring Location Map in Appendix B.

7.2 STREAM FLOW DATA COLLECTION

Since the USGS has hourly stream flow monitoring records and are projected to use existing sampling sites well into the future, it is recommended to use their existing locations and data for purposes of the HBMP. The City is responsible for collecting the stream flow data from the USGS and providing it in the annual reports. The data will be tabulated and preliminarily analyzed in the three-year reports, while the detailed analysis results and recommendations will be included in the five-year reports. Recommended sampling locations and data collection include the same gaging stations listed in Table 6-1 and depicted on the HBMP Monitoring Location Map in Appendix B.

7.3 STREAM QUALITY DATA COLLECTION

Since the KDHE, USGS, and the City have stream quality records and are projected to use existing sampling sites into the future, it is recommended to use the combination of the collected data for purposes of the HBMP. The City is responsible for collecting the data from KDHE and USGS, as well as from other departments in the City, on an annual basis for inclusion in the annual reports. The data will then be tabulated and analyzed in the three-year reports, while analysis results and specific recommendations will be included within the five-year reports. Recommended sampling locations and data collection, include the same monitoring sites listed in Tables 6-1, 6-3, and 6-5, as well as the City's detailed sampling schedule provided in Appendix D. All of the stream quality locations are also depicted on the HBMP Monitoring Location Map in Appendix B.

7.4 STREAM MACROINVERTEBRATE/BENTHIC DATA COLLECTION

Stream macroinvertebrate and benthic data from the KDHE and City is limited for the Little Arkansas River. For purposes of the HBMP, it is recommended that a combination of sampling sites and data collection from both the KDHE and the City be used, including the five additional sites on the Little Arkansas River as identified in Section 6.2.1.4, Biological Conditions. For purposes of monitoring as part of the HBMP, these biological sites can be monitored twice per year for five years after project implementation or until a project impact has been detected. Depending on the impacts observed, the appropriate monitoring schedules can be determined by the participating agencies and the City. The City is responsible for collecting the data from KDHE and conducting the necessary studies for the additional sites. The raw data will be provided in the annual reports; however, tabulated data and analysis results will be provided in the three- and five-year reports, respectively. The recommended monitoring locations include the same sites listed in Tables 6-4, 6-6, and 6-11. All of the biological monitoring locations are depicted on the HBMP Monitoring Location Map included in Appendix B.

7.5 FISHERIES DATA COLLECTION

It is recommended that the City of Wichita's current data collection methods and sampling locations, as identified in Appendix D Wichita's Current Bio-Monitoring Schedule, continue to be used to determine impacts to the fish populations within the Arkansas and Little Arkansas Rivers. It is also recommended that five additional sites on the Little Arkansas River be monitored, as described in Section 6.2.1.4 Biological Conditions. For purposes of the HBMP, these additional biological sites can be monitored twice per year for five years after project implementation or until a project impact has been detected; at that point, the City and participating agencies can determine an appropriate monitoring schedule. The City is responsible for collecting this data and providing it in annual reports. The tabulated data will be provided in the three-year reports. Current and historic trends of fish populations should be analyzed and compared to project operation schedules to determine if there are signs of impacts, either adverse or beneficial to the fish populations. The results are to be provided within the five-year reports. The recommended monitoring locations include the sites listed in Tables 6-4 and 6-11. The monitoring locations are also depicted on the HBMP Monitoring Location Map in Appendix B.

7.6 PHYSICAL HABITAT

It is recommended that the City's current data collection methods and sampling locations as identified in Table 6-4 Wichita's Current Monitoring Schedule be used to determine impacts to physical habitat within the Arkansas and Little Arkansas rivers. It is also recommended to monitor the five additional sites on the Little Arkansas River, as described in Section 6.2.1.4 Biological Conditions and shown in Table 6-11. For purposes of monitoring as part of the HBMP, these additional biological sites can be monitored twice per year for five years after project implementation or until a project impact has been detected; at this point, the City and participating agencies can determine a more appropriate monitoring schedule. The City is responsible for collecting this data and providing it in annual reports. The tabulated data will be provided in the three-year reports. Physical habitat studies will be reviewed and compared to past records and the

results are to be provided within the five-year reports. The monitoring locations are also depicted on the HBMP Monitoring Location Map in Appendix B.

8.0 DATA COLLECTION COORDINATION RESPONSIBILITIES

The City will be responsible for coordinating and collecting the pertinent data from the participating agencies that will be used to generate the annual HBMP reports. The City will also be responsible for conducting any additional studies or monitoring additional sites per recommendations made within this HBMP. The City will provide reports to the participating agencies for review and coordinate any follow-up meetings regarding the HBMP.

9.0 SCIENTIFIC PEER REVIEW

With the recommendation and concurrence of the City and the cooperating agencies, a "scientific peer review" panel may convene to review the progress and findings of the HBMP. The panel will provide non-binding technical input to the City regarding the HBMP. The panel will consist of five members to be selected from the scientific community who have expertise in terrestrial and aquatic ecosystems found within the ILWSP project area and surrounding region. Two of the panel members will be selected by the City, two by the cooperating agencies, and one by the City and cooperating agencies. The City will by responsible for scheduling meetings, maintaining files, and generally coordinating the logistics of the panel.

The cost associated with compensating the scientific peer review panel will be shared equally by the City and the cooperating agencies. Prior to each budget year, the City and the cooperating agencies shall agree on the reasonable and effective budgeted amount for compensating the panel for the following year. Agreement will not be unreasonably withheld by either party. Any change in the panel composition, structure, or scope of review may be made in writing with the City and the cooperating agencies.

10.0 QUALITY ASSURANCE MANUAL

The water quality or water chemistry analyses included in the HBMP should be performed using established procedures included in the ILWSP Quality Control Manual prepared by the City, EPA, and the USGS. This manual, the *Quality Assurance Plan for Water Quality Sampling Analysis, Equus Beds Groundwater Recharge Demonstration Project*, was completed in 1997 and remains in effect today. All field and laboratory methods used in the HBMP must be as described in the 1997 manual. If modifications to the procedures are required, these procedural changes should be approved by the City, EPA, USGS, and cooperating agencies before being implemented. Documentation of the changes should be appended to the HBMP as they occur.

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http://www.kdhe.state.ks.us
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APPENDICES

Appendix A

NORTH

2.5 0 2.5 Miles

Index Map

1 Harvey
Reno
2 Sedgwick
3 Sumner
Cowley
4

Reno County

Harvey County

Sedgwick County

Willowbrook
Robert St
Carlton Rd
30th Ave
Kansas State Highway 96
Lakeview Rd
Ken Kennedy Fwy
Spyglass Dr
Linksland Dr
43rd Ave
30th Ave
23rd Ave
Airport Rd
17th Ave
Kent Rd
Willison Rd
Buhler Rd
Victory Rd
Palamino Trl
Arabian Dr
Worthington Rd
24th St
4th Ave
Avenue G
Frank Rd
Swede Rd
Hutchinson
Clark Rd
Morton Dr
6th Ave
3rd Ave
Avenue E
South Hutchinson
Blanchard Rd
Illinois Ave
Wilshire Dr
Whiteside St
Arthur St
Jackson St
Adams St
Poplar St
Ford St
Severance St
Maple St
Lorraine St
Halstead St
Valley Pride Rd
Mohawk Rd
Sand Creek
Obee Rd
Mayfield Rd
Brandy Lake
Mallard Rd
Blanchard Ave
Meguire Lake
Kisiwa Creek
Woodbury Rd
Woodberry Rd
Cow Creek
Arkansas River
Stroud Rd
Eales Rd
Trail West Rd
Long View Rd
Red Rock Rd
Greenfield Rd
Lake Cable Rd
Arlington Rd
Irish Creek Rd
Main St
Haven
Willison Rd
Haven Rd
Rayl Rd
Gar Creek
Switzer Rd
Dixville Ditch
Crow Creek
Sandcreek Rd
McNew Rd
Yoder Rd
Essex Rd
Broadacres Rd
State Road 17
Mills Ave
Morgan Ave
Apache Rd
82nd Ave
69th Ave
56th Ave
Woodberry Rd
Wheat State Road
Victory Rd
Rayl Rd
Burmac Rd
Willow Lake Rd
Tipsley Creek
Sand Creek
W 96th St
72nd St
60th St
48th St
24th St
Golden Prairie Rd
Spring Lake Rd
Old Settlers Rd
Halstead Rd
Hertzler Rd
Essex Heights Rd
Mission Rd
West Plum Creek
Dry Creek
Dutch Ave
Lincoln Blvd
Knott St
Hesston
Hickory St
Hoover Rd
West Rd
Emma Creek Rd
East Spring Creek
County Road 813
Hesston Rd
I-135
Andersen Rd
State Highway 15
Kansas Rd
Grant St
36th St
NorthNewton
23rd St
Meridian Rd
Old Trail Rd
Hillside Rd
Main St
Oak St
High St
Plum St
5th St
3rd St
Newton
6th St
14th St
County Road 574
Mud Creek
Cow Palace Rd
Sand Creek
Ridge Rd
Spencer Rd
12th St
United States Highway 50
Epping Ln
Shartzler Rd
Prairie Lake Rd
Sand Hill Rd
Blaine St
Market St
Burrton
1st St
6th St
24th
30th St
2nd St
10th St
Halstead
36th
48th
60th
72nd
84th
96th
125th
W 125TH ST N
E 125TH ST N
E 1ST ST
W 117TH ST N
W 109TH ST N
N 263RD ST W
N 215TH ST W
N 199TH ST W
N 151ST ST W
N 135TH ST W
N 119TH ST W
N 103RD ST W
N 87TH ST W
N 71ST ST W
N 55TH ST W
N 39TH ST W
N 24TH ST W
N 10TH ST W
N 135 HWY
N HILLSIDE AVE
Beyle Lake
Sauce Lake
Patterson Lake
Greenfield Lake
Emma Creek
MOUNT_HOPE
BENTLEY
SEDGWICK
Halstead
Hesston
Newton
Burrton
Haven

LEGEND

- City Biological Test Sites
- City Chemical Test Sites
- City Chemical & Biological Test Sites
- Health Department Test Sites
- City Aquatic Monitoring Sites (1995-1997)
- USGS Flow Stations
- USGS Stream Flow Test Sites
- KDHE Test Sites
- KDHE Fish Tissue Sampling Sites
- KDHE Stream Chemistry Test Sites
- KDHE Macro-Invertebrate Sampling Sites

CITY OF WICHITA

Stream Monitoring Test Sites Near Wichita
Wichita Hydrobiological Monitoring Plan
Sheet 1 of 4

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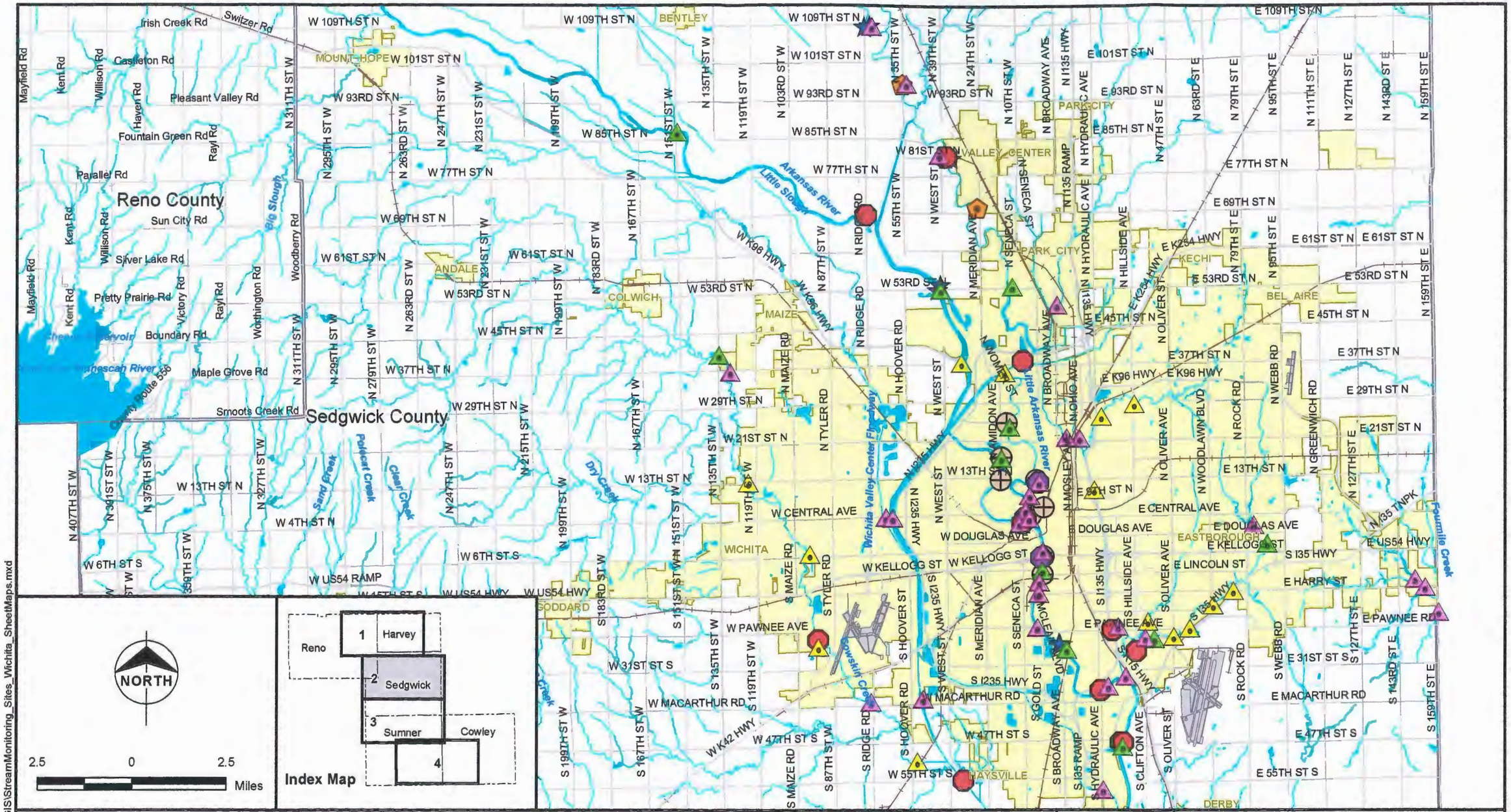
Revised September 14, 2004



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CITY OF WICHITA

Stream Monitoring Test Sites Near Wichita
Wichita Hydrobiological Monitoring Plan
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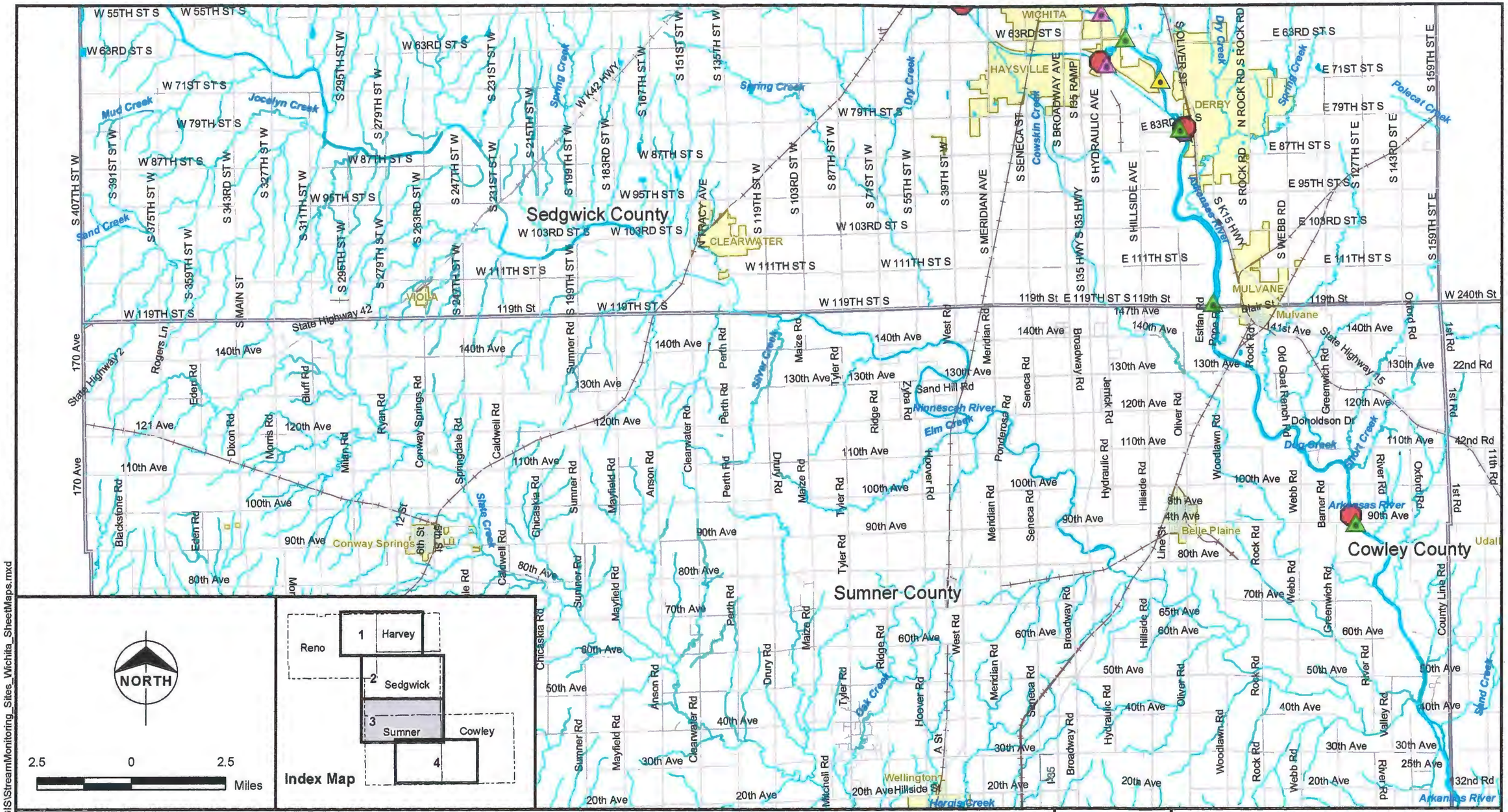

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Wichita Hydrobiological Monitoring Plan
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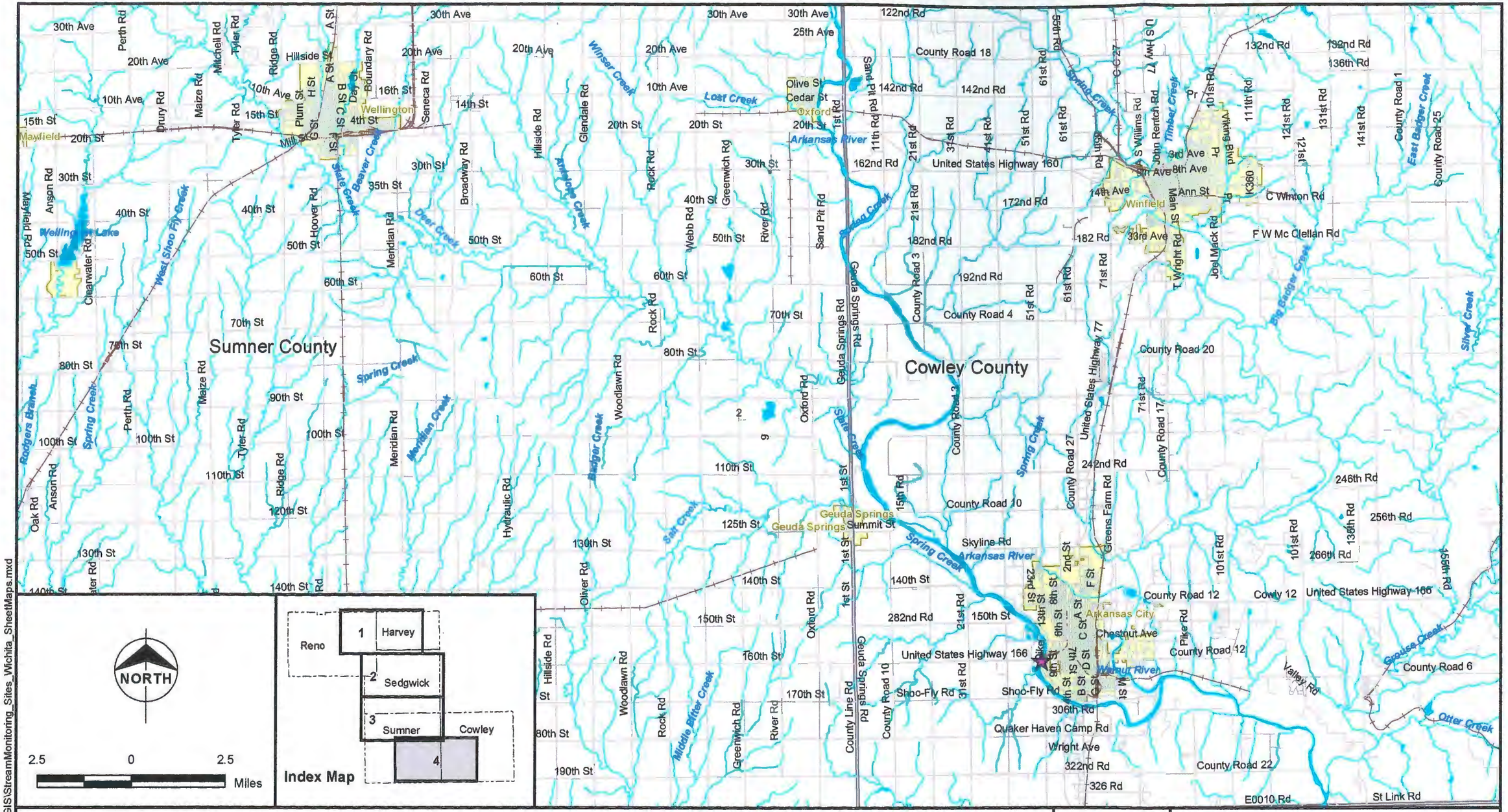

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CITY OF WICHITA

Stream Monitoring Test Sites Near Wichita
Wichita Hydrobiological Monitoring Plan
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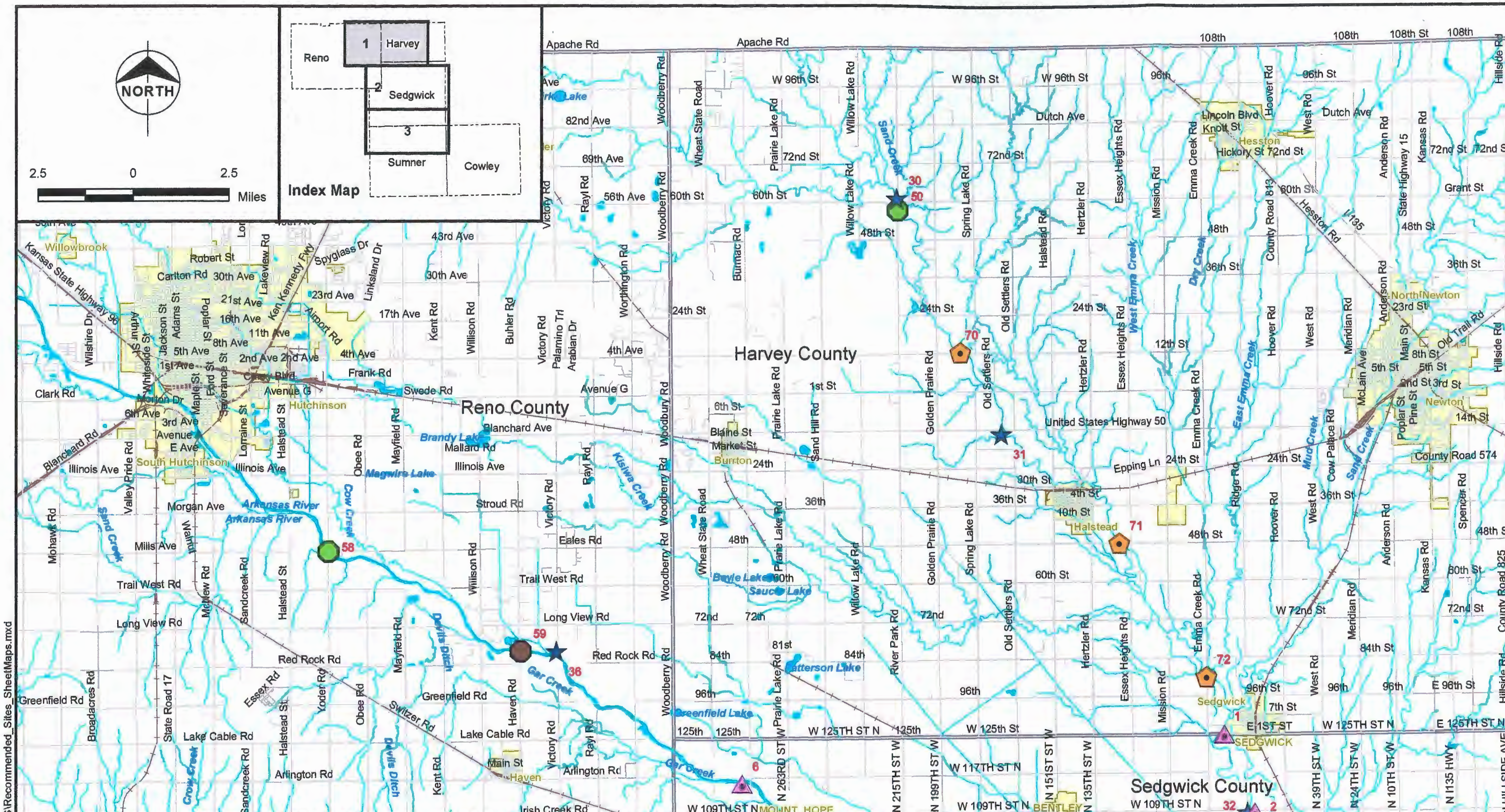

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- KDHE Chemical Test Sites
- KDHE Fish Tissue & Macro-Invertebrate
- KDHE Fish Tissue & Stream Chemistry

CITY OF WICHITA

Recommended Stream Monitoring Test Sites
Wichita Hydrobiological Monitoring Plan
Sheet 1 of 3

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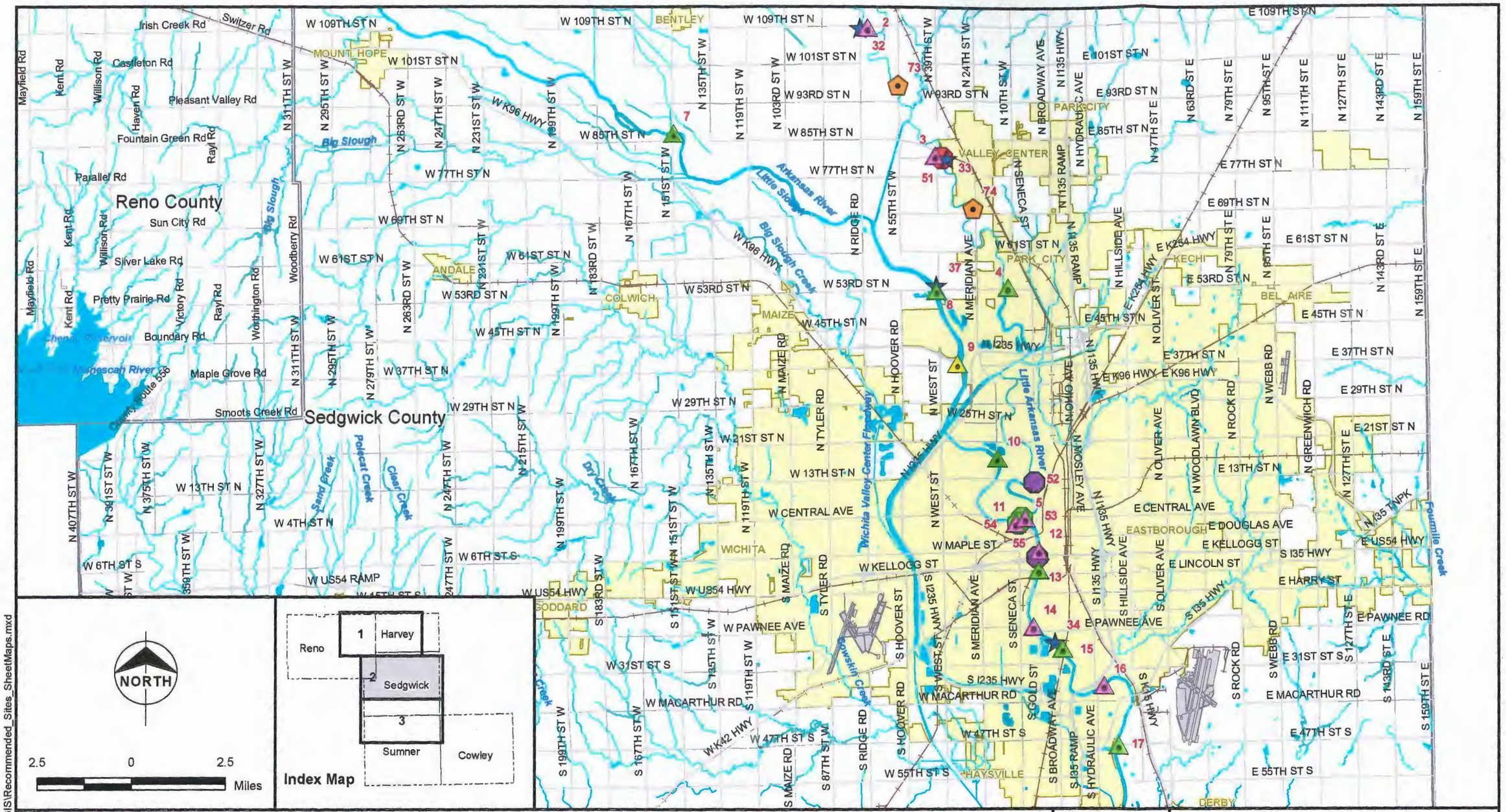
Revised September 13, 2004



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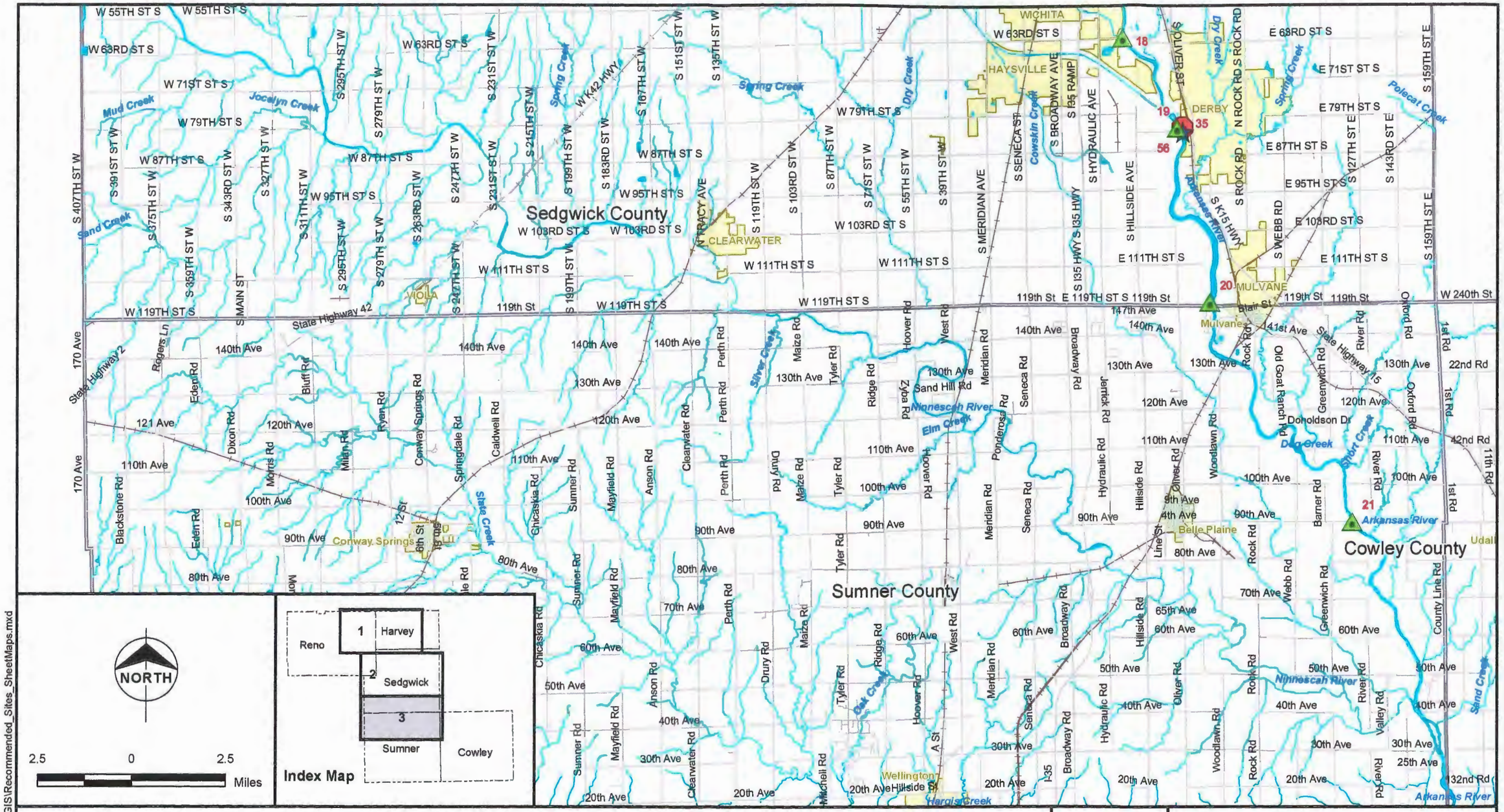
Revised September 13, 2004

Recommended Stream Monitoring Test Sites
Wichita Hydrobiological Monitoring Plan
Sheet 2 of 3



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- KDHE Fish Tissue & Stream Chemistry

CITY OF WICHITA

Recommended Stream Monitoring Test Sites
Wichita Hydrobiological Monitoring Plan
Sheet 3 of 3

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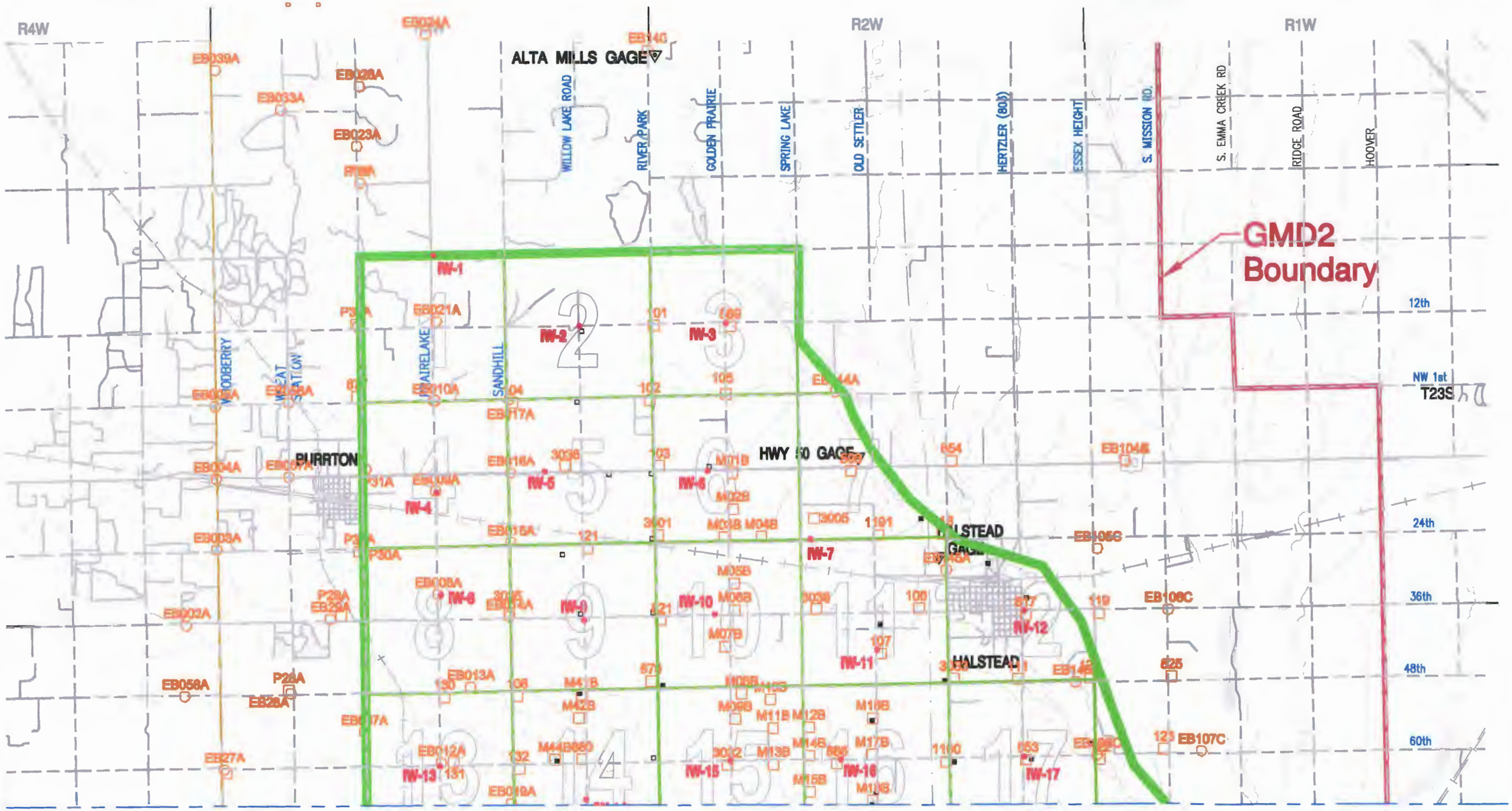
Revised September 13, 2004

Recommended HBMP Groundwater Monitoring Test Sites



NOTE:

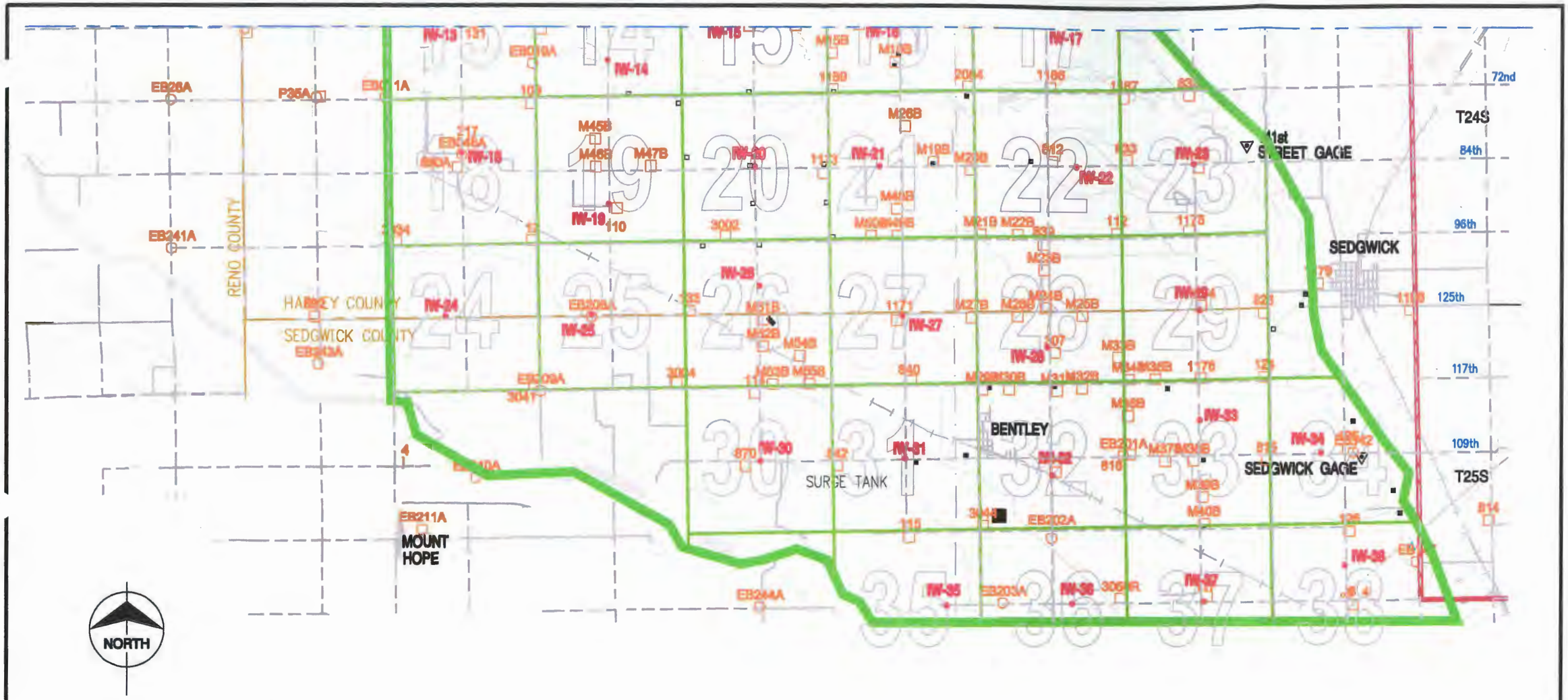
"EB" WELLS ARE PART OF THE GROUNDWATER MANAGEMENT DISTRICT MONITORING SYSTEM.

CITY OF WICHITA

Monitoring Well Locations

SHEET 1 OF 2

Burns & McDonnell
SINCE 1898



LEGEND

- HISTORICAL MONITORING WELL
- INDEX WELL LOCATION (CONSTRUCTED 2001)
- STUDY AREA BOUNDARY
- 35 INDEX AREA

CITY OF WICHITA

Monitoring Well Locations

SHEET 2 OF 2

Burns & McDonnell SINCE 1898

Appendix B

Recommended HBMP Stream Monitoring Test Sites

Appendix C

Recommended HBMP Monitoring Locations Table

HBMP Recommended Monitoring Sites

Map Site No.	Station or ID No.	General Location	Stream Flow	Stream Quality/ Chemistry	Stream Macroinvert./ Benthic	Fisheries	Physical Habitat
City Monitoring Sites							
1	NA	Little Arkansas R near Sedgwick-Harvey County Line, KS		X			
2	NA	Little Arkansas R near 109th N. St., Wichita, KS		X			
3	NA	Little Arkansas R near 85th N. St., Wichita, KS		X			
4	NA	Little Arkansas R near 53rd N. St., Wichita, KS		X	X		
5	NA	Little Arkansas R near Central St., Wichita, KS		X[1]			
6	NA	Arkansas R near Mt. Hope, KS		X			
7	NA	Arkansas R near Bentley, KS		X	X	X	X
8	NA	Arkansas R near 53rd N. St., Wichita, KS		X	X	X	X
9	NA	Arkansas R near K-96, Wichita, KS		X	X	X	
10	NA	Arkansas R near Twin Lakes, Wichita, KS		X	X	X	
11	NA	Arkansas R near Seneca St., Wichita, KS		X			
12	NA	Arkansas R near Lewis St., Wichita, KS		X[1]			
13	NA	Arkansas R near Lincoln St., Wichita, KS		X	X	X	X
14	NA	Arkansas R near Pawnee St., Wichita, KS		X[1]			
15	NA	Arkansas R near Herman Hill, Wichita, KS		X[1]		X	
16	NA	Arkansas R near Hydraulic St., Wichita, KS		X			
17	NA	Arkansas R near 47th St., Wichita, KS		X	X	X	X
18	NA	Arkansas R near 63rd St., Wichita, KS		X	X	X	X
19	NA	Arkansas R near Derby, KS		X	X	X	X
20	NA	Arkansas R near Mulvane, KS		X	X	X	X
21	NA	Arkansas R near Hwy 55, Belle Plaine, KS		X	X	X	X
USGS Gaging Stations							
30	7143665	Little Arkansas R near Alta Mills, KS	X	X[2]			
31	7143672	Little Arkansas R near Hwy 50, Halstead, KS	X	X[2]			
32	07144100	Little Arkansas R near Sedgewick, KS	X	X[2]			
33	07144200	Little Arkansas R near Valley Center, KS	X	X[2]			
34	07144300	Arkansas R near Wichita, KS	X	X[2]			
35	07144550	Arkansas R near Derby, KS	X	X[2]			
36	07143330	Arkansas R near Hutchison, KS	X	X[2]			
37	07143375	Arkansas R near Maize, KS	X	X[2]			

HBMP Recommended Monitoring Sites

Map Site No.	Station or ID No.	General Location	Stream Flow	Stream Quality/ Chemistry	Stream Macroinvert./ Benthic	Fisheries	Physical Habitat
KDHE Monitoring Stations							
50	SC246	Little Arkansas R near Alta Mills, KS		X[3]			
51	SC282	Little Arkansas R near Valley Center, KS		X[3]	X		
52	No ID	Little Arkansas R near 13th St. in Wichita, KS		X[4]			
53	SC728	Little Arkansas R near Wichita, KS		X[3]			
54	SC729	Arkansas R near Wichita, KS		X[3]			
55	No ID	Arkansas R near US54/Kellog St. Wichita, KS		X[4]			
56	SC281	Arkansas R near Derby, KS		X	X		
57	No ID	Arkansas R near Belle Plaine, KS		X[4]			
58	SC524	Arkansas R near Yoder, KS		X[3]			
59	SB283	Arkansas R near Haven, KS (3 Mi. North)		X[4]	X		
60	SC536	Arkansas R near Maize, KS		X			
Burns & McDonnell Aquatic Monitoring Sites							
70	AQM1	Little Arkansas R near NW 12 Rd. in Halstead Township			X	X	X
71	AQM6	Little Arkansas R near NW 48 Rd. in Lakin Township			X	X	X
72	AQM9	Little Arkansas R near S Emma Creek Rd. in Sedgwick Township			X	X	X
73	AQM12	Little Arkansas R near 55th St. West in Valley Center Township			X	X	X
74	AQM13	Little Arkansas R near 24th St. W/69th St. N in Park Township			X	X	X

X[1] - Bacteria testing only

X[2] - Sampling schedule varies annually

X[3] - Stream chemistry sampling only

X[4] - Fish tissue sampling only

City of Wichita's BioMonitoring Detailed Schedule
(as of January 16, 2004)

		Chemical													Biological		
* Site No.	Site Location	pH	Temp	D.O.	Conductivity	Ammonia	Nitrates	TKN	Chlorophyll A	Chlorides	Phosphorous	Hardness	Bacteria	Metals	Cyanide	Fish	Benthic	Phy-Hab
1	Little Arkansas R near Sedgwick-Harvey County Line, KS	x	x	x	x	x	x				x		x					
2	Little Arkansas R near 109th N. St., Wichita, KS	x	x	x	x	x	x				x		x					
3	Little Arkansas R near 85th N. St., Wichita, KS	x	x	x	x	x	x				x		x					
4	Little Arkansas R near 53rd N. St., Wichita, KS	x	x	x	x	x	x		x		x		x				x	
5	Little Arkansas R near Central St., Wichita, KS												x					
6	Arkansas R near Mt. Hope, KS	x	x	x	x	x	x				x		x					
7	Arkansas R near Bentley, KS	x	x	x	x											x	x	x
8	Arkansas R near 53rd N. St., Wichita, KS	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
9	Arkansas R near K-96, Wichita, KS	x	x	x	x								x			x	x	
10	Arkansas R near Twin Lakes, Wichita, KS	x	x	x	x											x	x	
11	Arkansas R near Seneca St., Wichita, KS	x	x	x	x	x	x				x		x					
12	Arkansas R near Lewis St., Wichita, KS												x					
13	Arkansas R near Lincoln St., Wichita, KS	x	x	x	x											x	x	x
14	Arkansas R near Pawnee St., Wichita, KS												x					
15	Arkansas R near Herman Hill, Wichita, KS												x			x		
16	Arkansas R near Hydraulic St., Wichita, KS	x	x	x	x	x	x				x		x					
17	Arkansas R near 47th St., Wichita, KS	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
18	Arkansas R near 63rd St., Wichita, KS	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
19	Arkansas R near Derby, KS	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
20	Arkansas R near Mulvane, KS	x	x	x	x											x	x	x
21	Arkansas R near Hwy 55, Belle Plaine, KS	x	x	x	x											x	x	x
	Sampling Frequency	F	F	F	F	M	M	M	M	M	M	M	M	M	M	A	B	B

M=monthly; B=bi-annual; A=annual; F=any field visit

LA = Little Arkansas River

BA = Arkansas River above confluence with the Little Arkansas River

AR = Arkansas River below confluence with Little Arkansas River

" * " Denotes that site numbers correspond with the HBMP Recommended Monitoring Sites Map.

Appendix D

City's Detailed Current Bio-Monitoring Schedule

Appendix E

Water Quality Study of the Arkansas River
Phase II Report November 2003 (CD)