II. Nine Element Watershed-Based Strategy

The Clean Water Action Plan, initiated by the Environmental Protection Agency (EPA) and United States Department of Agriculture (USDA), asks states to prepare watershed based strategies, for impaired waters, that are designed to identify the sources and causes of impairment and provide a roadmap to achieve water quality standards. The Arkansas Natural Resources Commission (ANRC), the agency charged with planning and implementing the Arkansas Nonpoint Source Management Program, accepts the nine element watershed-based strategy as an appropriate way to identify, quantify, mitigate, and monitor water quality impairments due to nonpoint source pollution.

The Kings River Watershed Partnership is following the lead of the ANRC by developing the following nine element watershed-based strategy for the Kings River Watershed (KRW). Neither the Kings River nor its tributaries have been designated by the Arkansas Department of Environmental Quality as impaired due to non-point source pollution. However, the Kings River Watershed is part of the Upper White River Watershed, which is a priority watershed under the Nonpoint Source Management Program in Arkansas. Furthermore, the entire Table Rock Lake, including the Kings River arm, is listed as impaired for phosphorus by the Missouri Department of Natural Resources.

For these and many other previously stated reasons, the KRWP has made the completion of this watershed plan a priority. The KRWP believes that this watershed plan, with its focus on education, will help to ensure the extraordinary water quality that is currently enjoyed in the watershed. The overall goal of the watershed plan for the KRW is to continue to meet the designated uses as set forth by the Arkansas Department of Environmental Quality and the Missouri Department of Natural Resources.

A. Description of the Nine Elements

Element 1: Identification of Causes and Sources of Nonpoint Source Pollution

Goal: To identify the causes and sources or groups of similar sources that will need to be addressed to achieve the water quality goals of the watershed based strategy.

Eight categories representing present and future concerns are identified in Section B below. Each of these concerns, the first four being types of pollutants, is discussed in detail including: their impact to water quality, their cause or source, relevant water quality standards, and their prevalence within the Kings River Watershed. These concerns were all specifically identified by stakeholders of the KRW; therefore, all need to be addressed for the watershed plan to be considered successful. Top priorities among the concerns are sediment and nutrients.

Element 2: Load Reductions

Goal: To estimate the load reductions necessary to achieve water quality standards.

With the exception of one segment on Osage Creek, all streams within the KRW are meeting designated water quality standards. A TMDL is currently being approved for the lower section of Osage Creek, which is listed as impaired because of Total Phosphorus with the point source being discharge from the municipal waste water treatment plant. The stipulations of this TMDL have been included in this plan (Section I.B.13.1). Expected load reductions are included for some action items where they are applicable and calculable. In order to meet the plan's goal of continuing to meet water quality standards, the KRWP will continue its water quality monitoring to determine pollutant trends and appropriate management measures as needed.

Element 3: Management Measures to Achieve Load Reduction

Goal: To describe the nonpoint source management measures that will need to be implemented to achieve the identified load reductions.

Each of the eight categories in Section II.B. includes a section on the management measures, i.e. action items, chosen by the Kings Roundtable to mitigate that particular concern.

Element 4: Technical and Financial Assistance Needed

Goal: To estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed based strategy.

The projected cost for each action item (if calculable), including the expected local and state contribution, is available in the chart in Section II.C. The KRWP will be working to secure local grants and financial assistance as each project warrants, but these contributions cannot currently be projected.

Element 5: Information/Education

Goal: To provide an information/education component that will be used to enhance public understanding of the watershed strategy and encourage public participation in selecting, designing, and implementing nonpoint source management measures.

The primary focus of this watershed plan is information exchange and education. Because of the current water quality of the Kings River Watershed, the KRWP feels that community education on water quality issues and management measures is the appropriate strategy to ensure long term benefits. Each category below contains a myriad of education and information exchange action items. In addition, general education on water quality issues, not specific to one certain pollutant, can be found in the Public Education category.

Element 6: Schedule

Goal: To provide a schedule for implementing the nonpoint source management measures identified in the watershed-based strategy.

The implementation of each action item will depend largely on available funding. The schedule for implementation, available in Section II.C., is based on the prioritization order as set by the Kings Roundtable.

Element 7: Milestones and Reevaluation

Goal: To describe interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

Interim milestones on a project basis are included in the chart of Section II.C. Progress will be evaluated by the Kings River Watershed Partnership on an annual basis with overall progress and reevaluation occurring at the end of a five-year period.

Element 8: Criteria to Evaluate Loading Reductions and Water Quality Progress

Goal: To identify a set of indicators for determining if loading reductions are being achieved and progress is being made towards attaining water quality standards and, if not, the decision criteria for determining if the watershed based strategy needs to be revised.

The criteria to evaluate the success of the management measures will be the continued attainment of water quality standards by all streams within the Kings River Watershed. If a stream is determined to be impaired due to nonpoint source pollution, this watershed based strategy will be revised by the KRWP. If the water quality standards for Arkansas or Missouri are altered in such a way that streams within the KRW are no longer meeting standards, this strategy will need to be revised. This situation might occur if Arkansas or Missouri sets numerical limits on nutrients or when Missouri publishes an approved TMDL for Table Rock Lake.

Element 9: Monitoring

Goal: To establish a monitoring component to evaluate the effectiveness of the implementation efforts.

The ADEQ will continue its monitoring program as described in Section I.B.13.2.

The AWRC will continue its water quality monitoring program at the Grandview station as long as funding is available. Cost of station for 2005 was $43,000. The approximate cost for this station for five years is $215,000.

The Kings River Watershed Partnership will continue its monthly water quality testing for chemical parameters as described in Section B.12.b. In addition, the KRWP will implement a macroinvertebrate sampling program that will include collection two times per year at sites yet to be determined. The KRWP will also coordinate with the county health department to sample for bacteria concentrations at high use locations (3 sites/4 times per year).

Station or entity in charge	**Cost for one year**	**Cost for five years**
ADEQ	unknown	
AWRC	$43,000	$215,000
KRWP		
Chemical testing	$1593.18	$7965.90
Biological testing	$6000	$30,000
Bacterial testing	$204	$1020

B. Issues of Concern and Mitigating Action Items

Possible issues of present and future concerns identified by the Kings Roundtable and the Kings River Watershed Partnership include (in no particular order):

1. Sediment
2. Nutrients (primarily Phosphorus)
3. Pesticides, Herbicides, and other Toxic Substances
4. Bacteria and other Pathogens
5. Illegal dumping
6. Habitat alterations
7. Public Education
8. Property Rights

1. Sediment

Sediment in our waterways is a result of both natural processes as well as human influences. The main sources of inorganic sediment are: erosion of uplands, lateral movement of channels into streambanks, and downcutting of streambeds. Evidence of natural erosion is present almost everywhere – hills, valleys, and canyons sculpted by wind and water. However, most natural sediment inputs are very small and can be incorporated by stream processes into nondestructive forms and quantities. It is excessive sediment that often overwhelms a stream and damages its biological components. Impacts to human populations of excess erosion and sediment deposition include loss of agricultural soils, increased flood frequency, and rapid filling of reservoirs. (Waters 1995)

The size of sediment particles determines their final location within the fluvial system. Heavier, coarse-grained particles (bed load) can be tumbled along the streambed while fine-grained sediment can be entrained in the continuous flow of the water column and eventually deposited in low energy areas of a streambed such as the terminus of a point bar. An excess of deposited sediment can physically smother the benthic aquatic insect community, cause a reduced survival rate for fish eggs, and fill interstitial space otherwise occupied by burrowing animals. (Waters 1995) Eventually the sediment in the Kings River system will be flushed downstream to Table Rock Lake, where it could reduce the life span of the reservoir and negatively impact biological species.

Suspended solids can include silt and clay particles, plankton, algae, fine organic debris, and other particulate matter. An excess of suspended solids can affect the clarity of the water and thus cause a decrease in the passage of light through water. Possible impacts include reduced photosynthesis by aquatic plants, an adverse impact on aquatic insects, and shifts in the fish community towards more sediment tolerant species. Suspended solids are also of concern because they are capable of absorbing nutrients and other contaminants to high levels, thus transferring them from the terrestrial to the aquatic environment. Hem (1985) studied Phosphorus attachment and concluded that approximately 95% of phosphorus in streams tends to adhere to sediment particles. Depending on the factors of slope, runoff, vegetation, and soil infiltration the P-rich sediment can then be deposited or transported throughout the fluvial system. (White 2001) Phosphorus will be covered in more detail in following sections.

Water Quality Standards Related to Sediment

The State of Arkansas does not have numeric water quality standards for Total Suspended Solids in streams. The State instead chose to regulate sediment according to the level of turbidity in the waterway. Sampling for total suspended solids measures all of the suspended particles of a given stream. Testing the turbidity of a stream does not offer a measurement of the total suspended solids because smaller particles impact turbidity more than larger particles. There is no constant correlation between turbidity and total suspended solids.

Reg. 2.503 Turbidity

There shall be no distinctly visible increase in turbidity of receiving waters attributable to municipal, industrial, agricultural, other waste discharges or instream activities. Specifically, in no case shall any such waste discharge or instream activity cause turbidity values to exceed the primary values listed below. Additionally, the non-point source runoff shall not result in the exceedance of the in stream storm-flow values in more than 20% of the ADEQ ambient monitoring network samples taken in not less than 24 monthly samples.

Waterbodies	Primary Values(NTU)	Storm-FlowValues(NTU)
Streams		
Ozark Highlands	10	17
Boston Mountains	10	19

Sediment in the King River Watershed waterways

By measuring the total suspended solids, the Arkansas Water Resources Center found that the average sediment load at the sampling location near Grandview for 1999 – 2003 was 50,496 tons/year (AWRC 2005). The Grandview station is approximately sixteen miles from the mouth of Table Rock Lake and offers the closest data available for total sediment load moving into the lake from the Kings River.
According to a 2004 sampling report from the Arkansas Water Resources Center, the King River Watershed has average TSS loads compared to six other watersheds in Northwest Arkansas (Illinois River, White River, West Fork of the White River, Osage Creek, and Moores Creek). Most of the TSS in the Kings River watershed is transported during storm events. The average annual TSS load from storms was 273 kg/ha, which was approximately 91% of the total load. Between 1999 and 2003 the mean concentration of TSS in the Kings River decreased significantly. (Nelson and Cash 2003) See below.

Figure 8. Flow weighted mean concentrations. AWRC data; Grandview site

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Average Discharge (m^3/s)	15	9	10	18	7	17	8.9
Total -TSS (mg/L)	167	125	111	108	64.76	123	114.83
Storm load – TSS (mg/L)	Need data	Need data	Need data	Need data	Need data	Need data	314.21
Base load - TSS (mg/L)	Need data	Need data	Need data	Need data	Need data	Need data	5.38

The KRWP collects turbidity information for the Kings River Watershed. Below are the results for Site 5. The KRWP sites are sampled monthly without a distinction between storm or base loads. This site is located at the AG&FC access point, Stony Point, downstream of Grandview and just upstream of Table Rock Lake.

Figure 9. 2005 Turbidity Readings. KRWP data; Stony Point site

Date	**Depth (m)**	**Turbidity (FAU)**	**Date**	**Depth (m)**	**Turbidity (FAU)**
01/2005	n/a	6	07/2005	0.80	6
02/2005	1.20	1	08/2005	0.80	6
03/2005	1.10	5	09/2005	0.80	10
04/2005	1.10	3	10/2005	0.60	2
05/2005	0.90	1	11/2005	0.65	4
06/2005	0.78	4	12/2005	0.75	0

According to the KRWP data for 2005, the Kings River is meeting the water quality standards for turbidity.

FTN Associates estimated the sediment loads at the outlets of each sub-watershed. According to their estimates, the sub-watersheds contributing the most sediment are Clabber Creek, Lower Osage Creek, Kenner Creek, and Dry Fork Creek. Interestingly, these sub-watersheds were all estimated to have the highest level of streambank erosion as well. The KRWP will prioritize sub-watersheds for sediment reduction projects after onsite surveying can be completed to ascertain the actual amount of sediment contributed by streambank erosion and thus by each sub-watershed.

The watershed assessment completed by FTN Associates for the Kings River Watershed provided a listing of sediment sources with the calculated percentage of sediment that each was contributing to the watershed outlet. See below.

Figure 10. Sources of sediment and estimated contribution in Kings River Watershed. (FTN 2005)

Sediment Source	**Percentage of Contribution**
1. Rural Land Uses	49.00%
2. Streambank Erosion	38.54%
3. Roads and Ditches	11.90%
4. Urban Land Uses	0.29%
5. Construction Sites	0.25%
6. Point Sources	0.02%

1.1. Sediment from erosion caused by rural land uses:

For the purpose of the watershed assessment written by FTN Associates, rural land uses includes forests, pasture/hay/grass, cropland, and barren land. The percentage of sediment coming from these land uses is the highest comparatively, but at least a portion of it is coming from lands not being presently impacted by human populations.

The annual erosion rate was determined by applying the Universal Soil Loss Equation to the Kings River watershed. The watershed was divided up into 30 meter by 30 meter square grid cells and a USLE value incorporating five different factors was determined for each one. The factors of rainfall and cropping practice were set at the same value for all grid cells. The cover factor, soil erodibility factor, and topographic factor were determined based the landscape of each individual grid cell. These values were multiplied together to calculate average annual erosion in tons/acre/yr for each grid cell. These values were then adjusted to account for the actual amount of sediment that reaches each outlet mouth (a lot of sediment is deposited along the way). (FTN 2005)

Goal: Increase the number of effective best management practices implemented on rural lands in the Kings River Watershed.

Action Items:

1.1.1 Cooperate with the local Conservation Districts, NRCS, and ANRC offices to inform the public about opportunities for assistance with pasture improvement and establishment or protection of buffer zones

1.1.2 Gather existing research and scientific facts on Best Management Practices (BMPs) in order to assess their feasibility and effectiveness.

1.1.3. Cooperate with local farmers to facilitate "demonstration days" for landowners who request information concerning BMPs. Solicit input from farmers not currently participating in government conservation programs.

1.1.4. Work with local partners (Conservation Districts, NRCS, ANRC) to distribute information and facilitate voluntary conservation easements next to streams.

1.2. Sediment from erosion of streambanks:

The erosion of streambanks is a natural process that takes place under normal conditions in streams. However, some human activities can exacerbate erosion of streambanks by causing or accelerating destabilization. Whether the sediment produced by streambank erosion is natural or human induced, the quantities involved may be large and are often greatly detrimental to water quality and fisheries management. (Waters 1995)

In order to obtain an estimate of sediment coming from streambank erosion, FTN Associates used the average annual rate of erosion per mile of stream as measured by the Arkansas Department of Environmental Quality for a study on the West Fork of the White River. During the study, streambank erosion was measured over a one year period in several different stream reaches. The value for the West Fork White River was selected as the most appropriate value for this project because its watershed is similar to and nearby the Kings River Watershed and because the estimate represents an average over several tributaries and several parts of the main channel, not just for one short reach. Based on this information, the streambank erosion rate was calculated at 329 tons/yr/mile. (FTN 2005)

In 2000 and 2001, the Arkansas Game and Fish Commission surveyed a portion of the main stem of the Kings River to develop a qualitative inventory of streambank erosion conditions. They recorded 29 severe stream bank erosion sites, 35 moderate stream bank erosion sites, and 8 slight stream bank erosion sites along the main stem alone. (AG&FC 2002) However, streambank erosion sites along the tributaries of the Kings have not been surveyed and no quantitative measurements of streambank erosion or its indicators are known to exist for the watershed.

Goal: Determine the number and extent of eroded stream banks in the King River Watershed, and distribute information to stream side landowners concerning mitigation and precautions for streambank erosion.

Action Items:

1.2.1. Form a streambank restoration committee composed of landowners, Partnership members, Arkansas Game and Fish staff, ANRC staff, and Conservation District staff. The committee will map and analyze streambank erosion sites along the main stem of the Kings and its tributaries. The committee will also prioritize the sites for restoration, contact landowners, and actively seek funding possibilities for assistance with restoration projects.

1.2.2. Work with partners to complete a streambank restoration project in the Keels Creek sub-watershed. Site was chosen based on landowner interest and participation, sediment contribution to watershed, and vicinity of site to Clabber Ck./Lower Kings subwatershed, which contributes the most sediment from streambank erosion in the Kings River watershed. Through landowner interviews and a site visit, it is estimated this reach has contributed approximately 114,100 ft^3 of sediment in the past two years.

Keels Creek Streambank Restoration Demonstration Site

1.2.3. Hold a demonstration workshop illustrating the problems associated with excess sediment, possible causes within the watershed, problem areas identified in the watershed, ways to address these areas, and ways to reduce or abate potential problems. Landowners with extensive streambank erosion problems identified during the mapping project will be invited to attend the workshop. First workshop will focus on landowners in the Clabber/Lower Kings, Lower Osage, and Keels Creek sub-watersheds.

1.2.4. Create a landowner resource handbook detailing the regulations, required permits, financial assistance, stream hydrology, sediment impact, passive riparian restoration, engineered streambank restoration options, and possible tax credits for local landowners.

1.2.5. Expand education on riparian zone benefits. Create an educational curriculum that will include a multi-media approach with modules on hydrology, stream ecology, watershed management and monitoring, and fluvial geomorphology. Develop a series of secondary education modules which satisfy the state's science requirements.

1.2.6. Clarify ERW status, including rules and regulations, and make them available to the public. Disseminate information regarding gravel mining regulations specifically.

1.2.7. Keep updated on the activities and policies of the Corps of Engineers within the watershed and attempt to streamline the permitting process whenever bank or channel modification is needed to reduce future erosion.

1.3. Sediment from erosion of roads and ditches

Unpaved roads and ditches have the potential to be a significant source of suspended sediment in rural watersheds. Erosion from the roadbed can result from overly steep gradients, close proximity to streams, lack of proper drainage, and improper stream crossings. (Waters 1995) Erosion of sediment can also occur in great quantity during the construction and maintenance of unpaved roads. The main objective of erosion control on unpaved roads is to keep water from accumulating and concentrating on the road surface. Fast-moving waters can readily erode soil from road surfaces. When water is dispersed at regular intervals, road erosion can be controlled.

In 2005 the Watershed Conservation Resource Center evaluated unpaved roads in the Dry Fork Creek Watershed, a sub-basin of the Kings River Watershed. Attributes that were inventoried for the 60.6 miles of unpaved public roads included; road surface substrate type, presence and condition of ditches and ruts, the presence of berms, and location and condition of bridges, culverts, cross-drains, wing-ditches, fords, and low water crossings. The Center then used this information to estimate the sediment production and delivery from unpaved roads using the web-based WEPP Road model which was based on the Agricultural Research Service's Water Erosion Prediction Project. The estimated total sediment delivery to streams for both public and privately owned unpaved roads for the Dry Fork Creek Watershed was 1,799 tons/year or 17.4 tons/year/mile. It is interesting to note that single lane unpaved roads with an eroded ditch greater than twelve inches deep provides the greatest sediment export coefficient. (Van Eps 2005)

FTN Associates used the above export coefficients to extrapolate the estimated total sediment loads coming from unpaved roads in the entire Kings River Watershed. A small amount of sediment is also exported from paved roads, but for the purpose of this plan, that amount (estimated at 0.38 tons/mi/yr for 30 foot wide paved roads) was considered negligible.

Total miles of unpaved roads = 919.38 miles
Total sediment to Table Rock Lake from unpaved roads (tons/yr) = 15,997

Goal: Ensure that Best Management Practices are being implemented for the construction and maintenance of all roads in the Kings River Watershed.

Action Items

1.3.1. Work with County Judges and the County Road Departments to develop a list of the top 20 highest eroding road segments. Starting in Carroll County (expand to Madison County as funding and time allow), prioritize these road segments; develop a plan of action for restoration project and continued maintenance; develop a cost estimate for each road segment; contact all landowners for information exchange and permission to remediate road segment if private land would be impacted by water movement. Write up report for each segment project, including landowner comments, continued maintenance costs, savings per year if any, and estimate of sediment load kept from waterways. Encourage the County Road Departments to follow recommendations. Follow up each restoration project with landowner interviews to determine overall effectiveness of project.

1.3.2. Create an information program targeted at landowners, county road crews, developers, and private operators concerning best management practices that can be used during road building. Possible BMPs include:
Planning phase:
- Minimize stream crossings
- Allow for a properly sized stream management zone when locating roads
- Avoid unstable and poorly drained areas
- Locate roads on ridges whenever possible
- Use gravel to surface high-traffic roads
- Keep sustained grades on permanent roads to no more than 10 percent. Allow grades up to 18 percent where pitches are short and steep, but not more than 500 feet long.
- Balance road cuts and fills. Do not borrow from roadside slopes.
Implementation and Maintenance Phase
- Install properly sized culverts at recommended spacing on sloped roads

- Locate culverts so they do not outlet directly into streams
- Plug the ditch immediately downhill of the culvert inlet to direct all water into the culvert
- Use frequent turnouts to provide drainage of ditch water
- Seed badly eroding areas where necessary.
- Regularly inspect ditches, culverts, turnouts, dips, and water bars for blockage and restore to working condition
- Grade road surfaces only when necessary to eliminate rutting and surface erosion channels. Grading loosens road surface materials, causing erosion.

1.3.3. Stay informed of the low-water bridge maintenance and construction. Work with the county to document and plan for potential impacts that low-water bridges can have on aquatic species.
1.3.4. Recognize County Road Departments for the condition of the county roads. Work with counties to update grader training program to include considerations for improved water quality.
1.3.5. Encourage County Judges to refuse to take in roads that do not meet minimum county road standards. Encourage developers to meet these county road standards.

1.4 Sediment from Urban Land Uses and Urbanization

A mere 0.6% of the Kings River Watershed is considered "urban." The watershed assessment shows that sediment from urban land including construction activities makes up only 0.54% of the total sediment coming from the watershed. (FTN 2005) However, urban land use is increasing in the watershed at an accelerating rate. Neighboring watersheds are experiencing record growth and are having to take a reactive rather than proactive stance towards urban pollution.


Stream flowing near Berryville Community Center

Numerous studies over the past 10 years have shown that increased impervious cover in urban areas leads to increased volumes of runoff, increased peak flows and flow duration, and greater stream velocity during storm events. Other impacts include loss of large woody debris (LWD), increased bank erosion and bed scour, changes in sediment loadings, increased stream temperature, and decreased base flow. These effects are currently occurring in the urban streams that run through Berryville, increasing the sediment loads being delivered to the Kings. The construction activities that are associated with urbanization can also be a major source of sediment if abatement measures are not installed. The National Pollution

Discharge Elimination System (NPDES), regulated in Arkansas by ADEQ, requires a permit for all construction activity that will be disturbing 1 acre or more of land. The City of Berryville is not required to get a permit for the management or discharge of storm water because it does not qualify as an MS4 under the NPDES storm water program.

In order to calculate the sediment loads coming from urban areas in the watershed, FTN Associates multiplied the average percent of rainfall that becomes runoff in urban areas by the estimated total suspended solids concentrations found in the runoff. According to the USGS, the following runoff percentages apply, on average:

Low/Medium Intensity Residential – 50% rainfall becomes runoff
High Intensity Residential – 60% rainfall becomes runoff
Commercial/Industrial/Transport. – 70% rainfall becomes runoff
Urban Other (park, golf course, cemetery) – 35% rainfall becomes runoff

The TSS concentrations were obtained from data collected during the National Urban Runoff Program, a program completed by the EPA in 1983. The amount of sediment coming from construction sites can vary significantly depending on the types of sediment control structures used. Edwards (2003) found that the total suspended solids from sites with no BMPs could be as high as 11,217 mg/L, but the TSS from sites with BMPs could be as low as 637 mg/L. For the purpose of this assessment an average of the two extremes was used.

FTN found that the Lower Osage Creek sub-watershed, including the City of Berryville, contributed the highest amount of sediment from urban land uses at 356.6 tons/yr. The total sediment contributed from urban land uses for the entire Kings River Watershed is 736.1 tons/yr. (FTN 2005)

Goal: Reduce the amount of sediment from urban areas by distributing information on construction best management practices to all developers and builders in the watershed and information on erosion control to landowners within Berryville city limits.

Action Items:

1.4.1. Recommend the completion of floodplain maps for the Kings River Watershed. Work with FEMA, quorum courts, City of Berryville, lending institutions, and other partners to get more information about the location and management of local floodplains. Make floodplain maps easily accessible to the public.
1.4.2. Obtain detailed information regarding low impact development, protection of natural hydrologic features, and stream buffers for builders/developers/landowners. Utilize the Homebuilder's Association to exchange information with developers and builders.
1.4.3. Recognize builders who are utilizing construction best management practices with a Builder of the Year award.

1.4.4. Obtain information about the movement of water through the City of Berryville. Commission maps for the city limits which include city property, streams, topography, etc.
1.4.5. Work with the City of Berryville to create an urban stream management plan to bring back the natural hydrologic features of urban streams. Include community by creating an "Adopt an Urban Stream" program.
1.4.6. Place signs at stream crossings within Berryville city limits with the stream name and the draining water body (Example: "Town Branch, a tributary of the Kings River").
1.4.7. Work with partners to complete a demonstration project in a highly visible area exhibiting urban landscaping and management to reduce erosion.
1.4.8. Study the use of stormwater detention ponds in other urban areas. Make contact with managers in Rogers to gain information on the subject. Disseminate information to citizens on the benefits of stormwater detention ponds to settle sediment out of run-off.

2. Nutrients

Nutrients are essential to plant and animal life, however when introduced at excessive levels, they can disturb the natural ecosystem balance. Predominately forested watersheds, like the Kings River Watershed, do release natural background levels of phosphorus. Nutrients such as nitrogen (N) and phosphorus (P) are also commonly found in non-point source runoff from both agricultural and urban environments. Eutrophication, or accelerated nutrient levels, includes an over-abundance of algae that competes with fish for oxygen and decreases overall water clarity and quality. These abnormal aquatic processes are slightly affected by the naturally occurring nutrients and more affected by the unnatural nutrients that leak into the intricate drainage network. Decreased oxygenation is the primary negative effect of eutrophication because low dissolved oxygen levels seriously limit the growth and diversity of aquatic biota and, under extreme conditions, cause fish kills. (White 2001)

Nutrient levels in surface water often restrict the growth of aquatic plant species. In freshwaters such as lakes and streams, phosphorus is typically the nutrient limiting growth, though occasionally nitrogen is the most limiting nutrient. Potassium is not a limiting element in water, so water quality concerns focus on nitrogen and phosphorus. Phosphorus is essential to all forms of life on earth and has no known toxic effects. (Lory 1999) Almost all of the P in nature is in the form of orthophosphate, a negatively charged ion that may be free or bonded with positively charged atoms or particles. Phosphate deposits and phosphate-rich rocks release P during weathering, erosion, and leaching. The elemental concentration of P in shale is 733 ppm(parts per million), in sandstone is 539 ppm, and in limestone/dolomite is 281 ppm. (White 2001) Phosphorus can also enter the fluvial system from discharge of wastewater treatment plants, runoff from fertilized fields or home gardens, or effluent from septic systems. Upon entrance into a fluvial system, P can move through several watershed processes as it makes it way downstream. The phosphorus can be transported by geomorphic or hydrologic process, deposited in low-energy side-pools/gravel bars/floodplains, taken up by aquatic flora and fauna, dissolved in the water column, or absorbed by suspended and streambed sediments. (White 2001) Eventually the P is flushed downstream towards the White River and the Table Rock Lake reservoir where it goes through lake processes. Like other elements, P can change forms throughout many processes, but it will never disappear altogether.

The State of Arkansas does not have numeric regulations for nutrients loads in waterways. Instead it has a narrative description, please see below.

Regulation 2.509

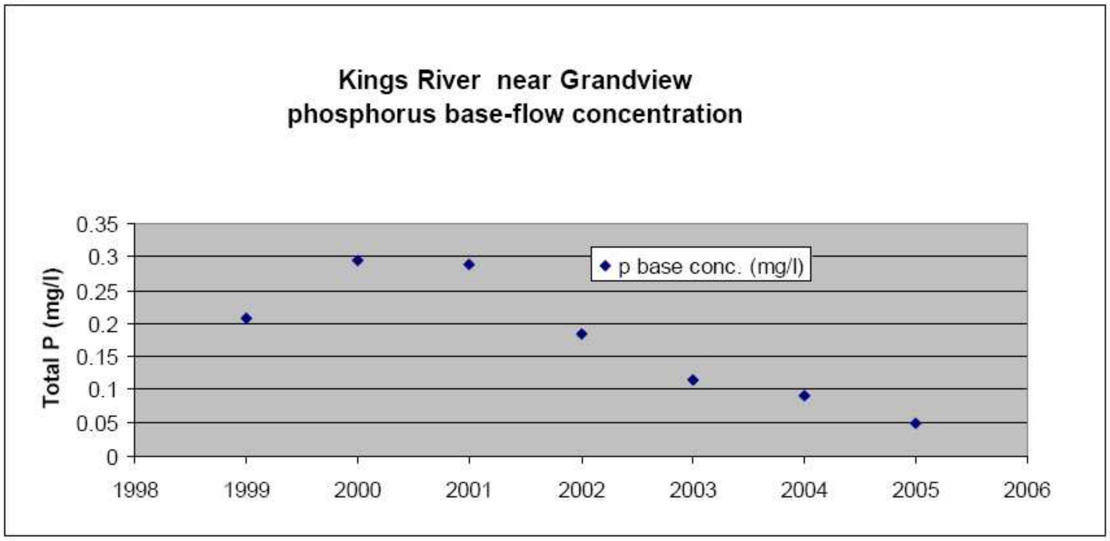
Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities or other nuisance aquatic vegetation or otherwise impair any designated use of the waterbody. Impairment of a waterbody from excess nutrients are dependent on the natural waterbody characteristics such as stream flow, residence time, stream slope, substrate type, canopy, riparian vegetation, primary use of waterbody, season of the year and ecoregion water chemistry. Because nutrient water column concentrations do not always correlate directly with stream impairments, impairments will be assessed by a combination of factors such as water clarity, periphyton or phytoplankton production, dissolved oxygen values, dissolved oxygen saturation, diurnal dissolved oxygen fluctuations, pH values, aquatic-life community structure and possibly others. However, when excess nutrients result in an impairment, based upon Department assessment methodology, by any established, numeric water quality standard, the waterbody will be determined to be impaired by nutrients.

EPA Region 6 has shown their concern about phosphorus in the Kings River watershed by overruling ADEQ in 2002 and adding Reach 045L, the lower portion of Osage Creek (downstream of the Berryville municipal wastewater treatment plan), to the Arkansas 2002 303(d) list as impaired due to total phosphorus (EPA 2003). EPA Region 6 is currently in the process of approving a TMDL for this portion of Osage Creek.

Phosphorus in the Kings River Watershed

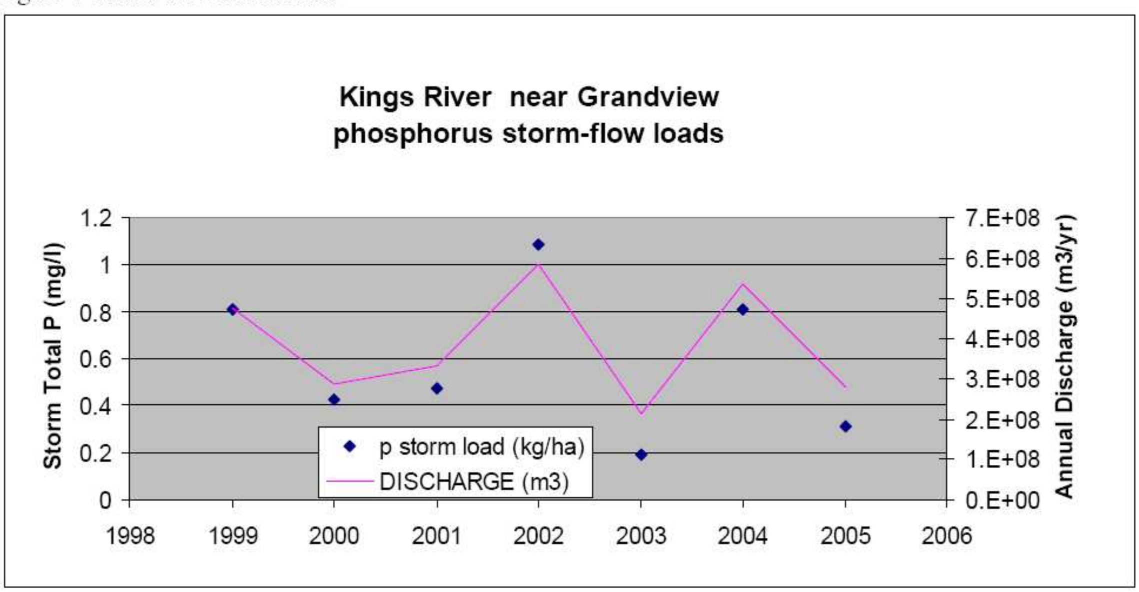
The average annual phosphorus load calculated by the Arkansas Water Resources Center for 1999 through 2003 was 257,996 lbs/yr. Their monitoring shows that the base-flow concentration of phosphorus has decreased significantly since 2000. The base-flow concentration of phosphorus usually reflects the amount of phosphorus released from point sources and the relative levels of P that are impacting in-stream biological activity during most of the year. The reduction seen below could be a result of the removal of a Tyson's facility in the watershed.

Figure 11. Phosphorus base flow concentrations 1999-2005 (AWRC 2006)



The Phosphorus loads occurring during storm events is a good indication of the impact of non-point sources in the watershed. As you can see in the graph below, there is a direct correlation between storm events and phosphorus loads.

Figure 12. Phosphorus Storm Flow Loads 1999 – 2005 (AWRC 2006)



The watershed assessment completed by FTN Associates for the Kings River Watershed provided a listing of phosphorus sources with the calculated percentage of phosphorus that each was contributing to the watershed outlet. See below.

Figure 13. Sources of Phosphorus in KRW (FTN 2005)

Phosphorus Source	Percentage of Contribution
1. Pasture	59.79%
2. Point source discharge	19.72%
3. Forest	9.41%
4. Streambank erosion	7.55%
5. Roads and ditch erosion	1.52%
6. Septic tanks	1.18%
7. Urban land uses	0.80%
8. Construction site erosion	0.03%

The phosphorus being contributed by streambank erosion, roads and ditch erosion, and construction site erosion is assumed to be attached to sediment particles. These topics have been sufficiently covered in the previous section on Sediment.

2.1 Phosphorus from Pasture

Pasture usually accounts for a significant percentage of the total load of phosphorus for most watersheds in northwest Arkansas. Phosphorus losses from agricultural fields can be divided into three categories:

- Flash losses of soluble phosphorus soon after application of manure or fertilizer
- Slow leak losses of soluble phosphorus
- Erosion events.

Flash losses of soluble phosphorus

Manure and fertilizer have vastly higher concentrations of soluble phosphorus than soil. If a rainfall event causing runoff occurs soon after a surface application, the concentration of soluble phosphorus in the runoff can be more than 100 times higher than normal. Over time, highly soluble manure and fertilizer phosphorus on the soil surface will react with the soil reducing soluble phosphorus in runoff back to initial levels. Normal levels return over the course of a month in warm soils, but this process takes longer in cold soils. Manure and fertilizer application is not recommended on frozen or snow-covered soils because phosphorus never has a chance to react with the soil before runoff occurs.

Research from Arkansas on poultry litter and swine manure applied to pastures shows that soluble phosphorus concentrations increase in direct proportion to increasing application rate in these flash phosphorus loss events.

Flash soluble phosphorus losses have high concentrations of phosphorus in a form that is readily available to aquatic organisms. These events occur with runoff soon after a surface application of phosphorus or when phosphorus is surface applied to frozen or snow-covered fields. However, one ill-timed application can contribute more phosphorus to surface water than is lost by all other processes over the course of a year or more.

Slow leak losses of soluble phosphorus
All soils naturally release some soluble phosphorus into surface runoff. The concentration of soluble phosphorus in runoff is affected by the soil test phosphorus level of the soil. Soil tests for phosphorus were developed to help estimate phosphorus fertilizer requirements for crops. Research on soils from other states indicate that soils near optimum soil test levels for growing crops typically supports soluble phosphorus concentrations of 0.5 parts per million (ppm) or less. Considerable evidence suggests that soluble phosphorus concentration in runoff increases in direct proportion to increasing soil test phosphorus levels. This linear relationship changes from soil to soil. Tripling soil test phosphorus above the high soil test category may increase soluble phosphorus in runoff to 0.5-2.5 ppm.

Erosion losses
When runoff water gains sufficient energy to cause soil erosion, the amount of phosphorus lost from the field increases dramatically. Reducing erosion losses through reduced or no-till on corn or wheat can reduce total phosphorus losses by 50 percent or more. In soil, total phosphorus is much higher than the soluble phosphorus content. Soil particles have a tremendous capacity to fix soluble phosphorus allowing only a small proportion of the total and plant-available phosphorus to exist in the soluble form.

The natural sorting of soil particles during erosion causes those with the highest phosphorus concentration to be carried with runoff. Soils with higher soil test phosphorus levels will have higher phosphorus content in eroded particles.
(Lory 1999)

Nutrient Surplus Watersheds
Eight watersheds in Arkansas, including the Upper White River Basin, have been designated as nutrient surplus areas by the Arkansas Natural Resources Commission (formerly the Arkansas Soil and Water Conservation Commission). These areas have been so designated because the application of more phosphorus or nitrogen could harm water quality due to already high levels of nutrients. The primary goal of Acts 1059, 1060, and 1061 of 2003 is to maintain the benefits derived from the wise use of poultry litter, commercial fertilizers, and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters within the State. The rules in these Acts went into effect on January 1, 2006. These Acts give ANRC the authority to impose penalties for violations.

In summary, these Acts state:

1) The ANRC will develop and implement programs to train nutrient applicators and writers of nutrient management plans
2) Poultry feeding operations with a minimum of 2500 birds will register annually with the ANRC
3) All nutrient applications within a nutrient surplus area shall only be applied by a certified nutrient applicator at a rate not to exceed the protective rate. All poultry feeding operations and nutrient application sites greater than two and one-half acres must have a nutrient management plan approved by the ANRC

(U of A Div. of Ag Coop Ext. Service)

For the purpose of the watershed assessment, total phosphorus loads from pastures was calculated by multiplying the amount of phosphorus found in runoff, as documented in various studies in Northwest Arkansas, by the average annual volume of streamflow. The median value for the studies of phosphorus in run-off in NW Arkansas was 0.44 mg/L. When multiplied by the average annual volume of streamflow it equals 1.50 lbs/acre/yr of total phosphorus in run-off from pastures. (FTN 2005)

Goal: Determine the extent of phosphorus run-off from pastures and cooperate with local partners to assist local farmers with nutrient reduction programs.

Action Items:

2.1.1. Work with the local Conservation Districts, NRCS offices, ANRC technicians, and independent farmers to determine which pasture lands in the Kings River Watershed are currently implementing successful Best Management Practices. Use existing local research to determine reasonable statistics for amount of phosphorus in runoff coming from pastures with and without BMP implementation. Create plan of action for offering technical services to farmers who are not currently implementing BMPs.
2.1.2. Compile existing research and scientific facts on the effectiveness of specific BMPs for pastures and make available to local agencies and farmers.
2.1.3. Offer a voluntary class (possibly during the nutrient management classes) that gives the "big picture" of water quality issues in the region. Class will cover initiatives taken by other sectors of the population (eg. urban stormwater) as well as topics identified by local farmers desiring more information.
2.1.4. Cooperate with the local USDA offices, County Extension, Cattleman's Association, the Poultry Grower's Association, and Farm Bureau to create/facilitate and/or offer support for a local Master Farmer Program. This stewardship program will offer incentives and recognition for farmers taking extra measures to protect the long-term viability of the land and water resources.
2.1.5. Address the issues and perception of poultry litter in the watershed with a series of informational newspaper articles and newsletter features.

2.2. Phosphorus from Point Sources

The largest point source in the watershed is the Berryville Waste Water Treatment Plant (WWTP), which releases its effluent into Osage Creek. This wastewater treatment plant currently serves approximately 2100 people as well as a Tyson's processing facility, which provides approximately 80% of the daily influent into the WWTP. (Percentage of influent from Tyson's processing facility is currently in a state of flux because of the closing of certain facilities in the watershed). The existing treatment plant was designed to treat an average daily flow of 2.4 MGD (millions of gallons per day) with a Biochemical Oxygen Demand loading of 380 mg/L and Total Suspended Solids loading of 200 mg/L. For 2001 through 2004 the average daily flow was 2.30 MGD while the maximum daily flow was 5.96 MGD. Figure 14 shows the influent wastewater flows and computed loadings for the plant. (USI 2004)

Figure 14. Influent Wastewater flows and Computed Loadings for Berryville wwtp (USI 2004)

BOD	**Concentration**	**Loading**
Minimum	43 mg/L	493 lbs/day
Average	170 mg/L	3,260 lbs/day
Maximum	520 mg/L	10,130 lbs/day
TSS		
Minimum	30 mg/L	198 lbs/day
Average	126 mg/L	2,682 lbs/day
Maximum	332 mg/L	6,614 lbs/day
Total P		
Minimum	0.20 mg/L	4 lbs/day
Average	9 mg/L	164 lbs/day
Maximum	17 mg/L	320 lbs/day

Historical water quality data have been collected by ADEQ at approximately monthly intervals for two locations in Osage Creek, above and below Berryville. Figure 15 summarizes the ADEQ total phosphorus data collected at these two sites.

Figure 15. Summary of ADEQ total phosphorus data for Osage Creek (FTN 2005) Data given in mg/L.

Station	Begin	End	Count	Min	Avg	Median	Max
Osage Ck. above Berryville (WHI0068)	11/21/83	10/19/04	229	0.003	0.050	0.036	0.92
Osage Ck. Below Berryville (WHI0069)	11/21/83	10/19/04	197	0.010	1.049	0.410	24.62

Regulation of phosphorus from point sources in the Kings River Watershed

Please refer to **Section 2. Nutrients** to read the narrative standard for phosphorus in Arkansas. In specific relation to point sources, please refer to the following regulations.

Arkansas Regulation No. 6, Chapter 4

"No permit for discharge of domestic wastewater to Osage Creek or its tributaries, by the City of Berryville, shall authorize more than 1.0 mg/L Total Phosphorus based on a monthly average." Compliance with the regulation is required by 2012 (APCEC 2004b).

Arkansas Regulation No. 2

"All point source discharges into the watershed of waters officially listed on Arkansas' impaired waterbody list (303d) with phosphorus as the major cause shall have monthly average discharge permit limits no greater than those listed below. Additionally, waters in nutrient surplus watersheds as determined by Act 1061 of 2003 Regular Session of the Arkansas 84th General Assembly and subsequently designated nutrient surplus watersheds may be included under this Reg. if point source discharges are shown to provide a significant phosphorus contribution to waters within the listed nutrient surplus watersheds."

Facility Design Flow	Total Phosphorus discharge limit
15 MGD or more	Case by case
3 to <15 MGD	1.0 mg/L
1 to <3 MGD	2.0 mg/L
0.5 to <1.0 MGD	5.0 mg/L
<0.5 MGD	Case by case

Missouri Title 10 CSR 20-7.015 Section (3)(G)

"In addition to other requirements in this section, discharges to Table Rock Lake watershed, defined as hydrologic units numbered 11010001 and 11010002, shall not exceed five-tenths milligrams per liter (0.5 mg/l) of phosphorus as a monthly average according to the following schedules except as noted in paragraph (3)(G)5.:

1. Any new discharge shall comply with this new requirement upon the start of operations;
2. Any existing discharge, or any sum of discharges operated by a single continuing authority, with a design flow of 1.0 mgd or greater shall comply no later than four (4) years after the effective date of this rule."

set at 10% of the assimilative capacity, i.e. 9.66 lbs/day. The allowable load of phosphorus from the City of Berryville was based on existing Arkansas Regulation No. 6, requiring no more than 1 mg/L concentration. To reach this target concentration, the Berryville WWTP will have to reduce their daily phosphorus load by 85%, to a maximum of 20.02 lbs/day. Other point sources located in the watershed, most notably the Bedford Falls Mobile Home Park, will not be mandated to reduce phosphorus in their effluent. The remaining load allocation allowable for nonpoint sources in Osage Creek watershed is 64.54 lbs/day. The existing nonpoint source load (concentration of total phosphorus from ADEQ station above Berryville times the average flow) was calculated at 47.3 lbs/day. Based on these calculations, no reductions in nonpoint sources are necessary to reach water quality guideline of 0.1 mg/L total phosphorus. (FTN 2005)

This TMDL could change based on a number of circumstances. Either Missouri or Arkansas could set numeric water quality standards for Total Phosphorus in the future. In addition, Missouri is currently beginning the process of writing a TMDL for Table Rock Lake. If their TMDL finds that water flowing in the Kings needs to have a total phosphorus concentration less than 0.1 mg/L in order for their water quality standards to be met, they do have the right to set that standard at the state line.

Refer to Section B.4. of Appendix for complete Osage Creek TMDL draft.

Goal: Help the City of Berryville reach the goals set forth in the Osage Creek TMDL for phosphorus reduction in the effluent of the WWTP.

Action Items:

2.2.1. Continue to act as an information resource for the City of Berryville and maintain communication regarding plans for upgrades to the WWTP. Make KRWP resources available to the City in order to gain support for the financial plan necessary to upgrade the plant. Encourage the city to upgrade the wastewater treatment plant to the highest treatment level that is economically feasible.
2.2.2. Create an education campaign to "Be Wise" about waste products and the phosphorus that they contain.
2.2.3. Request that local supermarkets carry phosphorus free products.
2.2.4. Encourage local businesses, including Tysons, to reduce the amount of phosphorus in the effluent being sent to the Berryville WWTP. Work with them to find alternative detergents and preservatives to phosphorus based products.

2.3 Phosphorus from Onsite Waste Treatment Systems

The conventional septic system consists of the septic tank and the soil absorption system, also known as the drainfield or leachfield. The main function of the septic tank is to hold the household wastewater for a time period that will allow the solids to settle to the bottom and the greases and oils to float to the top. The partially clarified wastewater located in the middle layer is released to the soil absorption system. The drainfield treats the wastewater by allowing it to slowly trickle from the pipes out into a layer of gravel or sand and then down to the soil, which acts as a biological filter. The septic tank itself does not remove any phosphorus from the wastewater, but the soil around operational leach lines should uptake at least a portion of this phosphorus.

The watershed assessment for the Kings River Watershed found that septic tanks contribute 1.18% of the total phosphorus load, approximately 3,260 lbs per year. This calculation was based on the rural population density of the watershed, assumed number of septic tanks, and a calculated septic tank phosphorus load of 0.5 ton/yr (based on results from the West Fork of the White River study). In addition, only loads from septic tanks that are located near streams (an estimated 13%) were included to evaluate the phosphorus loading to the Kings River. (FTN 2005)

Goal: Eliminate phosphorus loads moving into waterways from onsite waste treatment systems.

Action Items:

2.3.1 Engage local septic tank owners in a voluntary survey in order to properly gauge the impact of onsite waste treatment to local water quality. Septic tanks of inviting landowners could be measured for effectiveness. Landowners with a failing septic system will be given a gift certificate for a pumping service or other services needed. Systems older than 1977 should also be included.

2.3.2 Work with local community groups to offer financial assistance to home owners with limited resources in need of proper onsite waste treatment. Advertise program through the county. Work with County Health Unit to offer assistance for 10 complete waste treatment systems and 100 coupons for $50 off of a domestic septic pumping.

2.3.3 Cooperate with local septic tank pumping service to offer a pumping demonstration day.

2.3.4 Create an information toolkit that covers proper maintenance of septic systems; Distribute information to plumbers, homeowners (especially new homeowners) and others who come in contact with septic systems. Encourage information exchange with the Hispanic population by printing all information in both Spanish and English. Research and offer education concerning alternatives and additions to conventional septic systems that will provide supplementary filtration and/or phosphorus removal.

2.3.5 Work with the Carroll and Madison County Health Units to expand presentation concerning onsite waste treatment.

2.3.6 Insure that existing rules and regulations for onsite waste treatment are easily accessible and understandable to the general public. Work with the Carroll and Madison County Health Departments to write a series of articles for the newspaper and radio. Example: 10 acre exemption.

2.4 Phosphorus from Urban Land Uses

As stated previously, a mere 0.6% of the Kings River Watershed is considered "urban with the watershed assessment showing that phosphorus loads from urban land including construction activities makes up only 0.83% of the total phosphorus loads. (FTN 2005)

Many of the Kings Roundtable participants felt that the application of fertilizers on home lawns should be researched as a possible source for phosphorus. It was noted that there are currently no regulations regarding home fertilizer use. Landowners with less than 2.5 acres are supposed to voluntarily apply nutrients at the protective rate set forth by the Arkansas Natural Resources Commission. Surveys suggest that roughly 70% of all lawns are regularly fertilized, regardless of whether additional nutrients are needed. Few homeowners bother to contact the local extension office for recommended fertilization rates. Instead, most rely on the local hardware store or garden center. In fact, a survey in Virginia found that product labels were the number one information source for homeowners, while Cooperative Extension Service ranked last (Aveni, 1994). Label directions vary in terms of specificity.

While all labels indicate how many square feet the bag should cover, each takes a different approaches on how often the product should be applied. Some specify two or three applications per year. Others give no frequency at all and say "may be applied at any season." Interestingly, the instructions for bagged fertilizer fail to mention soil tests. Depending on the type of lawn care product, a homeowner might apply anywhere between 44 and 261 lbs. nitrogen/acre and from four to 26 lbs. phosphorus/acre each year. This begs the question of whether or not homeowners follow package directions. There is very little actual data on homeowner application rates. In most regions, soils generally contain enough phosphorus to grow healthy lawns without any added fertilizer (NVSWCD, 1994). However, almost all retail lawn fertilizer products do contain phosphorus.

The Rodale Institute Research Center reports that an acre of clippings provides an average of 235 pounds of nitrogen, 210 pounds of potassium, and 77 pounds of phosphorus (Meyer,1995). Thus, if all clippings are returned to the lawn, they can meet much of the nutrient requirement. In addition, well maintained turfgrass seldom produces surface runoff, except during uncommonly intense storm events.

Urban phosphorus loads can be reduced when urban stormwater treatment practices are installed, such as stormwater ponds, wetlands, filters or infiltration practices. Performance monitoring data indicates that stormwater practices can reduce phosphorus loads by as much as 40 to 60%, depending on the practice selected.

Goal: Decrease the amount of nutrients entering the watershed from urban land areas.

Action Items:

2.4.1 Create an education campaign to increase awareness of urban fertilizer use and the potential impact on urban streams. Run a series of seasonal PSAs concerning fertilizer use; include information on optimum timing, application loads, importance of soil testing, and fertilizer choice. Work with the local Conservation Districts and fertilizer providers to increase consumer education.

2.4.2 Create Public Service Announcements and newspaper articles to educate watershed residents about potentially high phosphorus loads in untreated greywater.

2.4.3 Work with partners to complete a demonstration project in a highly visible area exhibiting urban landscaping and management to reduce nutrient leaching. Include information on grasses and other plants that need little or no fertilizer as well as fertilizing techniques that will reduce nutrient leaching.

3. Pesticides, Herbicides, and other Harmful Substances

3.1 Harmful Substances from Urban Land Uses

The U.S. EPA estimates that nearly 70 million pounds of active pesticide ingredients are applied to urban lawns each year. Collectively, urban lawns cover an estimated 20 to 30 million acres of our country's landscape. Homeowner surveys suggest that pesticides are regularly applied on roughly half of these acres. The diversity of pesticides applied in urban areas is staggering. Each pesticide differs greatly in mobility, persistence and potential aquatic impact, and it is difficult to ascertain what if any environmental risk they may pose. Pesticides can take a number of pathways to move from the lawn to the stream. Once applied, they can leave the lawn via surface runoff, leach into groundwater, or volatize into the air. The greatest pesticide loss occurs when an intense storm occurs shortly after pesticides are applied. The losses of some pesticides under these conditions can be substantial. Turfgrass researchers have shown that only small amounts of pesticides are lost to groundwater. Depending on the nature of the pesticide and the manner that it is applied, anywhere from 2% to 25% can drift away.

In general, the concentrations of most herbicides and banned pesticides in urban runoff appears to be well below the threshold for acute toxicity for most aquatic and terrestrial organisms. (Murphy, 1992) The greatest risk of toxicity appears to lie with the two insecticides found commonly in urban stormwater—diazinon and chlorpyrifos. Indeed, the use of diazinon is no longer permitted on golf courses, although it can still be used on residential lawns. Its toxicity to terrestrial wildlife, such as geese, songbirds, and amphibians is well documented. (Schueler 2000)

Testing for pesticides/herbicides/insecticides is a very expensive and time consuming process. At this time the KRWP will work to increase education about the proper application of these substances but will not expand its monitoring program until more scientific research has been completed.

Impervious surfaces collect and accumulate pollutants deposited from the atmosphere, leaked from vehicles or derived from other sources. During storms, accumulated pollutants are quickly washed off and rapidly delivered to aquatic systems.

Monitoring and modeling studies have consistently indicated that urban pollutant loads are directly related to watershed imperviousness. Imperviousness represents the imprint of land development on the landscape. It is composed of two primary components: the *rooftops* under which we live, work and shop, and the *transport* system (roads, driveways, and parking lots) that we use to get from one roof to another. Research also shows that stream degradation occurs at relatively low levels of imperviousness (~10%). To put this in more understandable terms, consider the runoff from a one-inch rainstorm. The total runoff from a one-acre meadow would fill a standard size office to a depth of about two feet (218 cubic feet). By way of comparison, if that same acre was completely paved, a one-inch rainstorm would completely fill your office, as well as the *two* next to it.

One potentially hazardous component of urban stormwater run-off is high levels of hydrocarbons. Gas stations, vehicle maintenance areas, and parking lots where large numbers of cars park for long periods of time are generally hydrocarbon hotspots. Infrequently used parking lots and streets produce far fewer hydrocarbons. Many hydrocarbons are potentially toxic to both humans and aquatic organisms. Acute toxicity from hydrocarbons is a rare because storm events only provide brief exposure, they strongly bind to sediments and thus are not readily available to aquatic life, and levels tend to be diluted by urban creeks. The greatest environmental risk appears to occur when hydrocarbon-laden sediments are deposited in downstream lakes, i.e. Table Rock Lake. (Schueler 2000)

Goal: Increase awareness of harmful substances moving into waterways and encourage their proper disposal.

Action Items:

3.1.1 Work with the Berryville Parks Department to manage city property in a way that will improve water quality by minimizing pesticide and herbicide use and by reducing mowed areas near urban areas

3.1.2 Cooperate with the Cooperative Extension Service to offer classes on proper application of pesticides and herbicides and natural pest management for lawncare.

3.1.3 Educate owners/managers of large impervious properties about management of stormwater to mitigate polluted run-off. Encourage the use of grease traps, vegetated filters, and other measures to filter run-off before it reaches local waterways.

3.1.4 Recognize the City of Berryville for its proactive stance on ordinance requiring oil separator and grease traps.

3.1.5 Outline practical pollution prevention practices for service stations and other hydrocarbon hotspots.

3.1.6 Create an educational campaign designed to inform pharmaceutical users, their families, and distributors about proper disposal.

3.1.7 Research the existence of local compassionate drug programs and find out which companies take back/recycle medications.

4.1 Pathogens and Other Bacteria

Microbes, including bacteria and protozoa, exist within us, on us, on plants, soils and in surface waters. Some microbes are beneficial to humans, others exert no impact at all, and other microbes cause illness or disease. They are produced from a variety of watershed sources, such as sewer lines, septic systems, livestock, wildlife, waterfowl, pets, soils and plants, and even the urban stormdrain system itself. The most widely known bacteria, the coliform family and *E. coli*, actually do not directly cause any illnesses in humans. Instead these bacteria are an indicator of a potential human health risk because they are typically found within the digestive systems of warm-blooded animals. Each of these can indicate the presence of fecal wastes in surface waters, and thus the possibility that other harmful bacteria, viruses and protozoa may be present. Public health authorities have traditionally used fecal coliform bacteria to indicate potential microbial risk, and to set water quality standards for drinking water, shellfish consumption or water contact recreation.

The Kings River and its major tributaries have the designated use of both primary contact recreation (full body contact involved) and secondary contact recreation (activities such as fishing, wading canoeing involved) as outlined in Arkansas Regulation No. 2. The Arkansas Department of Health has the responsibility of approving or disapproving surface waters for public water supply and of approving or disapproving the suitability of specifically delineated outdoor bathing places for body contact recreation.

Regulation No. 2 states:

Primary Contact Waters - Between May 1 and September 30, the fecal coliform content shall not exceed a geometric mean of 200 col/100 ml nor a monthly maximum of 400 col/100 ml. Alternatively, in these waters, *Escherichia coli* colony counts shall not exceed a geometric mean of more than 126 col/100 ml. or a monthly maximum value of not more than 298 col/100 ml in lakes, reservoirs and Extraordinary Resource Waters or 410 col/100 ml in other rivers and streams. During the remainder of the calendar year, these criteria may be exceeded, but at no time shall these counts exceed the level necessary to support secondary contact recreation (below).

Secondary Contact Waters - The fecal coliform content shall not exceed a geometric mean of 1000 col/100 ml, nor a monthly maximum of 2000 col/100 ml. E. coli values shall not exceed the geometric mean of 630 col/100 ml or a monthly maximum of 1490 col/100 ml for lakes, reservoirs and Extraordinary Resource Waters and 2050 col/100 ml for other rivers and streams.

4.1 Pathogens and Other Bacteria from Urban Land Uses

Pathogens and other bacteria can come from many sources within the urban setting, both human and non-human. Potential pathways of human sewage to surface waters include combined sewer overflows, sanitary sewer overflows, illegal sanitary connections to storm drains, and transient dumping of wastewater into storm drains. Other sources of bacteria include dogs, cats, birds, and livestock.

Goal: Collect year round data on bacteria counts at high use locations on the Kings River and meet the Arkansas Department of Health's criteria for full body contact at all locations and at all times.

Action Items:

4.1.1 Work with the City of Berryville to complete sewer line testing for all lines in its jurisdiction. Encourage the City to replace faulty or leaking pipes as soon as possible.
4.1.2 Recognize City of Berryville for their sewer line testing to date.
4.1.3 Work with the County Health Department to get a baseline of bacterial monitoring data for urban streams. Monitor during base flow and storm flow.

4.2 Pathogens and Other Bacteria from Onsite Waste Treatment Systems

The Arkansas Health Department regulates onsite waste treatment systems through the local County Health Departments. All onsite waste treatment systems must comply with Arkansas code. However, only systems built on less than 10 acres are required to have a permit through the County Health Department. Onsite waste treatment systems can be a source for bacteria and other pathogens if a failure in the system occurs. Please see the following examples.

Problems within the tank can occur if:

- The tank is not watertight – solids can leak solids into the groundwater, or excess water can enter the tank
- The tank becomes overloaded by influent or incoming water - water will move through the system too quickly and the solids will not have time to settle out
- Inlet tee becomes clogged with solids, paper, or other products - sewer can back up into the house
- Solids build up in the tank – Water will move through the system without any settling, solids can be floated right out of the tank

Problems within the drainfield can occur if:

- Draining pipes become clogged by build-up of bacterial mat feeding on the wastewater – effluent will pond on top of the leachfield
- Receiving soil becomes saturated by effluent or seasonal water changes – effluent will pond, biological filtration will be limited
- Leachfield is located on karst topography – biological filtration will be limited and contamination of groundwater could occur
- Soil is inadequate to treat the effluent – untreated effluent can move to local waterways or groundwater

Goal: Assist the County Health Department in eliminating inadequate or failing onsite wastewater treatment systems.

Action Items: (In addition to items below, please refer to items under Section 2.3)

4.2.1 Create educational brochures, presentations, and newspaper inserts concerning karst topography and the hazards of high bacterial counts from inadequately treated human waste.

4.2.2 Work with the Carroll County Health Unit to teach water quality education as a health issue. Focus specifically on the issues of onsite waste treatment and well installation. Example: You dump it, you drink it.

4.2.3 Participate in the Cooperative Extensive Service Health Fair.

4.2.4 Encourage electric providers and real estate agents to cooperate with County Health Department to ensure that new houses will have adequate waste treatment.

4.2.5 Create a informational handout on BMPs for well drillers and hold workshop.

4.2.6 Cooperate with businesses dealing in mobile housing to educate buyers about proper onsite waste treatment.

4.2.7 Create an information packet for new land/home owners in the watershed concerning waste treatment, wells, and local water quality concerns.

4.2.8 Work with the City of Berryville and the AR Game and Fish Commission to ensure that public gathering places have adequate waste treatment.

4.2 Pathogens and Other Bacteria from Rural Land Uses

Although pathogens and other bacteria are likely to come from certain rural land uses, the likelihood that these sources are dangerous to human health or overall water quality is very small.

5. Illegal Dumping

Goal: Assist the Solid Waste Districts to eliminate that illegal dumping which is negatively impacting water quality.

Action Items:

5.1.1 Label all storm drains with the ultimate discharge location of the drain.
5.1.2 Create an information campaign informing folks that storm drains DO NOT lead to the treatment plant.
5.1.3 Encourage the use of the transfer station for disposal of hazardous substances. Talk to businesses dealing in hazardous wastes about proper handling and disposal. (Example: Businesses that sell anti-freeze.)
5.1.4 Collaborate with the Solid Waste District's environmental officer to determine the extent of illegal dumping and possible non-regulatory mitigation measures.
5.1.5 Continue and expand annual clean-ups.

6. Habitat Alterations

Habitat alterations within the Kings River Watershed have primarily included clearing of forest land, destruction of riparian corridors, and in-stream gravel mining. The watershed is essentially devoid of channel modification, coal or mineral mining operations, large scale highway construction projects, or reservoirs.

6.1 Habitat alterations from gravel mining

Many Ozark streams and their floodplains have abundant quantities of sand and gravel that have been mined extensively for their use in commercial, industrial, and residential construction including concrete, general fill, and subgrade material for highways, railroad beds, bridges, airports, road surfacing, and water and sewer systems. Stream gravel can be in high demand for some applications, because abrasion during the water transport process typically removes weak materials leaving gravel that is durable, rounded, well sorted, and suitable for high quality concrete. Unfortunately, instream extraction of these minerals can reduce water quality and can destabilize the stream bed and banks, causing aquatic habitats to be simplified and reducing or eliminating populations of aquatic species. Gravel mining can also lead to an increase in stream bank erosion both upstream and downstream of the mine site, lower the floodplain water table, damage public infrastructure (bridges, pipeline crossings), and result in reduced fishery productivity, recreational potential, and real estate value. (Roell 1999)

Arkansas Regulation Number 15

Section 15.403 (K): No material removal shall be conducted in streams designated as extraordinary resource waters (ERW) except as provided in Section 15.301 (F) and (G) of this code.

Section 15.301 (F) allows county and municipal governments to operate open-cut mining operations without a permit for use on highways or public projects, in order to protect bridges or low water crossings, to protect a governmental owned structure, or for a flood control project authorized by the U.S. Army Corps of Engineers.

Section 15.301 (G)(1) states that the Code shall not apply to the noncommercial removal of clay, bauxite, sand, gravel, soil, shale, or other materials from lands by the owner of said lands or by a contractor hired by the owner for the exclusive use by the landowner for construction, maintenance of roads, or other projects on land owned by said owner, or any environmental improvements to previously disturbed lands, or the concurrent or short term, ninety days or less, excavation of materials during the construction of buildings either for residential commercial or industrial purposes.

Refer to Section B.2. of the Appendix for the complete text of AR Reg. 15

Commercial gravel mining operations are no longer allowed to operate on the main stem of the Kings River because of its designation as an Extraordinary Resource Waterway. However, the protection of the ERW designation does not extend to tributaries of the Kings River. Removal of gravel from stream beds is allowed in the tributaries of the Kings River as long as the operators follow the mining standards of Regulation 15 and obtain all applicable mining permits. Conditions for gravel mining mandate that removal must not be conducted below an elevation of one foot above the elevation of the surface of the water and at no time should removal create a condition that will cause the stream to change course or alter the location of the deepest part of the stream channel or cause bank or channel instability. (APC&EC 2002)

Local citizens have voiced much concern over the long term effects of the buildup of gravel within the Kings River Watershed's streams. A prevalent view among citizens is that gravel removal is beneficial to the long term stability of the streams.

Goal: Increase local knowledge of regulations and short/long term impacts of stream channel gravel mining.

Action Items:

6.1.1 Clarify the ERW designation and regulations regarding gravel removal
- Facilitate a workshop on gravel mining (impacts to environment, regulations, necessary permits, etc)

- Create a reader friendly information sheet concerning regulations of gravel mining

6.1.2 Work with willing partners to contract a geomorphological study of the Kings River Watershed detailing the long term impact of gravel loads on the ecosystem

6.1.3 Expand education to developers and homeowners concerning low impact development near streams in an effort to reduce stream habitat alterations.

7. Public Education

The Kings Roundtable focused primarily on public education throughout the watershed planning process. This section includes the general public education action items that were not covered under the previous specific sections.

7.1 Community Education

Goal: Increase community awareness of water quality issues.

Action Items:

7.1.1 Create a local Kings River Watershed Partnership office space with a library of water quality information.

7.1.2 Offer presentations to local civic, church, school, and other organizations on water quality issues.

7.1.3 Create an interactive and informative display booth displaying local water quality issues for county fairs, health fairs, Agri days, etc. Include information in Spanish.

7.1.4 Complete the KRWP website and keep it updated with water quality educational materials.

7.1.5 Hold an annual Watershed Day with water related activities to celebrate, unite, and learn.

7.1.6 Increase number of available service activities such as water monitoring, clean ups, etc.

7.1.7 Form a committee to work with the Quorum Courts. Make frequent presentations and encourage use of funds for water quality improvements.

7.2 School age children education

Action Items:

7.2.1 Expand High School Science Club Program with stream education to schools in the watershed beyond Berryville. Offer water quality testing field days to all schools in the watershed (include Eureka Springs and Kingston schools as well).

7.2.2 Hold a workshop for 6^{th} grade teachers demonstrating watershed and water quality education.

7.2.3 Create a local watershed and water quality curriculum to be prepared and implemented in numerous levels in schools.
7.2.4 Develop different ways/venues to present information. Example: using puppetry in schools and libraries.
7.2.5 Conduct exploratory discussions with the Ozark Natural Science Center, directed towards watershed stewardship programs.

8. Property Rights

The Kings Roundtable members are concerned about maintaining the protection of historic property rights. The KRWP reaffirms that the organization has not and will not lobby for policy changes, promote watershed regulations, or promote mandatory land use practices for the Kings River Watershed. The Roundtable adopted the following action items to ensure that local citizens and public officials understand their property rights as they relate to water quality standards and regulations.

Action Items:

8.1.1 Maintain relationships with local agencies to remain current on issues. Pass on information through the newsletter and website.
8.1.2 Maintain information on county land use plans and issue to the public.
8.1.3 Educate landowners, stream users, and local law enforcement about property rights and trespass laws.
8.1.4 Work with local officials to ensure that local control of the watershed is not undermined.

C. Technical/Financial Assistance Needed, Schedule, and Interim Measurable Goals

(Numbers are an estimate, actual amounts may vary as projects are finalized and funded)

1.1. Sediment from erosion caused by rural land uses

Action Item #	**Technical/Financial Assistance Needed**	**Schedule**	**Interim Measurable Goals**
1.1.1 Inform public about technical/financial assistance for rural areas	Funds needed: $3150 In-kind match:	01/08 - ongoing	
1.1.2 Research on BMPs	Funds needed: $5200 In-kind match:	6/07 – 9/07	
1.1.3 On-site demo of BMPs	Funds needed: $6300 In-kind match:	2/year for five years	9/09 – 4 demonstration days complete
1.1.4 Inform pubic about conservation easement opportunies	Funds needed: $3150 In-kind match:	12/06 - ongoing	

1.2. Sediment from erosion of streambanks

Action Item #	**Technical/Financial Assistance Needed**	**Schedule**	**Interim Measurable Goals**
1.2.1 Map streambank sites, prioritize, seek funding	Funds needed: $32,906 In-kind match: $17,265	7/06 – 7/08	7/07 – Main stem of the Kings R. will be mapped and analyzed using BEHI
1.2.2 Complete Keels Ck. streambank restoration project	Funds needed: $3,650 In-kind match: $33,535	12/06 – 10/07	6/07 – Site assessment complete. Restoration design complete. Work permits obtained from Corps of Engineers.
1.2.3 Demo workshop about streambank erosion	Funds needed: $8,430 In-kind match: $2,814	1/08 – 6/08	6/08 – First workshop completed in Keel’s Ck. subwatershed. Second workshop scheduled.
1.2.4 Landowner resource Handbook	Funds needed: $8,430 In-kind match: $2,814	7/06 – 12/07	7/07 – Draft resource handbook completed and sent to technical advisors for review.
1.2.5 Education curriculum on riparian zones etc.	Funds needed: $8,430 In-kind match: $2,814	6/06 – ongoing	6/07 – Curriculum completed.
1.2.6 Clarify ERW status	Funds needed: $915 In-kind match: $415	5/06 – ongoing	5/06 – Information packet completed.
1.2.7 Keep updated on activities of Corps	Total cost: $750/year for labor costs (assume 3 yr)	6/06 – ongoing	6/06 – Initial meeting with Corps of Engineers.

1.3. Sediment from erosion of roads and ditches

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
1.3.1 List, prioritize, report on most eroded road segments	Funds needed: $8,820 In-kind match: $1,000	11/07 – 11/09	11/09 – 5 priority road segments completed
1.3.2 Information program on BMPs of road building & maintenance	Funds needed: $2,520 In-kind match: $1,800	10/08 – 10/09	
1.3.3 – 1.3.5 -Stay informed on low bridges -Recognize road departments -Encourage developers to meet minimum road standards	Funds needed: $1,050 In-kind match: $0	5/06 – ongoing	

1.4. Sediment from urban land and urbanization

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
1.4.1 Completion of flood plain maps	Funds needed: Unknown In-kind match: unknown	3/08 – 12/08	
1.4.2 – 1.4.3 & 1.4.7 -Info on cluster systems -Builder of Year award -Study stormwater detention ponds	Funds needed: $1900 In-kind match: $200	11/07 – 6/08	
1.4.4 Maps of Berryville	Funds needed: $6,000 In-kind match: unknown	7/07 – 7/08	3/07 Contract with mapping partners finalized and funded
1.4.5 Berryville urban stream management	Funds needed: $8,800 In-kind match:$8,040	7/08 – 7/09	
1.4.6 Demonstration project on landscaping to reduce erosion	Funds needed: $16,500 In-kind match: $26,055	7/08 – 7/10	7/09 Restoration project funded, designed, and all partners notified

2.1. Phosphorus

Action Item #	**Technical/Financial Assistance Needed**	**Schedule**	**Interim Measurable Goals**
2.1.1 Study pasture BMPs in watershed and recruite landowners	Funds needed: $5200 In-kind match:	1/10 – 1/11	
2.1.2 Research BMPs effectiveness	Funds needed: $1,260 In-kind match: $400	8/07 – 8/08	
2.1.3 Voluntary class on big picture of water quality	Funds needed: $3,350 In-kind match: $1,400	8/08 – 8/09	8/09 – First water quality class offered in conjunction with nutrient management classes
2.1.4 Local Master Farmer Program	Funds needed: unknown In-kind match		
2.1.5 Articles about poultry litter	Funds needed: $840 In-kind match	3/08 – 7/08	
2.2.1 Encourage city to upgrade plant to highest treatment possible	Funds needed: $420 In-kind match: unknown	6/06 – 2/07	9/06 – City of Berryville has finalized plans for update to waste water treatment plant that will reduce phosphorus in the effluent to 20.02 lbs of total phosphorus per day.
2.2.2 Be Wise about waste products	Funds needed: $840 In-kind match: $700	3/07 – ongoing	4/07 – Research compiled and publications created for "Be Wise" campaign
2.2.3 – 2.2.4 -Local supermarkets carry phosphorus free products -Encourage businesses to reduce phosphorus in waste	Funds needed: $630 In-kind match: $255	10/06 – 2/07	11/06 – Tyson's and local supermarkets approached about possible changes to their product lines.
2.3.1 Survey of septic tanks	Funds needed: $5,650 In-kind match: $3,400	3/10 – 3/11	5/10 – First 20 septic tanks surveyed.
2.3.2 Financial assistance for onsite waste systems and septic pumping	Funds needed: $39,200 In-kind match: $24,200	8/07 – 8/11	5/08 – Made contact with community groups and identified possible grant monies and possible grant recipients
2.3.3 Pumping demo day	Funds needed: $630 In-kind match: $370	8/07 – 1/08	
2.3.4 Info toolkit on septic systems	Funds needed: $1,860 In-kind match: $300	8/08 – 8/09	2/09 – Have information packet ready for printing and distribution
2.3.5 – 2.3.6 -Presentation on septic systems -Inform public of rules about septic	Funds needed: $1,050 In-kind match:$1,200	10/06 - ongoing	

systems			
2.4.1-2.4.2 -Consumer education of urban fertilizer -education on greywater	Funds needed: $1,050 In-kind match: $1,100	1/09 – 10/09	
2.4.3 Demo project to reduce nutrient leaching in urban run-off	Funds needed: See 1.4.6 In-kind match:	7/08 – 7/10	

3. Pesticides, Herbicides, and other Harmful Substances

Action Item #	**Technical/Financial Assistance Needed**	**Schedule**	**Interim Measurable Goals**
3.1.1 Improve management of city owned areas	Funds needed: $630 In-kind match:	7/09 – 7/10	
3.1.2 Offer class on application of pesticides/herbicides	Funds needed: $3,100 In-kind match: $800	3/10 – 8/10	5/10 First pest management class completed in cooperation with County Extension Service
3.1.3 Education of stormwater run-off from impervious areas	Funds needed: $3,150 In-kind match:	2/09 – 2/10	2/10 Owners of five largest impervious surfaces contacted.
3.1.4 Recognize Berryville for grease trap ordinance	Funds needed: $63 In-kind match: $50	6/06 – 8/06	8/06 City of Berryville's urban landscaping plan available for public
3.1.5 Outline pollution prevention for service stations	Funds needed: $630 In-kind match: $340	1/10 – 1/11	5/10 BMP information sheet created
3.1.6 & 3.1.7 -Education of disposal of pharmaceuticals -Research local drug recycling programs	Funds needed: $1,470 In-kind match:	1/10 – 1/11	5/10 Research completed on compassionate drug program. All area hospitals/clinics etc. contacted.

4. Pathogens and Other Bacteria

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
4.1.1 Complete Berryville sewer line testing	Funds needed: $6,300 In-kind match: $28,310	11/06-ongoing (winter months)	3/10 – All Berryville sewer lines tested initially.
4.1.2 Recognize Berryville for sewer line testing	Funds needed: $0 In-kind match: $68	ongoing	
4.1.3 Baseline bacterial testing	Funds needed: $680 In-kind match: $702	3/07 – 3/09	3/08 First year of baseline data on bacteria gathered
4.2.1 – 4.2.3 -Education on karst topography and bacteria -You dump it, you drink it education -Coop Ext. Health Fair	Funds needed: $2,500 In-kind match: unknown	3/09 – ongoing	
4.2.4 Ensure new houses have adequate waste treatment	Funds needed: ? In-kind match: ?	?	
4.2.5 Info for well drillers on BMPs	Funds needed: $840 In-kind match: $800	1/11- 1/12	5/11 Handout completed
4.2.6 Info for businesses selling mobile houses & waste treatment	Funds needed: $1,680 In-kind match: $300	5/10 – 5/11	
4.2.7 Info for new land/home owners about waste treatment	Funds needed: $525 In-kind match: $300	8/08 – 8/09	See 2.3.4
4.2.8 Ensure that public places have waste facilities	Funds needed: $315 In-kind match: unknown	6/06 – 6/07	6/07 Restroom facilities (portable potty) and dumpster at 62 access and Rockhouse access.

5. Illegal Dumping

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
5.1.1 – 5.1.2 -Label storm drains in Berryville -Info about storm drains	Funds needed: $3390 In-kind match: $1404	1/08 – 1/09	6/08 – All storm drain locations plotted, teams for labeling assembled.
5.1.3 Encourage use of transfer station for hazardous waste	Funds needed: $1,000 In-kind match: $0	1/10 – 1/11	
5.1.4 Determine extent of illegal dumping	Funds needed: unknown In-kind match: unknown		
5.1.5 Continue and expand annual clean-ups	Funds needed: $0 In-kind match: $5,780	5/06 - ongoing	6/06 – First spring clean-up completed.

6. Habitat Alterations

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
6.1.1 Clarify ERW status	Funds needed: $1,800 In-kind match: $850	1/10 – 1/11	6/10 – Workshop scheduled, speakers confirmed, invitations sent out
6.1.2 Complete geomorph study of watershed	Funds needed: $18,000 In-kind match: $3,510	1/09 – 1/11	

7. Public Education

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
7.1.1 KRWP office space with library	Funds needed: $3,600 (5 yrs) In-kind match: $31,200 (5 yrs)	6/06	6/06 Office space opened to the public.
7.1.2 Presentations on water quality	Funds needed: $12,600 (5 yrs) In-kind match:	6/06 – ongoing	1 presentation per month.
7.1.3 Create display booth	Funds needed: $2,150 (5 yrs) In-kind match:	5/06 – ongoing	8/06 – Booth updated and set up at min. of 2 public events/year.
7.1.4 KRWP website	Funds needed:$1,500 (5 yrs) In-kind match: $19,500 (5 yrs)	6/06 – ongoing	9/06 – website complete
7.1.5 Annual Watershed Day	Funds needed:$3,150 (4 yrs) In-kind match:$8,800 (4 yrs)	5/07 – ongoing	6/07 – First watershed day completed. 100+ children attend.
7.1.6 Increases service activities	Funds needed: See other service related action items. In-kind match:	6/06 – ongoing	
7.1.7 Committee to work with Quorum Courts	Funds needed: $0 In-kind match: $13,600 (4 yrs)	6/07 – ongoing	6/07 – Formed committee and had first meeting with Quorum Court members
7.2.1 & 7.2.3 -Expand Science Club -Local watershed curriculum	Funds needed: $16,800 (4 yrs) In-kind match: $5,860 (4 yrs)	5/07 – 5/09 (high school) 5/09 – 5/11 (elementary)	8/07 – High school curriculum complete. 8/09 – Elementary school curriculum complete.
7.2.2 Workshop for teachers on water quality	Funds needed: $1,000 In-kind match: $500	8/08	8/08 – Workshop complete.
7.2.4 Develop new venues for information	Funds needed: unknown In-kind match: unknown	8/06 - ongoing	

8. Property Rights

Action Item #	Technical/Financial Assistance Needed	Schedule	Interim Measurable Goals
8.1.1-8.1.4 Property Rights Education	Funds needed: $1,050 In-kind match:	1/07 - ongoing	

D. Glossary of Terms and Acronyms

303(d) list – A state compiled list of impaired waters needing total maximum daily loads (TMDLs) to reach EPA standards. This list is submitted to the EPA on April 1 of even numbered years.

ADEQ – The Arkansas Department of Environmental Quality is the principle environmental enforcement agency in Arkansas that implements decisions of the Arkansas Pollution Control and Ecology Commission.

AGFC – The Arkansas Game and Fish Commission is a major state agency for water conservation, planning, and management. The Commission's mission is to wisely manage all the fish and wildlife resources of Arkansas while providing maximum enjoyment for all people.

Alfisols – Moderately leached forest soils that have relatively high native fertility. These soils are well developed and contain a subsurface horizon in which clays have accumulated. Alfisols are mostly found in temperate humid and subhumid regions of the world

Alluvium – Material, such as sand, silt, or clay, deposited on land by streams

ANRC – Arkansas Natural Resources Commission (formerly the Arkansas Soil and Water Conservation Commission). The Commission's mission is to manage and protect our water and land resources for the health, safety and economic benefit of the State of Arkansas. Website at http://www.anrc.arkansas.gov/

APC&E – The Arkansas Pollution Control and Ecology Commission: The environmental policy-making body for Arkansas. With guidance from the Governor, the Legislature, the EPA, and others, the Commission determines the environmental policy for the state and the Arkansas Department of Environmental Quality implements those policies.

Benthic - Organisms and habitats of the bottoms of lakes, rivers, and creeks.

BMPs – Best Management Practices: These are management practices (such as nutrient management) or structural practices (such as terraces) designed to reduce the quantities of pollutants, such as sediment, nitrogen, phosphorus, and animal wastes washed by rain and snow melt from land into nearby receiving waters such as lakes, creeks, streams, rivers, and ground water.

BOD – Biochemical (biological) oxygen demand is a test that measures the rate of uptake of oxygen by micro-organisms in the sample of water at a fixed temperature and over a given period of time. It is basically a measure of the relative oxygen-depletion effect of a waste contaminant.

CAFO – Concentrated animal feeding operations are defined by ADEQ for the purposes of a general permit as follows: An animal feeding operation (AFO) where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period and if the facility stables or confines at any one time as many as or more than the numbers of animals as specified in any of the following categories:
(a) 1,000 slaughter or feeder cattle;
(b) 700 mature dairy cattle (whether milked or dry cows);
(c) 2,500 swine each weighing 55 pounds or more if the facility uses other than a liquid manure handling system;
(d) 10,000 swine weighing less than 55 pounds if the facility uses other than a liquid manure handling system;
(e) 500 horses
(f) 10,000 sheep or lambs;
(g) 55,000 turkeys;
(h) 125,000 chickens (other than laying hens) if the facility uses other than a liquid manure handling system;
(i) 82,000 laying hens if facility uses other than a liquid manure handling system;

COE – The Corps of Engineers is a department of the Army that regulates navigable waters of our country and builds major water projects as directed by Congress. Website can be found at: http://www.usace.army.mil/

Colluvium – Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Dendritic drainage pattern – Dendritic drainage systems are the most common form of drainage system in the world. They consist of a main river with tributaries with their own tributaries. From above, it looks like a tree or a river delta in reverse.

Designated uses – Those uses specified in the water quality standards for each waterbody or stream segment whether or not they are being attained.

Dissolved oxygen – Oxygen weakly bound to water molecules that is available to aquatic organisms for aerobic respiration.

Ecoregion – Distinct areas defined by physical features such as geology and topography physiography, vegetation, climate, soils, land use, wildlife, and hydrology.

Endemic – Native to and confined to a specific region.

EPA – The Environmental Protection Agency is a federal agency that develops and enforces environmental laws enacted by Congress. They also provide funding, research, and education. The Kings River is actually part of two EPA districts: Region 7 in Missouri and Region 6 in Arkansas. The websites are as follows: Region 7 - http://www.epa.gov/region07/, Region 6 - http://epa.gov/region6/index.htm.

Erosion – The wearing away of the land surface by wind, water, ice, or other geologic agent. Erosion occurs naturally from weather or runoff but is often intensified by human land use practices.

Eutrophication – The enrichment of an ecosystem with nutrients, typically compounds containing nitrogen or phosphorus. Eutrophication is considered a form of pollution because it promotes plant growth, favoring certain species over others and forcing a change in species composition. In aquatic environments, enhanced growth of choking aquatic vegetation or phytoplankton (that is, an algal bloom) disrupts normal functioning of the ecosystem, causing a variety of problems. Human society is impacted as well: eutrophication decreases the resource value of rivers, lakes, and estuaries such that recreation, fishing, hunting, and aesthetic enjoyment are hindered. Health-related problems can occur where eutrophic conditions interfere with drinking water treatment.

Evapotranspiration – The sum of evaporation and plant transpiration. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapour through stomata in its leaves.

Fecal form e.coli – A group of bacteria normally present in large numbers in the intestinal tracts of humans and other warm blooded animals. The presence of this type of bactieria in water, beverages, or food is usually taken to indicate that the material is contaminated with solid waste.

FEMA – Federal Emergency Management Agency. Federal agency in charge of emergency and disaster response. Website found at: http://www.fema.gov/index.shtm

Floodplain – (1) A strip of land bordering a stream built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. (2) The lowland that borders a stream or river, usually dry but subject to flooding.

Friability - The degree to which a solid can easily be crumbled into powder or small particles. A clump of damp sand that sticks together but easily crushes into its individual grains, for example, is very friable.

Groundwater – Water located beneath the ground surface in soil pore spaces and in the fractures of geologic formations

Hardness – A measure of the sum of multivalent metallic cations expressed as calcium carbonate ($CaCO_3$).

Hydrography – Study which focuses on the measurement of physical characteristics of waters and marginal land. Hydrography of streams will include information on the stream bed, flows, water quality and surrounding land.

Hydrologic Unit – (1) A geographic area representing part or all of a surface drainage basin or distinct hydrologic feature. (2) A classification of soils concerning water infiltration characteristics used in hydrologic analyses.

HUC – Hydrologic unit code:

Impairment – Exceedences of the water quality standards by a frequency and/or magnitude which results in any designated use of a waterbody to fail to be met as a result of physical, chemical or biological conditions.

Indicator species – Species of fish which may not be dominant within a species group and may not be limited to one area of the state, but which, because of their presence, are readily associated with a specific ecoregion. All indicator species need not be present to establish a normal or representative fishery.

Indigenous – Produced, growing or living naturally in a particular region or environment.

Interstitial – In this context, the space or small openings between the substrate particles

Karst – A network of subsurface openings and an irregular rock surface characterized by sinkholes, caves, springs, and other types of openings caused by the dissolution of carbonate rocks. Water that recharges an aquifer with a karstified surface either enters as direct runoff through sinkholes and sinking streams or enters by downward diffuse infiltration through shallow soil cover in the upland, interstream areas.

Key species – Fishes which are normally the dominant species (except for some ubiquitous species) within the important groups such as fish families or trophic feeding levels. All specified key species need not be present to establish a normal or representative fishery.

KRWP – Kings River Watershed Partnership

Kings Roundtable – Group of stakeholders who offered input for the Kings River watershed plan.

Mesotrophic – Waters with intermediate productivity and clarity.

MDNR – Missouri Department of Natural Resources. Website found at: http://www.dnr.mo.gov/

Nonpoint source – A contributing factor to water pollution that is not confined to an end-of-the pipe discharge, i.e., stormwater, agricultural or silvicultural runoff, irrigation return flows, etc.

NTU (Nephelometric Turbidity Unit) – A measure of turbidity based upon a comparison of the intensity of light scattered by a sample of water under defined conditions with the intensity of light scattered by a standard reference suspension; NTU are considered comparable to the previously reported JTU (Jackson Turbidity Units).

Nutrient – Any substance assimilated by an organism which promotes growth and replacement of cellular constituents. The usual nutrient components of water pollution are nitrogen, phosphorus and carbon.

Oligotrophic – Poorly nourished, clear waters with limited sediment and biological activity.

Pennsylvanian Period – The **Pennsylvanian** is an epoch of the Carboniferous period lasting from roughly 325 Ma to 286 Ma (million years ago).

Periphyton - A complex matrix of algae, cyanobacteria, heterotrophic microbes, and detritus that is attached to submerged substrata in almost all aquatic ecosystems.

pH – The negative logarithm of the effective hydrogen-ion concentration in gram equivalents per liter.

Phytoplankton – autotrophic (produces its own energy using light) algae that live near the water surface where there is sufficient light to support photosynthesis. Among the more important groups are the diatoms, cyanobacteria and dinoflagellates.

Point Source Pollution – Any discernible, confined, or discrete conveyance from which pollutants are or may be discharged, including (but not limited to) pipes, ditches, channels, tunnels, conduits, wells, containers, rolling stock, concentrated animal feeding operations, or vessels. Point source is legally and more precisely defined in federal regulations, but the general idea refers to pollution that comes from an ascertainable “point”.

Residuum – unconsolidated material that has been formed from rock mineral in its current location

Riparian – Pertaining to the banks and land adjacent to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water.

Riparian Buffer – A Best Management Practice that dictates leaving the riparian zone of water bodies undeveloped so that pollutants (sediment, pesticides, nutrients, etc) in runoff are hindered from entering the water and erosion is reduced.

Runoff – The water that drains from the land into stream or river channels after precipitation and is a function of precipitation amounts, topography, geology, soil moisture, and other factors.

Sinkhole – Also known as **sinks**, **shakeholes** or **dolina** (in the Slovene language *dolina* means *valleys*), and **cenotes**, are formed by the collapse of cave roofs and are a feature of landscapes that are based on limestone bedrock, particularly karst landscapes. The result is a depression in the surface topography.

Stakeholders – A group or individual who works, plays, or lives in the watershed.

TDS – The combined content of all inorganic and organic substances contained in a liquid (present in a molecular, ionized or micro-granular suspended form) which are small enough to survive filtration through a sieve size of two micrometres.

TMDL – Total Maximum Daily Loads: For waters that are not meeting water quality standards or have a significant potential not to meet standards as a result of point source discharges or nonpoint source activities, TMDL's are developed which establish the maximum amount of a pollutant that can enter a specific water body without violating the water quality standards.

TSS – The combined content of all inorganic and organic substances contained in a liquid (present in a molecular, ionized or micro-granular suspended form) which are **not** small enough to survive filtration through a sieve size of two micrometres and yet are indefinitely suspended in solution.

Turbidity – A cloudiness or haziness of water (or other fluid) caused by individual particles that are too small to be seen without magnification: used as a measure of water clarity.

Ultisols - Strongly leached, acid forest soils with relatively low native fertility. They are defined as mineral soils which contain *no calcareous material anywhere within the soil*, have less than 10% weatherable minerals in the extreme top layer of soil, and have less the 35% base saturation throughout the soil. The high acidity and relatively low quantities of plant-available Ca, Mg, and K associated with most Ultisols make them poorly suited for continuous agriculture without the use of fertilizer and lime. With these inputs, however, Ultisols can be very productive.

Watershed – The geographic area that drains to surface water bodies; a watershed generally includes lakes, river, wetlands, estuaries, surrounding landscape, and contributing groundwater.

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