HYDROLOGICAL TRANSITIONS:
A STORY OF KANSAS WATERSHED DISTRICTS

by

CHRISTY ROBERTS JEAN

B.A., Kansas State University 2014

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF ARTS

Department of Geography
College of Arts and Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2016

Approved by:

Major Professor
John A. Harrington, Jr.

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Abstract

Kansas watershed projects have been responsible for reducing floodwater damage across the state since the formation of watershed districts, following the Kansas Watershed District Act of 1953. A total of 80 organized watershed districts now take on the responsibilities associated with watershed management and protecting the land uses within them. Today, Kansas watershed districts face challenges in completing nearly half of the 3,000 structures proposed since 1953. Insufficient funding, burdensome policy changes, and a declining interest from local board members and landowners are key challenges boards must overcome in addition to managing rapidly aging infrastructure and dealing with projects that have exceeded their life expectancy.

Research methods used for this report include content analysis of general work plans, relevant federal and state policies, and interviews with local stakeholders. In order to understand the economic, political, social and geographic impacts of watershed development, the following issues are addressed: cost-benefit ratios using monetary and non-monetary benefits, differences between federal and state funding in regards to rehabilitation and best management practices, local perceptions of watershed development, and spatial factors that exist among watershed districts. This study found that watershed projects have the potential to provide up to $115 million each year in monetary and flood damage reduction benefits in Kansas protecting over 35,000 miles of transportation routes while providing recreation opportunities and enhancing environmental conservation efforts. Political and social impacts were identified through in-person interviews with 21 local stakeholders that include landowners, board members and state representatives, representing 21 different watershed districts. Perceptions of political and social issues indicate that when government assistance is available, watershed districts are more willing to deal with increased regulations. However, a lack of financial support that has existed in

Kansas watershed districts over the last eight years has contributed to a general opposition of increased federal regulations and reluctance to continue building watershed structures. Spatial factors among watershed districts illustrate the spatial and temporal differences in district development, watershed structure construction, and precipitation gradients that influence land use and ecoregions between western and eastern Kansas.

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Acknowledgements

I have had the privilege of being surrounded by incredible people during this project. My greatest appreciation is to Herb Graves and the State Association of Kansas Watersheds for allowing me to tell the story of Kansas Watershed Districts. I would like to thank Hakim Saadi from the Kansas Department of Agriculture-Division of Conservation, Roger Masenthin and his team at USDA-NRCS in Salina, Kim Hunninghake from the Kansas Department of Agriculture-Division of Water Resources, and Tina Rajala from the Kansas Water Office, for their guidance, knowledge and unwavering support during the entire project. I especially owe my gratitude to the members of each watershed district who set aside valuable time to share their insight and experiences with me.

Thank you to my advisor, Dr. John Harrington, for your sound judgment, understanding and encouraging words as I made my way through this final semester, and all the ones prior to it. Special thanks to my committee members: Dr. Matthew Sanderson for putting your trust in me and allowing me to work on this project with you, and Dr. Lisa Harrington for your patience, and advice.

Most importantly, thank you to my family and friends who stuck out the emotional rollercoaster of grad school with me. I want to thank my husband, Kreig Jean and my sweet babies, Ayla and Ethan, who have taught me the importance of time management and strong coffee. Thank you to my parents, Maria and Scott Charles and Les Roberts for believing in me and continuing to be my biggest fan club. An especial thank you to my brother, Kenneth Roberts, who never lets me forget where I came from or where I can go in life. This experience has taught me the importance of surrounding myself with good people and for that, I will be eternally grateful.

Chapter 1 - Calming the Storm

For the first time in Kansas history, in 2014, there was a collaborative interest among state, federal and local governments to assess and articulate a combined story of Kansas Watershed Districts. The need to understand the development, progress and future of watershed districts is essential in maintaining and improving the safety and productivity of Kansas' success in both agricultural and non-agricultural ventures. The bottom line is that the knowledge obtained from the collaboration between the state and federal agencies involved in this project will justify the need for funding in Kansas to fulfil the development of the remainder of proposed watershed structures, continue to create the case for maintaining the existing investment, while creating an awareness of the social capital invested into these uniquely defined communities.

Water is an important commodity for human settlement and survival. In Kansas, a history of climate variability, with multi-year droughts and extreme flooding at other times has presented water resource management challenges to local residents. This research examines the environmental history and management practices of 80 organized watershed districts in the state, following the enactment of the Kansas Watershed District Act in 1953. Methods include content analysis of general work plans, relevant federal and state policies, and interviews with local landowners.

Examination of the establishment and activities of watershed districts over six decades enables a better understanding of changing societal emphases over time. In order to understand the economic, political, and social impacts of watershed development, the following issues are addressed: cost-benefit ratios using monetary and non-monetary benefits, differences between federal and state funding in regards to rehabilitation and best management practices, and local perceptions of watershed development. This research also addresses spatial patterns associated

with the location, size and timing of the watershed district establishment. Benefits from watershed management projects span economic sectors, from industry to recreation, around the world. Fortunately for Kansas, watershed projects also contribute to protecting and enhancing agriculture and transportation infrastructure efforts.

For the purposes of this research, "watershed project" is used as an overarching term to describe all watershed conservation and flood control practices used to reduce flooding, reduce erosion, or enhance land use in an effort to provide safety and uphold the performance standards of the project. Understanding the effects of precipitation and flooding in Kansas is essential to understanding how the state must operate at the watershed district level. The unique characteristics of the state's physical geographic landscape gives way to the variations in which watershed districts design and implemented watershed structures across the state.

Precipitation and Flooding in Kansas

The land-locked location of Kansas and its proximity to moisture flow from the Gulf of Mexico causes significant spatial variation in the annual precipitation gradients across the state (Figure 1). Southerly winds originating in the Gulf of Mexico, which extends westward to 98°W longitude, the occasional remnants of hurricanes from the Gulf, and the minor role of seasonal moisture that originates from the Pacific Ocean, all contribute to the numerous severe floods and droughts that affect Kansas (Clement, Bark, and Stiles 1991).

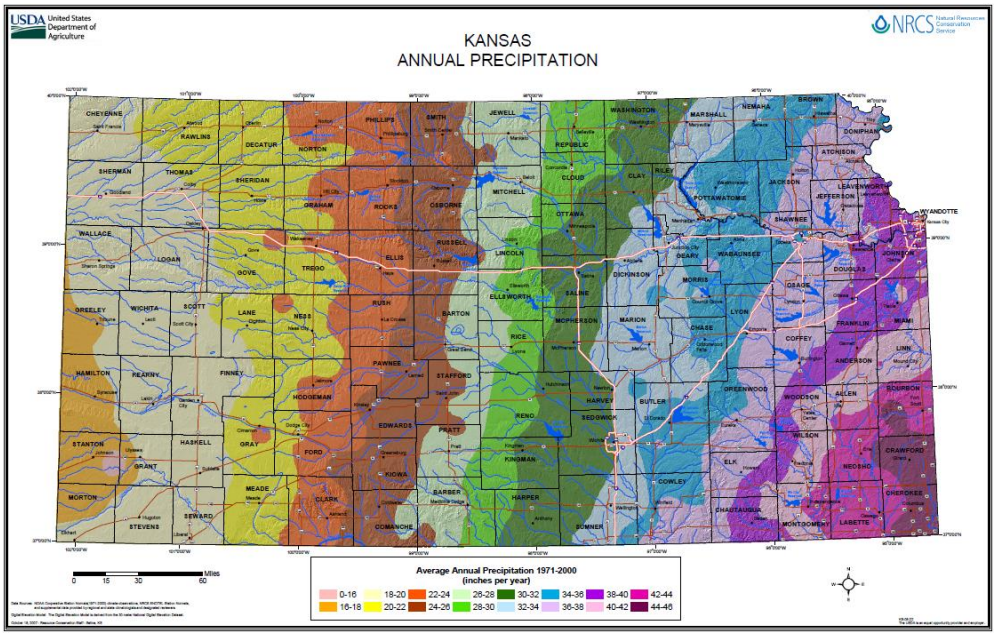

Figure 1.1: Kansas Annual Precipitation (Source: USDA 2007)

Moist air riding north on the low level jet makes its greatest impact between May and July, when Kansas receives the bulk of its precipitation (Howard and Harrington 2012). Divided into thirds, the average annual precipitation for Kansas varies across the state, with 35.3 inches in the eastern third, 26.5 inches in the middle third and approximately 19.0 inches in the western third of the state (Flora 1948). Practically every part of the state has experienced a downpour of 5 inches or more, generally in September, July and/or June (Flora 1948).

There are over 10,000 miles of rivers and streams running through Kansas. With a drainage area that exceeds any state east of the Mississippi River, the drainage areas of the Kansas River and Arkansas River often experience immense overflow conditions (Flora 1948). In fact, flood producing rains are the cause of at least one Kansas stream to experience severe flooding during an average year (Clement, Bark, and Stiles 1991). Despite location and time, the hydrological conditions prior to each significant flood of the 20th century shared similar characteristics: an extended rainy period that produced enough precipitation to saturate the soil

followed by a major storm system and associated heavy rains that result in excessive precipitation over a large area (Juracek, Perry, and Putnam 2001).

In the 1951 flood that impacted the eastern half of the state, agriculture and urban areas experienced $800 million in damage, with 15 deaths and 900 injuries (Clement, Bark, and Stiles 1991). Again in 1965, a flood in southwestern Kansas caused considerable damage to croplands near Garden City and Dodge City, as well as nearly $16 million worth of urban damage within the city limits (Clement, Bark, and Stiles 1991). Substantial flood damage is found most often in areas where extensive development has occurred, which was evident in the 1903 and 1993 floods along the Kansas River (Juracek, Perry, and Putnam 2001).

Streamflow gaging stations located throughout the state, allow local stakeholders to experience real-time data in the event of a flood. Since 1951, the United States Geological Survey (USGS) has increased the number of stations from 96 to 209 (USGS 2015).

History and Formation of Kansas Watershed Districts

The demand to protect growing urban populations, rural farmlands, and communities in flood-prone areas resulted in enactment of the U.S. Flood Control Act of 1936. The Act made flood-control a federal issue and responsibility was assigned to the Army Corps of Engineers who had been involved with water resource projects since 1824 (Arnold 1988). For the first time in history, the federal government agreed to a flood control program which would address flood destruction across the United States. Following the 1936 Act, reservoirs, levees and channelization projects (Arnold 1988) were constructed nationwide.

In Kansas, flood control measures, combined with a focus on protecting and enhancing the state's natural resources, led to the development of the Kansas Watershed District Act of 1953 (K.S.A. 24-1201 through 24-1237). Under this legislation, districts are defined as an area

"comprising a watershed or two or more adjoining watersheds exclusive of lands within other organized watershed districts for which organization is proposed or has been organized under the provisions of article 12 of chapter 24 of the Kansas Statues Annotated, and amendments thereto." (Kansas Watershed District Act 1953 24-1202, ¶ f). The Act allows local entities to form watershed districts in order to "construct, operate, and maintain works of improvement" to address water management problems. The Kansas Watershed District Act gave watershed districts eminent domain and the authority to level annual taxes (K.S.A. 24-1209) in order to generate enough funds to build and maintain the proposed watershed structures.

Technical assistance has aided local stakeholders in understanding, implementing and maintaining conservation efforts through programs developed by the United States Department of Agriculture's-Natural Resources Conservation Service (NRCS), and the Kansas Department of Agriculture's-Division of Conservation (DOC). Both agencies have played instrumental roles in the development of Kansas watershed districts by implementing cost-share programs to assist local watershed districts in construction and rehabilitation efforts.

Key legislation and programs include:

- P.L. 85-534 Flood Control Act of 1944
- Pilot Watersheds Program (1952-1954)
- P.L. 83-566 Watershed Protection and Flood Prevention Act
- Resource Conservation and Development Program (RC&D)
- KDA-DOC Watershed Dam Construction Program
- KDA-DOC Multipurpose Small Lakes Program
- Watershed and Flood Prevention Operations (WFPO)
- P.L. 106-472 Watershed Rehabilitation Program (Small Watershed Rehabilitation Amendments of 2000)
- KDA-DOC Watershed Dam Construction Program (Rehabilitation Component 2007)
- Agricultural Act of 2014 (Farm Bill 2014)

A Shifting Focus: Watershed Districts in 2015

In 2011, Kansas ranked 3rd nationally in the number of PL 83-566 dams, known generally as 'PL-566," following Texas and Oklahoma (Figure 1.2). Today, PL-566 dams account for nearly half of the 1,539 watershed structures that have been built in the state's 80 organized watershed districts over the past 60 years. There has been extensive infrastructure development occurred between 1964 and 1980, but new construction has declined every year since 1994.

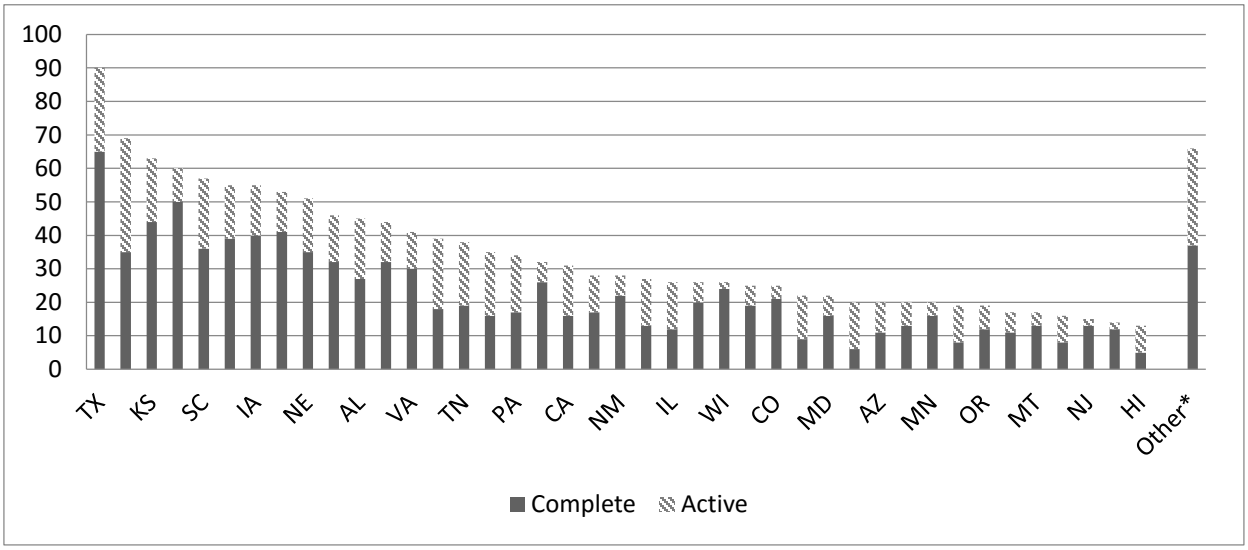

Figure 1.2: Watershed Structures by State (Source: NRCS 2011)

All 80 watershed districts have at least one dam built within the district, excluding Turkey Creek No. 109. Data collected from the KDA-Division of Water Resources (DWR) and Kansas Water Office (KWO) illustrate the number of constructed watershed dams in the state (Figure 1.3). The locations of watershed district structures continue to be verified by DWR and KWO through the use of satellite imagery and permitting applications. Figure 1.3 does not include Marias Des Cygnes Drainage District No. 1.

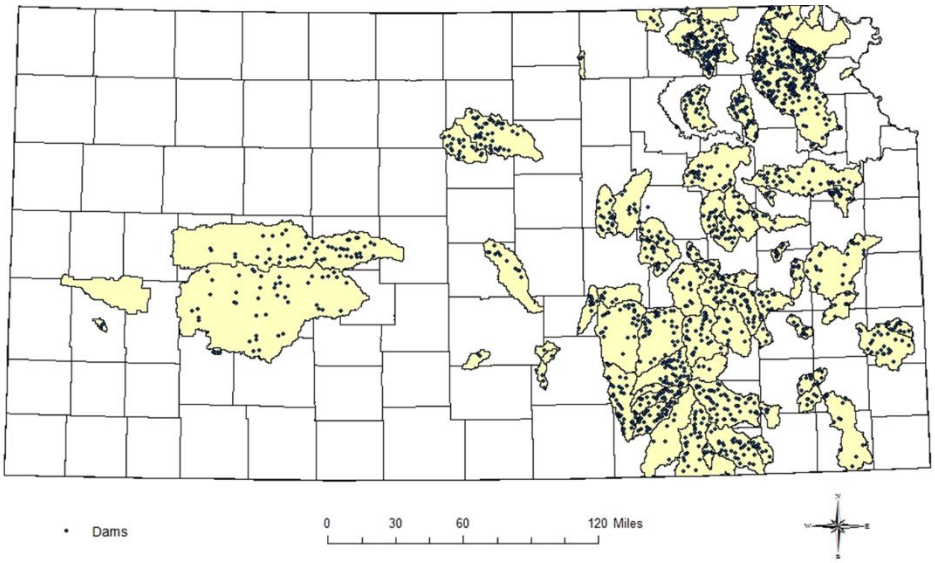

Figure 1.3: Kansas Watershed Districts with Existing Dams
(Source: Map by author; data from DWR and KWO)

As a result of aging infrastructure, watershed district boards have shifted their focus to rehabilitation. The United States Department of Agriculture (USDA) stipulates that watershed structures are designed with a sediment storage life of no less than 50 years and no more than 100 years despite variances in design features and construction materials (NWPM 2009). Proper maintenance and rehabilitation are critical in extending a dam's design life and providing the safety benefits so many Kansans now depend on. Both federal and state agencies have readjusted their focus from construction to rehabilitation in order to assist watershed districts in a period that is referred to as a "maintenance mode." In part, the transition to maintenance mode is due to the limited funding available for new construction.

Rehabilitation programs, such as the Watershed Rehabilitation Program (P.L. 106-472) under NRCS, and the State Watershed Dam Construction Program (K.A.R. 11-13-1) under the Kansas Division of Conservation (DOC), have provided cost-share assistance to qualifying watershed districts in order to extend the service life of a dam while maintaining safety performance standards. Under these programs, NRCS has completed 88 dam assessments and

provided funding for six rehabilitation projects. DOC has provided over $2.5 million in state cost-share assistance for at least 76 structures (Saadi 2015, pers. com).

Research Needs

Based on interest in documenting the history and status of watershed districts in Kansas, several research questions were developed to address management of designated watersheds in the state. Specific questions include the following:

1) How have economic variations over the past 60 years contributed to the effectiveness of watershed districts?
    a. Can watershed districts afford to keep building watershed districts at rising costs?
    b. Will a lack of economic stability needed for new watershed structure construction impact the safety of Kansans?
    c. Are incomplete watershed districts a potential risk hazard?
2) To what extent do local stakeholders perceive state and federal policies as a hindrance or aid to local watershed district flood control goals?
3) How have social capital issues played a role in Kansas watershed district efficacy?
4) How do spatial factors relevant to watershed management vary among Kansas watershed districts? Specific factors to be addressed include annual precipitation, population size, and land use.

With increasing competition among neighboring states for watershed funding, understanding how Kansas watershed districts are managed is important in outlining and accomplishing their future goals. Watershed districts have transitioned over time through

economic fluctuations, increased federal regulations, and social implications that have a direct impact on the way watershed districts have emerged and adapted over the past 60 years.

An examination of watershed management, the dynamics of society and hydrology, and the transformation of the landscape made by humans provide an opportunity to understand the social components that are associated within watershed districts, along with political and economic barriers that restrict new watershed structure construction.

Chapter 2 - Muddying the Water: A Review of the Literature

Watersheds and Watershed Management

Watersheds provide ecosystems services which contribute a great deal to the economic and social value of a community, particularly in regards to the hydrological services that contribute to water quality, seasonal flow regulation, erosion and sediment control, and habitat preservation (Postel and Thompson 2005). The value of watersheds has extended beyond the hydrological services they provide as growing populations have increased the demand of those services and have simultaneously created an economic value defining the importance of watersheds. Floodplains that once were uninhabited now undergo competition between cheap housing developments and a growing agriculture base in the United States. Designing flood control projects now requires a balance between economic benefits and environmental interests (Arnold 1988).

Watershed management was first proposed in the United States during the 1880s by John Wesley Powell who envisioned "organizing and governing according to watershed boundaries rather than political boundaries" (Smith 2013, 53A). The term water management has been defined as "the application of structural and non-structural measures to control natural and man-made water resources systems for beneficial human and environmental purposes" (Lautze 2011). The desire to create management practices that benefit human lives and livelihoods can be compared to the same desires that drove the conservation movement. Like the conservation movement, management practices address the human impact on the environment and the commitment to maintain that environment for future generations.

For over six decades, Kansas citizens have organized as local stakeholders to develop and implement plans to control flooding and reduce soil erosion. Today, we also consider "modern-day issues of water rights, water pollution and aquifer depletion" (Barham 2001, 183).

Similar to other movements that spark action, the watershed movement has become a valuable and fundamental part of one's community (Warriner 1961). The purpose of the watershed movement is:

> "to preserve the land for future generations (through flood control and soil conservation techniques); to help the farmer support the nation (by increasing his productivity through these watershed techniques); to maintain the American way of life (by improving the economic and social welfare of the farmer)"
>
> Warriner 1961

"People and industry still go "where the water is," but even water has become a mobile commodity in modern society, with its location and availability manipulated by human decision as never before" (Barham 2001, 185).

Effective watershed managers must go beyond the challenges that effect economic development, sustainability, social and bioregional interests, networks and partnerships (Smith 2013). Local populations have created geographical areas using watersheds, often resulting in unique mergers of communities and encouraging interaction between neighboring counties. Watershed districts face challenges in the unexpected dynamics that occur between hydrology and society, overcoming political and economic barriers and addressing social capital issues.

The Dynamics of Hydrology and Society

Historically, human settlements have benefited from the transportation corridors, fertile soils (Baldassarre *et al.* 2013), and easy access to irrigation water (Viglione *et al.* 2014) that streams and rivers provide. The attractiveness of settling in a floodplain from an economic perspective has encouraged the formation of settlements as close to rivers as possible (Viglione

et al. 2014.) As communities and agriculture develop in these areas, watershed management becomes an important factor in understanding the dynamics between hydrology and society.

Watershed management is a complex process wherein local stakeholders need to share knowledge about the current situation and desirable outcomes for group action. In dealing with a common pool resource, like water, watershed districts include both ecological and social components in which citizens must learn from the past, while managing the present and preparing for the future. "Coordinating farm-level outreach with watershed goals helps stakeholder groups engage in water resource management at multiple socio-ecological scales" (Enloe *et al.* 2014, p. 149A). Overtime, the long-term nature associated with water cycle dynamics has become a part of the interactions and feedbacks of human systems (Sivapalan, Savenije, and Bloschl 2012).

What was once identified as the solution to watershed management: Integrated Water Resources Management (IWRM), is now being reconstructed into something more appropriate for the actual needs of society. IWRM is defined by the Global Water Partnership (2000) as "a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable matter without compromising the sustainability of vital ecosystems." The underrepresentation of human systems in hydrology can be attributed to the typical role of humans as either a "boundary condition or external forcing to the floodplain systems" (Baldassarre 2013, 3295). Feedback mechanisms within socio-hydrology take into consideration how societies influence the frequency of flooding over time which in turn alters floodplain dynamics (Baldassarre 2013). Watershed structures, such as dams and levees, are built with the intention to reduce flooding frequency, however, a side effect of their presence is their exacerbation of high water levels and

the encouragement for humans to settle in floodplains which are then "vulnerable to high-consequence and low-probability events" (Baldassarre 2013, 3296).

The historical interaction between hydrology and societal changes has led to the development of a new science, socio-hydrology, which is aimed at understanding the dynamics of human-coupled water systems (Sivapalan, Savenije, and Bloschl 2012). Five different processes within this system include: hydrological, economical, political, technological, and social (Baldassarre 2013). Conceptualizing the interplay of socio-hydrological dynamics considers the intensions, risks and responses of a community in a floodplain area. Community development near a river is associated with economic benefits, however when the community experiences extreme flood events they respond by either moving away or building water structures to reduce flooding (Baldassarre 2013). Both responses impact the economy. The first option and safest way to avoid flood damage is to simply move away from flood prone areas. However, this comes at a cost, as moving away from rivers and streams means access to waterways brings on a host of new challenges. The economic opportunities, such as trade, agriculture and jobs diminish as the population moves further from the river (Viglione 2014). As technology advanced, a second option developed allowing societies to build structures which would enable flood protection and greater control over the capacity of the river (Viglione 2014). Unfortunately, living next to the river also means that communities will inevitably experience flood damage. The costs from construction and maintenance of flood reducing structures will affect the economy (Vigilone 2014). The danger with the second option is that the awareness of flood risk decays with time, eventually encouraging communities to move back towards the river in order to resume the benefits of economic gain (Baldassarre 2013). These short term-memories also impact water use by both individuals and administrators associated with management

policies (Ersten 2014). Another aspect of dealing with flood risks is the community's trust in the watershed structures meant to reduce flooding and protection the downstream population. "A higher level of trust in flood protection measures tends to reduce citizen's perceptions of flood likelihood which may hamper flood preparedness intentions" (Vigilone 2014, 72).

The difference between socio-hydrology and the science of IWRM goes beyond the "unrealistic" approaches for long term stationary predictions of water and society as individual phenomena. Instead, socio-hydrology includes the "spontaneous or unexpected behaviors" associated with coupled human-water systems and explore the "evolution and self-organization of people in the landscape with respect to water availability" (Sivapalan, Savenije, and Bloschl 2012, 271). An example of the complexities of socio-hydrology can be illustrated in understanding large scale irrigation management, by evaluating small scale, day-to-day operations of irrigation works (Ersten 2014). Changes in temporal and spatial scales used in irrigation systems in conjunction with human interaction can be influenced by climate changes, unequal water delivery from upstream to downstream farmers, and strains on relationships between those farmers, which are a prime example of the multiple feedbacks between humans and the environment (Ersten 2014).

The mindset of socio-hydrology is understanding how this dynamic system experiences multiple iterations as it evolves through time. Instead of treating social and hydrologic systems separately, socio-hydrology examines them jointly as they are experienced in the real world (Wescoat 2013). As our world becomes increasingly dominated by human-interaction in every aspect of our natural resources, the field of socio-hydrology will be key in making useful predictions of water cycle dynamics while simultaneously creating a more sustainable water management initiative (Sivapalan, Savenije, and Bloschl 2012).

The management of this temporal variability first requires understanding of space delineation and landscape transformation (Cutter, Golledge, and Graf 2002). The ideas of Cutter, Golledge, and Graf, (2002) are vital in understanding how space is delineated by the basic human desire to create boundaries and how humans are transforming the landscape. The tools necessary to answer these questions go beyond a qualitative means. They suggest that geographic information systems (GIS) and spatio-temporal modeling are essential in further defining watershed district boundaries while making sense of an ever changing landscape.

Delineating Space through Watershed District Boundaries

The human desire to organize space by creating arbitrary boundaries (Cutter, Golledge, and Graf 2002) has sectioned off county borders, landowner property and occasionally the "do not cross this line" squabble. Unlike clearly defined county boundaries and property lines, watershed districts are organized in a more organic nature, letting the tributaries of a river identify a new distinct set of geographical boundaries. Recognizing regional variations in climate, vegetation, and landform differences are essential for addressing land management issues among different ecosystems (Bailey 1980). A 1976 map entitled "Ecoregions of the United States," which was based on a combination of physical and biological characteristics, was one of the initial attempts to divide the country into ecoregions (Bailey 1980). The country was divided into 4 hierarchical levels: Domain (Level I), Division (Level II), Province (Level III) and Sections (Level IV). Figures 2.1, 2.2, 2.3, and 2.4 illustrate Bailey's ecoregions within the state of Kansas.

At approximately 97°W longitude, Kansas is divided in half, with the Dry Domain, Steppe Division on the western half and the Humid Temperate Domain, Prairie Division on the eastern half (Figure 2.1 and 2.2).

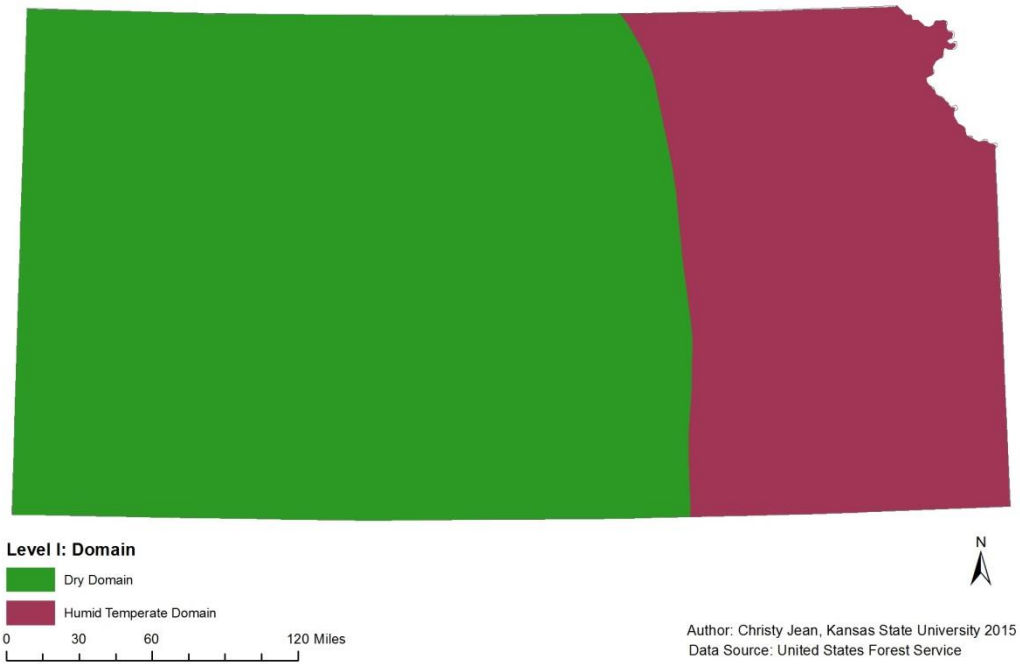

Figure 2.1: Bailey's Ecoregions Level I of Kansas
(Source: Map by author; data from USDA Forest Service)

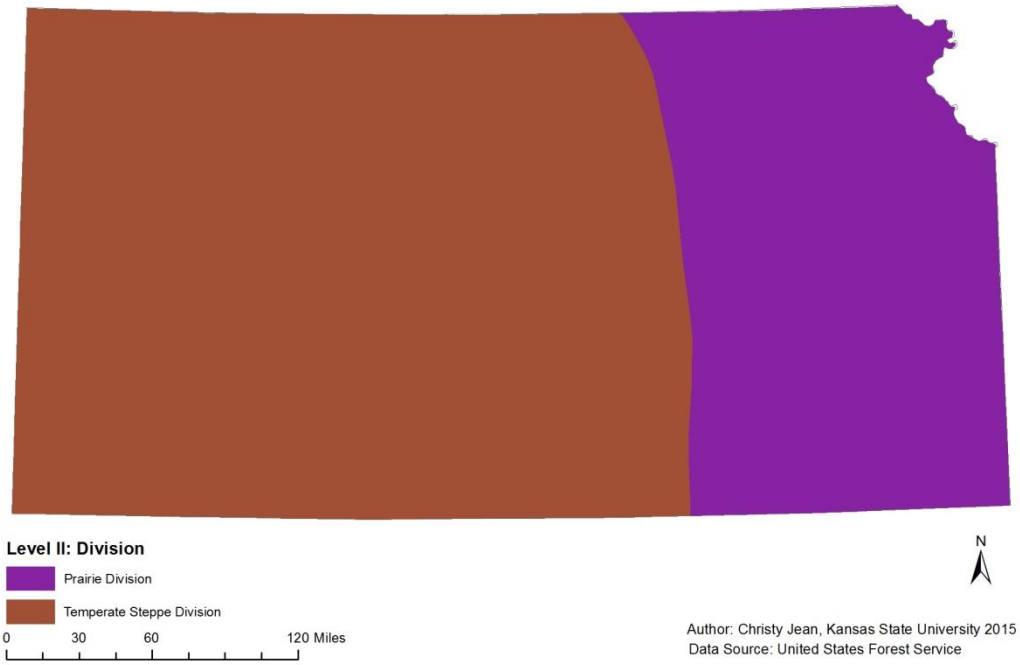

Figure 2.2: Bailey's Ecoregions Level II of Kansas
(Source: Map by author; data from USDA Forest Service)

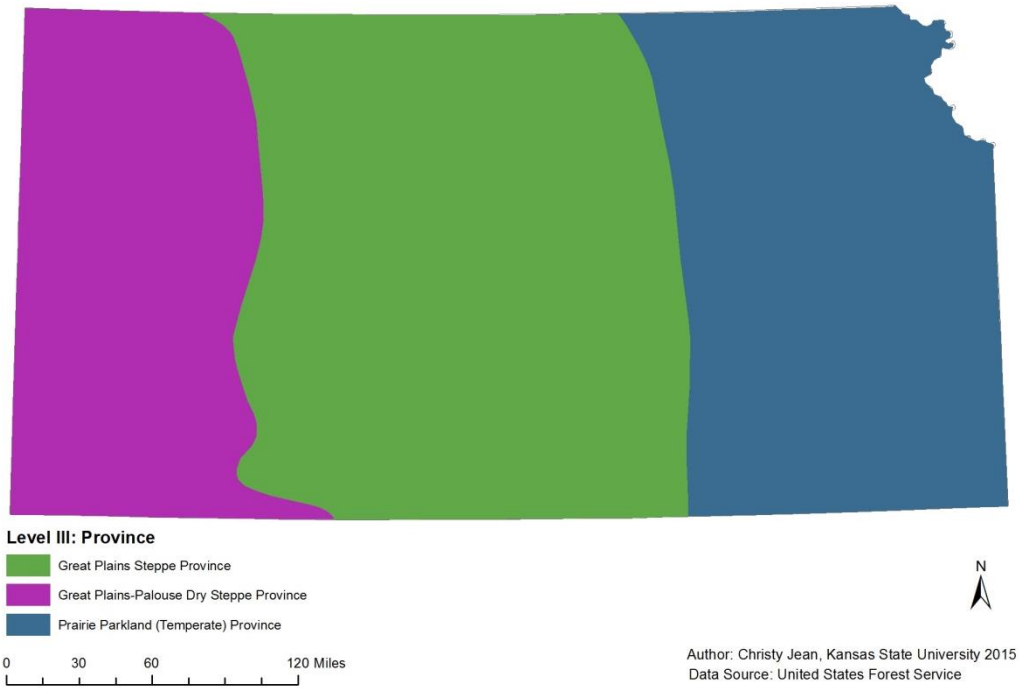

Figure 2.3: Bailey's Ecoregions Level III of Kansas
(Source: Map by author; data from USDA Forest Service)

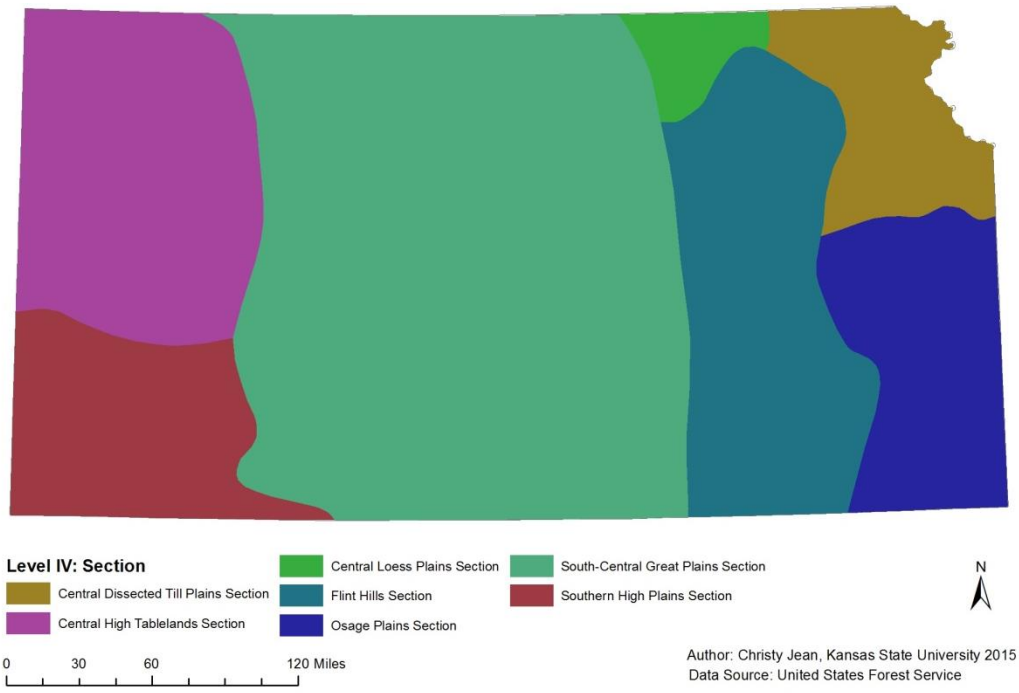

Figure 2.4: Bailey's Ecoregions Level IV of Kansas
(Source: Map by author; data from USDA Forest Service)

The distinct differences in ecosystems between western and eastern Kansas are key indicators in the argument to address land management issues by region. Prior treatments of land management in the Great Plains, have failed to take in to consideration the combination of the biophysical and human conditions that impact the region (Auch *et al.* 2011). Defining ecosystems on a level appropriate for proper land management becomes more complicated as "political and economic considerations regarding the values of ecosystems and environmental resources" are taken into consideration (Omernik and Griffith 2014, 1249).

The establishment of social systems and cooperation within watersheds in a systematic way is a mental shift in the way boundaries have been defined previously (Barham 2001). These newly defined watershed boundaries are also responsible for creating new communities in which water-users make up the majority of the stakeholder population. This population, as a whole, holds a concern over the effects of watershed development and management.

Displaying boundaries on maps has the ability to evoke different perceptions based on the types of borders illustrated. Different perceptions are created when a map displaying major river networks rather than basins is displayed (Cutter, Golledge, and Graf 2002). Perceptions can "direct knowledge and its application in divergent ways" (Cutter, Golledge, and Graf 2002, 309).

Each watershed district may include a range of ecological types that transcend political, economic and administrative boundaries and jurisdictions. Existing or newly created boundaries may become barriers in successful watershed planning because of regulations that might "abolish, downsize or streamline" watershed standards (Barham 2001, 189). Political boundaries present challenges for watershed policy implementation, which may require separate attention in different political jurisdictions in order to address similar areas of the watershed (McGinnis 1999).

Several ecological factors, including soil degradation, flood prevention, agricultural land practices, wildlife preservation and water control are only a few of the issues that watershed districts face around the world. These pose significant challenges in terms of how watershed districts integrate watersheds, ecosystems and human systems (Cutter, Golledge, and Graf 2002).

Human Transformation of Landscapes

The human desire for safety has to led to a need to control our environment, often with little consideration as to the value of the natural services from watersheds that benefit society (Postel and Thompson 2005). The command and control mindset has affected the way in which river basins and watershed districts are assessed, and the amount of control exerted over land use, water, sediment, transport and deposition, and contamination issues (Cutter, Golledge, and Graf 2002). Planning is now undertaken with the consideration of multiple interests (Barham 2001), especially as more and more land areas are converted to agriculture or other urban-industrial uses (Postel and Thompson 2005). Between 1920 and 1990, croplands and pastures in the Great Plains seemed relatively stable until Drummond (2007) discovered that 5,159 km² of grassland had been converted to cropland in a seven year period between 1973 and 1980 (Auch *et al.* 2011). Multiple interests among landowners were identified as a main driver between 1973 and 1980 when an increase in grain purchase, farming operations, and farmland prices, contributed to land use conversion from grasslands to agriculture in the Great Plains (Auch *et al.* 2011).

The shift to agriculture and industry in watershed lands creates a burden where pollutants, erosion and degradation of aquatic habitats (Postel and Thompson 2005) become the new norm. Land use tensions were identified as an issue of concern in the land cover and land use changes

between 1973 and 2000; especially for agriculture land use during extended periods of wetter or drier weather (Auch *et al.* 2011). Auch (2011) defined land-use tensions as "competition between or among two or more land uses, given the general biophysical conditions that result in the greatest economic gain for the landowner" (p 237). In Kansas and other parts of the Great Plains, where land use is primarily dominated by agriculture, the changes associated with contemporary land cover and land use changes have been influenced by both anthropogenic impacts and inter-annual weather variability (Auch *et al.* 2011). Additional factors include erosion control, water quality, farm ponds, water access for livestock and wildlife, recreation, and the safety of nearby homes and transportation corridors in the event of a flood.

Watershed districts in Kansas occupy places along a significant precipitation gradient between eastern and western parts of the state, and also vary in their transition from rural to urban landscapes. A 2011 study on water quality in the U.S. Midwestern Heartland Regions (Missouri, Kansas, Iowa and Nebraska) identified the differences in perceptions between urban, rural non-farm and rural farm residents (Hu and Morton 2011). The study found that individual perceptions differ which also influenced the way societies interact with nature (Hu and Morton 2011). Urban residents in these Midwestern states identified watershed conservation issues as more prominent compared to rural areas and that rural residents tended to be more focused on utilitarian or economic objectives such as agriculture (Hu and Morton 2011).

In areas, like Kansas, where a watershed district might cover 4-5 counties, the issue of geographic representation becomes an issue. Differences in population distribution throughout the watershed can also create local stakeholders who are likely to have different perspectives on the more important needs of the district (Chess, Hance, and Gibson 2000).

GIS and Spatio-Temporal Models in Watershed Management Applications

Capabilities provided by GIScience help enable more effective watershed management. The ability to use spatial overlays to update and/or produce new geographic information to establish spatial relationships and delineate buffer zones in a specified area (Yuan 1999), such as watershed districts, is important to understanding the overall concept of watershed management in Kansas. Natural resource agencies often propose the use of geographic information systems (GIS) to run models capable of predicting pollution or land use changes to address water quality problems (Lovejoy 1997). The use of spatio-temporal models provides an understanding of how objects, such as watershed structures, 'behave' in reality (Renolen 2000). Learning more about spatial and temporal patterns in watershed systems provides an opportunity to anticipate, manage and respond appropriately when watershed districts are faced with modern day challenges, such as droughts, floods and pollution.

Political and Economic Barriers

The Watershed Protection and Flood Prevention Act (PL-566) authorized the United States Department of Agriculture – Natural Resources Conservation Service (NRCS) to assist local organizations. That help included technical and financial assistance in planning and implementing watershed projects, to include flood prevention, damage reduction, habitat enhancement, environmental restoration and recreational opportunities. These political, economic and social structures have been essential in the establishment of watershed groups and their dams throughout Kansas.

Political

Since 1995, there has been a noticeable emphasis on ecosystem services and management by local, state and federal agencies who have tried to address environmental challenges that require new planning strategies (Barham 2001). Environmental regulations are often seen as decisions made by federal and state government agencies who seem to exude power over individual resources users and local businesses (Sabatier 2009).

Water's status as a valued resource brings it into the domain of politics, where individuals and groups struggle for control in decision making and to have their values become more paramount (Blomquist and Schlager 2005). An implied greater local control over efforts to achieve a balance between society and nature (Barham 2001) has changed the political agenda for watershed districts. The involvement of government agencies plays a significant role in reinforcing environmental services and in the success of watershed planning and implementation (Chess, Hance, and Gibson 2000). Unfortunately, a lack of funding, an increase in regulation restrictions and requirements, and the involvement of multiple government agencies have put a damper on watershed district activities. Addressing different interest groups and stressing partnerships across local, state and federal agencies requires all or part of a more holistic or integrated form of planning (Barham 2001).

Economic

Funding for many watershed districts comes from local taxes. As part of their decision-making authority, Kansas watershed districts were granted the authority to levy local taxes and assessments within the limitations of the Kansas Watershed District Act (KSA 24-1209). The funds acquired were used to help a) build small dams; b) create works of improvement for

conservation, utilization and disposal of water; and c) assist in the administration requirements of the watershed districts.

Contemporary concerns include getting access to the financial resources necessary to maintain the safety of existing dams. Decreased funding has been one of the major impacts to effect watershed district management. In addition, policies and regulations have impacted watershed districts through new agency rules and government regulations, putting up the so called "red tape" that inhibits new construction.

Social Capital

Social capital includes the sharing of information and an agreement on behavioral norms. Other aspects of social capital include enforcement of rules and monitoring resource conditions. For centuries, shared knowledge within a watershed contributed to the understanding of watershed management (Barham 2001). By creating a sense of belonging within a watershed community, perception of local conditions and context generates a sense of environmental responsibility which increases local knowledge and community awareness (Barham 2001). A combination of understanding local perception, examining the relationships among local stakeholders and government agencies, and identifying the collaborative approaches necessary to adapt to behavioral changes and societal acceptance are a foundation of successful watershed districts.

Local Perceptions

Humans perceive the environment around them and recognize changes in condition and connections over time (Tuan 1976). Local perception plays a major role in identifying management activities that can or cannot be accomplished by the watershed district. Ranging

from farm to urban populations, there is a variety in overall perceptions of how water should be managed, and who should be managing it. Differences stem from the varying expectations held by stakeholders over who is responsible for solving water problems (Hu and Morton 2011): "this suggests that acceptable solutions to water issues and decision about who will implement them may require more public dialogue and negotiation than other issues" (230). Although differences in perception vary among regions, the overall concern about water accessibility and management has created an opportunity for local residents to become more involved in complex decision making over social and environmental problems (Hu and Morton 2011). Hu and Morton (2011) suggest that differences in perception aid in the decision making process where the population has the ability to offer local knowledge and experience making local knowledge an integrative approach in addressing watershed management. Understanding "people's general knowledge, awareness, and believes about water" is a first step in pace-based management efforts among stakeholders (Hu and Morton 2011, 218).

A Love-Hate Relationship: Local Stakeholders and Government Agencies

The diversity of people living in different parts of these watershed districts may account for different perspectives (Chess, Hance, and Gibson 2000). Different thoughts related to the human-environment relationship influence the way stakeholders perceive their role in watershed districts. For the purpose of this research, a stakeholder is defined as a person, group or organization that has an interest or concern in Kansas watershed districts. This list includes local landowners, residents and business owners within the district, watershed district board members, the State Association of Kansas Watersheds (SAKW), Kansas Department of Agriculture – Division of Conservation (DOC), Kansas Department of Agriculture – Division of Water Resources (DWR), and the USDA Natural Resources Conservation Services (NRCS).

A unique perceptual divide often exists between landowner participation and government involvement in watershed districts. This divide creates an additional component in understanding the varying perceptions of watershed management at the local level. Some research openly involves the government's interpretation of watershed development and management, and seeks interviews from government officials in an attempt to understand their perception of watershed management at all levels. Yet other opinions, such as those expressed in the "wise use movement" are founded on the protection of private property from excessive environmental legislation (Brick 1995).

Interviews with state and federal agencies provide information on erosion, land degradation, and other forms of watershed management. Strategic interview questions provide the ability to influence local residents' perceptions on understanding trends concerning the current state of watershed management at their local level. Government agencies involved in watershed management commonly assist in creating and enforcing laws in regards to conservation practices, reducing pollution before it reaches the river, and addressing water use for agriculture (Mahesh *et al.* 2015). Developing a strong relationship where farmers and landowners are able to share the vision held by researchers and practitioners is vital to the success of a watershed district (Enloe *et al.* 2014).

Collaborative Watershed Approaches

Watershed management partners including environmental and agriculture organizations have collaborated in an effort to "improve environmental performance" while preserving "farmer well-being" (Enloe *et al.* 2014, 149A). Collaborative watershed approaches now include 1) the use of hydrographic boundaries over political ones, 2) stakeholders from multiple agencies and levels of government and community, 3) face to face interactions among participants, 4)

articulated goals to find common solutions in economic, social and scientific interests, and 5) the combination of scientific facts with local knowledge (Smith 2013). Collaborative partnerships form as organizations of people who share a common interest addressing policies associated with management issues (Sabatier 2009). Watershed districts are a key example of collaborative partnerships, as a group of volunteers who work together to address water resource issues in their area. In order to develop and/or implement policies, collaborative partnerships have regular meetings, without the facilitation of an outside party (Sabatier 2009). Assuming that watershed partnerships will continue to play a prominent role in natural resource management research, the objective is to identify the primary factors that promote successful partnership outcomes yet recognize the importance of local circumstances in understanding success (Leach *et al.* 2001)

Participation in Watershed District Boards

In Hardin's (1968) essay *The Tragedy of the Commons,* a scene is played out in which individual interests lead to the destruction of a common grazing ground for cattle. Perhaps it is the idea of a common resource pool that causes a need to understand the relationship between environmental policy collaboration and implementation (Smith 2013). An important concept of collaborative partnerships is that all relevant issues are represented effectively and that each stakeholder group has the ability to influence process and outcomes (Sabatier 2009). In a study conducted on 76 watersheds in Kansas, Sabatier found that overall federal and state agencies have the greatest influence on collaborative partnerships followed by local agencies, then resources users and environmentalists (Sabatier 2009).

The emphasis placed on collaboration among the "right people" in the "right way" is crucial in the effectiveness of watershed management (Chess, Hance, and Gibson 2000). Part of finding the right people in the right away can be connected to the level of public awareness about

water resource issues within the area. It is suggested that public outreach is likely to be more effective when tied to specific outcomes rather than widely circulated information that seems to carry little meaning to the general public (Chess, Hance, and Gibson 2000). Still, government involvement over private property is more than enough to detract even the most educated landowner. In an example of a watershed in Ohio, farmers refused to adopt practices that did not show a direct benefit to increased farm income (Chess, Hance, and Gibson 2000).

However, there seems to be a disconnect between the members who make up the watershed district board, and the agencies that are involved in shaping key decisions regarding the watershed districts. Government participation can have a significant impact on the watershed district in terms of successful planning, implementation, and funding (Chess, Hance, and Gibson 2000). Board member selection faces a key number of factors including, demographic diversity, geographic diversity, and participants as positional or reputational representatives (Chess, Hance, and Gibson 2000). The confidence of watershed district boards who felt they had representation from individuals "occupying important official positions" are more likely to be better informed and therefore more active in water resource issues (Chess, Hance, and Gibson 2000).

Despite being an all-volunteer organization, the time commitment required for board members can be quiet extensive. In fact, the "planning and implementation for watershed management" can span over decades causing once interested parties to lose interest (Chess, Hance, and Gibson 2000). Time commitments can be frustrating whether they are seen as short-term (a quarterly meeting which might last up to an hour or more) or long-term (a lifelong commitment) for even the most dedicated participant. It has been suggested that, where controversial issues are low, low participation and interaction may be key to the success of that watershed program (Chess, Hance, and Gibson 2000).

The two most frequently identified keys to success are funding and participation by an effective leader. Effective leadership typically includes an understanding of the importance of participants who are cooperative and committed to the process and who trust the other members (Leach *et al.* 2001).

The struggle for active participation in watershed districts is dependent on getting the "right" kinds of participation which may require different involvement at different stages of watershed management efforts (Chess, Hance, and Gibson 2000). The lack of relevant education and proper training for watershed initiatives has caused some districts to struggle with maintaining their board members. However, even the optimal combination of factors may not overcome passivity, disinterest, distrust of government, or fundamental value conflicts (Chess, Hance, and Gibson 2000).

Summary

Since the passing of the Kansas Watershed District Act in 1953, Kansas residents have experienced the ups and downs of resource management at the local level. Although, watershed management dates back to the 1880's, organized watershed management in Kansas is still a relatively new concept. Kansas' agriculture-dominated economy has forced local stakeholders to reevalute the sustainabilty and success of watershed strutures in their district. Going beyond an integrated water resource management approach and understanding the dynamics of human-coupled water systems is the next step in addressing the anthropogenic impacts within watershed districts. Rules and regulations are an important part of the social capital needed for successful local resource management (Pretty 2003), including better management practices. Better management practices require "integrated, multifaceted approaches" (Barham 2001, 181).

Accomplishing these approaches begins with examining the way in which humans have decided to delineate watershed district boundaries and make transformations on the landscape. Applications such as GIS and spatio-temporal models are critical to understanding how watershed structures behave in realitly without the influence of econmic and politcal factors. Local perceptions of aid and hinderance in regards to watershed management will need to be addressed in order to improve participation in watershed district boards, to assess statuses of watershed districts and to communicate to locals about the benefits and efforts of watershed district efforts.

Chapter 3 - Data and Methods

Data Collection

Data collected to address the research questions were derived from three main sources: archival research, interviews and surveys, and geospatial data from the State of Kansas. Each source played a role in addressing specific research questions on economic, political, social and geographical inquiries related to watershed districts. First, Archival research of general plans were used to examine economic variations and differences in spatial factors among watershed districts. Interviews and surveys were used to understand the economic and social perceptions of local stakeholders. Lastly, geospatial data was used to further examine and illustrate spatial factors, such as differences along the precipitation gradient, urban vs rural populations, and land use conditions.

Archival research was based on documents collected through local watershed districts and; state agencies (Kansas Department of Agriculture, Division of Water Resources; Kansas Department of Agriculture, Division of Conservation¸ State Association of Kansas Watersheds) as well as NRCS (Natural Resources Conservation Service). Two types of archival documents were used in this study, the first being a voluntary collection of documents provided by the watershed district and the second, a required legal document necessary for the establishment of the watershed district, known as a 'General Plan.' Select watershed districts were able to provide historical data exploring the social, economic, and environmental aspects unique to their district particularly during the initial development years. Watershed districts that developed historical documents did so as part of their own interest in either establishing their watershed district during its initial formation or as a collection of documents over years that told the story of their district. Each watershed districts is required to create a general plan pursuant to the

requirements of the Kansas Watershed District Act. The general plan details the cost of the installation, operation and maintenance of the proposed works, and information as to the location and extent of areas that benefit from the proposed works (General Plan, Nemaha Brown Watershed Joint District No. 7 1978). Proposed works include floodwater retarding structures, detention dams, and stream channelization.

In addition to archival research, a series of 21 interviews were conducted between November 2014 and June 2015 with local stakeholders, which included watershed district board members, landowners, and representatives from the a) Division of Conservation (DOC) and Division of Water Resources (DWR) of the Kansas Department of Agriculture, b) USDA Natural Resources Conservation Services and c) the State Association of Kansas Watersheds. An analysis was also conducted on a questionnaire developed by State Association of Kansas Watersheds (Appendix C) which was distributed to watershed districts during the fall of 2014. An initial SAKW questionnaire was sent to watershed districts, followed up by visits from a SAKW, NRCS, or KDA representative to watershed districts in an attempt to get a complete response from all 80 watershed districts. The questionnaire asked watershed district leaders to detail the status of the board member size, board member activity, and to give an update on any changes that had occurred since their last amended general plan. A 3-point Likert scale item was also included, so that watershed districts could indicate the challenges they found significant within their district. Respondents were asked to rate a series of 30 challenges, identified by SAKW, as a significant challenge, a manageable challenge or no challenge at all.

The Kansas Data Access and Support Center's data on demographics, watershed district boundaries, ecoregions, transportation points and routes, and water resources throughout the state

were obtained. These GIS data resources were used to examine the social aspects of Kansas watershed districts.

Archival Research

General plans and other relevant documents such as maps, newspaper articles, and watershed district board newsletters, were used to extract data that would be useful in updating economic values, validating watershed district boundaries, identifying the demographics and land cover/land use during the initial development of the district. DWR houses more than 100 proposed general plans from local watershed district boards in Kansas. For the purposes of this study, data were retrieved from the 80 current and active watershed districts. A watershed district was no longer considered active, if they did not meet the requirements of an active board (i.e. legal number of board members, consistently holding annual and quarterly meetings) or, if they were no longer maintaining dams as a result of either lack of interest or in order to allow the dam site to return to a natural state. Of the 80 general plans that were reviewed, no two were alike because of the variation in Kansas watershed districts across the state. General plans for watershed districts have been developed over time between 1953 and 2011. It stands to reason that as policies started to change, so, too, did the requirements that were expected to be covered in the general plan. Watershed districts across the state cover a wide range of ecosystems, which are a direct result of changes in precipitation and physiography. Physical changes are perhaps one of the most evident transitions among watershed districts.

Another component of the general plan is identifying how the watershed structures proposed will be financed. Watershed districts have the option to apply for either state or federal cost-share assistance. In instances where federal assistance was received, a watershed district might have one or more subset work plans. These subset work plans are set up the same way as

a general plan but are created because of the criteria necessary to obtain federal funding. In some of the larger watershed districts, it is necessary to create several sub-watersheds in order to receive federal funding.

General Plans vs Work Plans

In the event that a watershed district seeks federal assistance under PL-566, NRCS requires the watershed district to create a 'work plan.' Work plans are unique to NRCS and must meet criteria set forth by the National Watershed Program Manual (NWPM). Like a general plan, a work plan includes the detailing of proposed structures with associated benefits and costs to the watershed district area. To receive funding under PL-566, the watershed district must meet certain criteria in regards to district size, capacity of a single structure, and percentage of agriculture related benefits. Under the NWPM, watershed districts cannot exceed an area greater than 250,000 acres. State approved watershed districts seeking federal assistance that have a general plan but exceed 250,000 acres, are required to create sub-watersheds through work plans. In addition to the maximum acreage allowance, a single watershed structure cannot provide over 12,500 acre-feet of floodwater detention capacity or more than 25,000 acre-feet of total capacity. At the completion of the structure, the agriculture-related benefits must account for at least 20% of the total benefits of the project.

Watershed districts are assigned certain nomenclatures to indicate the number of counties within the district's boundary. If a watershed district covers more than one county, it is considered to be a 'watershed joint district (WJD). Watershed districts that exist within a single county is a 'watershed district' (WD). An example of a state watershed district that created sub-watersheds in order to receive federal funding is Delaware WJD No. 10 which includes 8 different sub-watersheds: Grasshopper Coal, Nebo, Elk, Spring Straight, North and South Cedar,

Walnut *et al.*, Rock *et al.* and Big Slough *et al.* Currently only three of those watershed districts include federally funded watershed structures (Grasshopper Coal, Nebo and Elk). Eleven of the 80 organized watershed districts currently have work plans managed by NRCS (Table 3.1).

Table 3.1: Sub Watershed District
(Source: Table by author; data from general plans and work plans)

Watershed District	WD/WJD	No.		Watershed District	WD/WJD	No.
Delaware	**WJD**	**10**		**Upper Walnut**	**WJD**	**33**
Elk Creek	SUB			*North Sector*	*SUB*	
Nebo	SUB			*South Sector*	*SUB*	
Grasshopper Coal	SUB			**Wakarusa**	**WJD**	**35**
Elk River	**WJD**	**47**		*Upper*	*SUB*	
Upper	SUB			*Lower*	*SUB*	
Lower	SUB			**Wet Walnut Creek**	**WJD**	**58**
Nemaha-Brown	**WJD**	**7**		*Wet Walnut No. 1*	*SUB*	
Upper Delaware and Tributaries	SUB			*Wet Walnut No. 2*	*SUB*	
Salt Creek	**WJD**	**46**		*Wet Walnut No. 3*	*SUB*	
Upper	*SUB*			*Wet Walnut No. 5*	*SUB*	
Lower	*SUB*			**Whitewater River**	**WJD**	**22**
Twin Caney	**WJD**	**34**		*Whitewater West*	*SUB*	
Twin Caney	*SUB*			*Whitewater East*	*SUB*	
Middle Caney	*SUB*			**Wolf River**	**WJD**	**66**
Upper Black Vermillion	**WJD**	**37**		*North-Middle Forks Wolf*	*SUB*	
Upper Black Vermillion	*SUB*			*South Fork Wolf*	*SUB*	
Irish Creek	*SUB*			*Squaw Creek Lower Wolf*	*SUB*	
North	*SUB*					

Work plans can be designed to accomplish the task of the proposed general plan. These watershed districts can be identified as 'federal' districts (Appendix A) where all watershed structures were completed with federal funding. Since work plans may also act as a subset of the general plan, it is possible for a) several plans to exist within one organized district, b) the work plan to be considered a completed project by NRCS despite other structures remaining to be built in the general plan or c) the work plan to complete the objective of the general plan. In 2014, NRCS approved a total of 63 work plans under P.L. 566 among the 80 watershed districts. Of

the 63 work plans, 48 are complete and 15 are active pending additional funding and construction.

Format of General Plans

Each general plan was formatted into five main categories: characteristics of the district, nature of soil and water problems, works of improvement to be installed, financial costs, and the provisions for operation and maintenance. The characteristics of the district often included a history of the district's formation, a description of the physical characteristics in the area such as annual precipitation and topography, economic and social characteristics that included land use and population, fish and wildlife found in the district, and possible or current uses of recreational areas. Analysis of the physical characteristics of each watershed district was important in addressing the fourth research question about spatial factors relevant to watershed management.

Watershed district data on annual precipitation, the economic impact on populations and variances in land use were all drawn from the 'district characteristics' portion of the general plan. The accumulated total of flood and related damages sustained annually in the watershed district was extracted from the second data category of the districts' general plans, the 'nature of soil and water problems.' Damages from floodwater, erosion, and sediment were taken into consideration, as well as drainage, irrigation and/or municipality concerns with water quality and distribution. The 'works of improvement to be installed' section of the general plans was used as a basis for the third category of data. The works of improvement includes a) the number of proposed watershed structures for floodwater retarding-grade stabilization, b) multipurpose structures providing municipal and industrial water and recreational facilities and c) for detention grade stabilization. In most cases, floodwater retarding-grade stabilization structures were proposed with the intent to receive federal funding while detention grade stabilization structures

were proposed to enable receipt of state funding. While some districts have watershed structures built with assistance from solely one entity, it is not uncommon for watershed districts to receive both state and federal assistance in addition to their own monies accumulated through local tax levies. Structure data which details detention storage, sediment storage and drainage extent are also included in a general plan under the works of improvement.

Financial costs covered in the fourth section of the general plan lay out the shared costs for the installation of each watershed structure and/or other measures. Shared costs can be taken on by one or more agencies, but are most commonly associated with either NRCS or KDA-DOC, the watershed district and the landowner.

The combination of data on works of improvement and on financial cost was used to determine the benefit/cost ratio for the watershed district. Assigning monetary values to benefits, allowed watershed districts to develop benefit/cost ratios in order to determine whether or not a watershed structure should be built. In order for a structure to be built the benefit/cost ratio has to exceed 1.0:1.1, meaning that the proposed watershed structures within the district would provide enough benefit to offset the cost endured by the community. Prior to the mid 1980's, general plans developed benefit/cost ratios based on the assumption that all the watershed structures proposed would be completed. After the mid 1980's, watershed districts started to incorporate benefit/cost ratios on a per structure basis.

Determining Benefits

How watershed districts justify the need for more watershed structure through the use of benefit/cost ratios was addressed in an effort to answer the first research question about economic variations over the past 60 years and effectives of watershed districts. The question was addressed by calculating benefit/cost rations for current economic conditions (2014).

Information on economic value in 2014 allows a discussion related to whether or not stakeholders can afford to keep building watershed district at rising costs and whether a lack of economic stability and incomplete development of watershed districts will impact the safety of Kansans.

Benefits represent costs or damages that would occur in the absence of the project (KLA Environmental Services 2014). Benefits listed in the general plans are categorized into two main categories as monetary benefits and flood damage reduction benefits. These benefits are identified by the watershed district in the general plan. Monetary and flood damage reduction benefits are then broken down into primary (direct) and secondary (indirect) benefits. Primary benefits include **reduced flooding** in cropped fields, pastures, and other agriculture areas, and of transportation routes and **reduced erosion** in terms of sediment damage, gullying, swamping, and floodplain scour. Secondary benefits include the cost saved for transportation, and the processing and marketing of agricultural commodities. Secondary benefits might also include recreation that is brought into the area in the form of hunting, fishing, camping, and boating as well as the fish and wildlife that benefit from a more reliable water source.

In addition to the monetary and flood damage reduction benefits, SAKW identified non-monetary benefits to bring awareness to the benefits provided by watershed districts. Non-monetary benefits are mentioned within the general plan, however they are not identified in the same way monetary and flood damage reduction benefits are categorized. Non-monetary benefits include the number of direct beneficiaries, transportation systems, and the enhancement of water and riparian habitats that exist within the watershed district. There are three important caveats to be aware of regarding determining benefit amounts. First, the benefit figures are only accurate when all the structures are completed. Second, flood damage reduction benefits and

monetary benefits account for all of the proposed structures in the general plan. Third, land use/land cover changes are not built into the calculations of a modern value.

Non-Monetary Benefits

Non-monetary benefits include the number of direct beneficiaries that live within the watershed district. Watershed structures have been referred to as "silent protectors" as they withhold floodwaters from the households, roads, and bridges that people use every day. Using U.S. Census (2011) data, the number of residents including the number of farms, ranches and households were determined per watershed district.

Monetary Benefits

Monetary benefits from improvements designed by the watershed district's engineer recognize both agriculture and non-agriculture enhancements following the construction and efficacy of the project. The most common types of monetary benefits can be subdivided in agricultural and non-agricultural (Table 3.2).

Table 3.2: Types of Monetary Benefits

Agriculture	Non-Agriculture
Agriculture Water	Reservoirs
Changed Land Use	Municipal and Industrial Water Supply
Ephemeral Streams	Environmental Enhancement
More Intensive Land Use	Water-based Recreation
Off-Project/Outside Watershed	Redevelopment
Domestic and Livestock Water	Rural Fire Protection
Tributary	Misc., Incidental and Secondary Benefits
Stored Water Use	Water Quality
Recharge	Stream Fishery
Groundwater Recharge	
Conservation Benefits	

Flood Damage Reduction Benefits

Flood damage reduction benefits proposed in each general plan outline the potential dollar amount saved within the watershed district as a result of the installed watershed structures. All flood damage reduction benefits are separated by whether they are providing agriculture or non-agricultural benefits. The most common flood damage reduction benefits found in the general plans reviews shown in Table 3.3. With over 45,000 farms (US Census of Agriculture 2012), agriculture is a key component of the state's economy.

Table 3.3: Most Common Flood Damage Reduction Benefits

Agriculture	Non-Agriculture
Crop and Pasture	Forestry
Erosion/grade stability	Silt and Debris Deposition
Floodplain Land Damage	Oil Damage
Indirect Damage	Sediment Damage Overbank Deposition
Noxious weeds	Road, Railroad and Bridge
Other Agriculture	Urban and Indirect

Price/Cost Indices

Since watershed districts were formed in different years, it is necessary to adjust the cost and price figures of the average annual benefits to reflect current values using price/cost indices. Determining watershed values are a challenge due to the different ways that General Plans were put together over time. The implication of these differences is coming up with modern stats that can compare the average annual benefits across the state. In order to determine benefit/cost ratios, watershed districts used different amortization rates to account for the benefits the watershed structures were projected to receive over time. Amortization rates differ between years and among states. The most effective way to adjust the original price base used in the general plan to a 2014 current value involves, a series of indices that were provided by KLA Environmental Services of Salina, KS.

Updating these index values was based on a Project Benefit Analysis for a watershed work plan in Pine Creek Watershed, Scott County, Tennessee in August 2014 by KLA Environmental Services. KLA Environmental Services is an engineering, agronomic and environmental consulting firm which provides personalized assistance to agriculture producers, landowners, municipalities and other natural resource users to help with issues concerning soil, water, and environmental regulations (KLA Environmental Services). Instead of using hydrologic and economic evaluations, indices were used to update the benefits to Price Base 2014 consistent with tools provided at the NRCS Economics website (Project Benefit Analysis 2014). The following sources were used for this method:

- http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/tools
- USDA-National Agricultural Statistic Service, Quick Stats Ad-hoc Query Tool (See Appendix F)
- Engineering News Record, Construction Cost Index History
- Consumer Price Index-All Urban Consumers (See Appendix F)

Benefits listed in the general plan are based on a price base prior to the approval of the plan. A general plan approved in 1979 would use a 1978 price base. If a price base was not listed within the General Plan, the year the general plan was proposed was used as the price base. Proposal date is indicated on the cover page for each watershed. Through the years, a watershed district may have added, moved, or deleted structures from the plan and would have recalculated their adjustments using the latest price base. In cases where amendments made significant changes and affected the benefit dollar amount, the last price base used in the general plan was updated to reflect the current value of the benefits. The economic indices listed Table 3.4 was used to calculate the original price base from each watershed district's general plan to the 2014 price base. A complete listing of index values can be found in Appendix C.

Table 3.4: Price Base 2014

Prices received by farmers	PRF	$173.00
Prices paid by farmers	PPF	$225.00
ENR Construction Cost	ENR	$9936.44
Land Value	LV	$1300.00
Consumer Price Index	CPI	$236.15

In the majority of General Plans, an itemized listing of a "Monetary Benefits from Works of Improvement" detail the expected flood damage reduction benefits based on different categories within that district. An example from the Nemaha Brown Watershed Joint District No. 7, Kansas, General Plan (Figure 3.1) illustrates the itemized average annual benefits.

Crop and Pasture Damage Reduction	$ 1,230,000	
Other Agricultural Damage Reduction	490,000	
Flood Plain Scour Reduction	50,000	
Road and Bridge Damage Reduction.	38,000	
Indirect Benefits	35,000	
Secondary Benefits	80,000	
Siltation Reduction into Lower Delaware Valley and Perry Reservoir	65,650	
More Intensive Use of Land Resources	15,000	
Recreational, Environment Enhancement	27,000	
Municipal and Industrial Water Supply	250,000	$2,280,000
Benefits to Development of Kickapoo Indian Reservation. Supplement to Above Listings.		
Municipal and Industrial Water	$ 450,000	
Supplemental Irrigation	125,000	
Recreational, Environmental Enhancement	80,000	$ 656,000
Annual Benefits Total		$2,936,650

Figure 3.1: Nemaha Brown WJD No. 7 Average Annual Benefits

Each item listed on the works of improvement within in the General Plan was then assigned an index based on examples from the Project Benefit Analysis by KLA Environmental Services and in consultation with representatives from NRCS, DWR, DOC and SAKW. Using economic indices provided by KLA Environmental Services, data from the original price base were obtained and estimates of the 2014 price base were determined. An example from Nemaha Brown WJD No. 7 is used again to show how the original 1978 price base data were updated to a 2014 price base (Table 3.5). The index from the price base year was determined by dividing the original price base by the 2014 value. That new index number was then multiplied by the original value of each itemized listing. This method was used to update the average annual benefits for all 80 watershed districts.

Table 3.5: Updated Average Annual Benefits for Nemaha Brown WJD No. 7 (Source: Table by author; data obtained from General Plans and Economic Indices)

Item	Price Base 1978	Index Code	1978 Value	2014 Value	Index 1978	Updated Benefits
Crop and Pasture	$1,230,000	PRF	79.31	173	2.18	$2,683,016
Other Agricultural	$490,000	PPF	62.07	225	3.62	$1,776,220
Road and Bridge	$38,000	ENR	2776	9936.44	3.58	$136,018
Secondary	$80,000	CPI	65.2	236.15	3.62	$289,755
Siltation Reduction into Lower Delaware Valley and Perry Reservoir	$65,650	ENR	2776	9936.44	3.58	$234,988
More Intensive Use of Land	$15,000	LV	418	1300	3.11	$46,651
Recreational, Environment Enhancement	$27,000	CPI	65.2	236.15	3.62	$97,792
Water Supply	$250,000	CPI	65.2	236.15	3.62	$905,483
Erosion Flood Plain Scour	$50,000	LV	418	1300	3.11	$155,502
Indirect	$35,000	CPI	65.2	236.15	3.62	$126,768
Kickapoo - Municipal and Industrial Water	$450,000	CPI	65.2	236.15	3.62	$1,629,870
Kickapoo - Supplemental Irrigation	$125,000	PPF	79.31	225	2.84	$354,621
Kickapoo - Recreational, Environmental Enhancement	$80,000	CPI	65.2	236.15	3.62	$289,755
Total	**$2,935,650**					**$8,726,438**

Conversations with Stakeholders

Exploring perceptions of individuals associated with watershed management and/or development has been addressed across a breadth of qualitative research methods, from surveys to focus groups. Qualitative methods allow the researcher to capture phenomena occurring in and around a specific time and place while attempting to understand the perceptions and relationships that exist within those conditions. Interviews are often used in accompaniment with environmental histories, local policies, and media analysis to uncover the complexity of watershed management issues and the various ways of perceiving them (Rudestam 2014). Choosing interviewees with relevant stakeholder positions is the most common approach in understanding the perceptions of watershed management and development. In a study conducted by Rudestam (2014) in the Willamette Basin of the United States Pacific Northwest, she chose to interview "only those whose livelihoods are directly connected to various aspects of the local water supply" (25). A combination of in-person interviews and the survey sent out by SAKW in 2014, was used to address research questions 2 and 3 about how local stakeholders perceive state and federal policies and how social capital issues played a role in Kansas watershed district efficacy**.** The data obtained from both the interviews and survey can address social capital issues by understanding local perceptions, relationships between landowner and government, examining new watershed approaches and evaluating participation on watershed district boards. Social capital is a key component of understanding the other half of socio-hydrology, which is the people side. The dynamic interaction that exists between hydrology and society cannot be explained without addressing aspects of social capital.

Sampling

Sampling methods were chosen based on the goal of the study to understand and tell the story of Kansas watershed districts. Four different types of sampling as identified by Teddlie and Yu (2007), include probability, purposive, convenience and mixed methods. A combination of purposive and convenience sampling was used for both the interviews and mailed-out surveys that contributed to the data collected in this study. Purposive sampling consists of four broad categories: 1) sampling to achieve representativeness or comparability, 2) sampling special or unique cases, 3) sequential sampling, and 4) sampling using multiple purposive techniques (Teddlie and Yu 2007). The survey sent out by the State Association of Kansas Watersheds, with assistance from KDA and NRCS, used the first broad category in purposive sampling: sampling to achieve representativeness or comparability. In this case, SAKW produced a three page questionnaire (Appendix G) asking watershed district board members to identify challenges on a 3-point Likert scale, as well as to identify the current status of the watershed district. Initially, questionnaires were sent out to all 80 watershed districts. Districts that did not respond by the January deadline had follow-up reminders and/or visits from representatives of the agencies that assisted in the development of the questionnaire.

The primary sampling method used for the interviews in this study was a combination of purposive sampling, using a type of sequential sampling technique called snowball sampling, and convenience sampling. Sequential sampling is used when the goal of the research project is to generate theory or when the sample evolves of its own accord as data is collected (Teddlie and Yu 2007). Four types of sequential sampling (theoretical, confirming and disconfirming, opportunistic, and snowball sampling) allow the investigator to sample people, institutions, documents or wherever the theory leads the investigation (Teddlie and Yu 2007). Initial

interaction with the State Association of Kansas Watersheds provided a list of names that they SAKW representatives thought would be useful in identifying a wide array of opinions among the district representatives. At the end of each interview or meeting, participants were asked to provide the name of someone they thought would be useful in providing additional information about watershed districts. In addition to snowball sampling, convenience sampling was used to draw on samples that were easily accessible and willing to participate in the study (Teddlie and Yu 2007). Participants were selected based on their willingness and availability to participate in an interview. The KDA website contains a listing of all watershed district board members, along with contact information for at least one or more of the board members, from which the convenience sample was drawn. Initial contact was made with a member of each watershed district board through either phone or e-mail between October and December 2014. Follow up phone calls and e-mails were continued throughout the research period (October 2014 – July 2015) in an attempt to reach out to all watershed district board members who might be interested in an interview over the formation, development and current status of their respective board.

A wide range of stakeholders were interviewed: participants included local landowners, board members, contracting officers, and representatives from DOC, DWR, NRCS, and SAKW. Interviews were conducted in various settings, such as the landowner's property, the site of watershed structure, within the home of a member or in a building used by the watershed district for quarterly and annual board meetings, and took place mostly in the eastern half of the state (Figure 4.15). The interviews were one-on-one, and generally lasted an average of 30 minutes, with variation of some participants who completed the interview in as little as ten minutes or as long as two hours. Interviews were not limited to one location and often included a tour of local

watershed structures either during or after the interview was completed. Each interview was recorded and transcribed for analysis in *NVivo 10.*

Twenty-one interviews were conducted between March and July 2015. Participants discussed watershed districts with which they were personally involved, covering 21 different watershed districts across the state. Three main limitations affected the interview process. First, the contact data were not completely up to date. There were several members who were listed on the directory but were no longer active with the board, or the information led to incorrect numbers or disconnected telephone lines. A second limitation was attempting to conduct interviews during peak agricultural times. A significant number of watershed district board members are landowners and farmers who rely heavily on the weather and seasons for their livelihoods. Interviews were often limited to periods when farmers were not in the process of harvesting, planting, or in preparation for either one. Contacting board members during peak agricultural times was one of the major limiting factors. The last limitation was the restriction of a 9-month research period, which affected time frames in which both parties would be available to meet.

Coding

Coding was used to identify common themes and patterns among stakeholders of Kansas watershed districts. Codes were based on the interview discussions and survey responses (Table 3.5). Each interview was transcribed and then manually coded for themes using the QSR International software *NVivo 10*. Auto code was used, with the instructions to follow the coding process that had already been established manually. Each time a participant used a specific word or theme that had already been identified as important, their comments were coded. In each case, an entire quote was coded, so context helped with identification of codes. For instance, the

code ‘permitting challenges’ were often connected to references of “404” or “COE Permits.” After the codes/themes were established, a word query was used to determine the number of times a word was used (e.g. “third party easements,” “government red tape,” “endangered species”). The SAKW questionnaire was analyzed using *NVivo 10* to identify common themes that would be useful in formulating the story of Kansas watershed districts (Table 3.6). Bold entries indicate major themes.

Table 3.6: Themes and codes applied to interviews and surveys

Climate	***Involved Agencies***
Economic	EPA
Financial Limitations	Fish and Wildlife
Flood Insurance	Historical Society
Infrastructure	Understaffed
Property Value	Recreation
Tax base	Wildlife
Landowner Acquisition	**Board Health**
Life of Structures	Board Participation Challenges
Maintenance	Knowledge of Watershed District Functions
Rehabilitation	Member Participation Success
Livelihood	**Family Heritage**
Crop Loss	**Perceptions**
Livestock	Lack of Public Awareness
Major Floods	Landowner Perception
General Flooding	Perceptions of Environmental Policies
Policies	***Perceptions of Landowners***
Corps of Engineers	Owners aware of dam benefits
Attitudes toward mitigation	Owners support the district
Attitudes toward permitting	***Perceptions of Local Support***
Attitudes toward third party easements	Negative Public Support
Environmental Policies	Positive Public Support
Clean Water Act	**Stewardship**
Conservation	**Thriving Community**
Endangered Species	
Groundwater Recharge	

Geographic Information

Physical characteristics described in the Watershed Districts’ General Plans and data provided by the Kansas Data and Spatial Center were collected to address research questions 4:

How do spatial factors relevant to watershed management vary among Kansas watershed districts? Spatial factors relevant to watershed management include variations in the physical environment, perception, land use and population distribution among Kansas watershed districts. Descriptions of each watershed district are listed in the general plan and generally contain information on the location and size, physical data such as annual precipitation, soil textures and topography of the area, and economic data to include major land uses within the district.

Data retrieved from DASC was created by the U.S. Census Bureau as a part of the Decennial Census Program, American Community Survey (ACS). The ACS data is designed to provide current demographic, social, economic and housing characteristics throughout the decade (DASC 2015). ACS provides information on over 40 topics including education, marital status and many more (DASC 2015). The data collected spanned from 2007-2011 and 2008-2012, and uses geographic representation based on TIGER line files (DASC 2015). Overlapping years were used in the data obtained, to cover more topics.

Data were entered into a GIS environment to extract non-monetary benefits that exist within the watershed district. For the purposes of this research, non-monetary benefits include the number of residents, farms, ranches, households, roads, and bridges within a watershed district. Data retrieved from ACS were uploaded into ArcGIS 10.3.3 and then clipped into the watershed district boundaries provided by the Kansas Water Office.

To locate the differences in ecoregions and land uses among watershed districts, national land cover dataset files were retrieved from the Multi-Resolution Land Characteristics Consortium (MRLC) website: http://www.mrlc.gov and from DASC. The National Land Cover Database (NLCD) from 2011 is the most recent land cover product created by MRLC with a 16-class land cover classification (Figure 3.2) scheme at a spatial resolution of 30 meters (MRLC

2015). Spatial references and descriptive data of land surfaces (urban, agriculture and forest) support Federal, State and local, and nongovernmental applications seeking data to understand ecosystem healthy, spatial patterns of biodiversity and to develop land management policies (MRLC 2015).

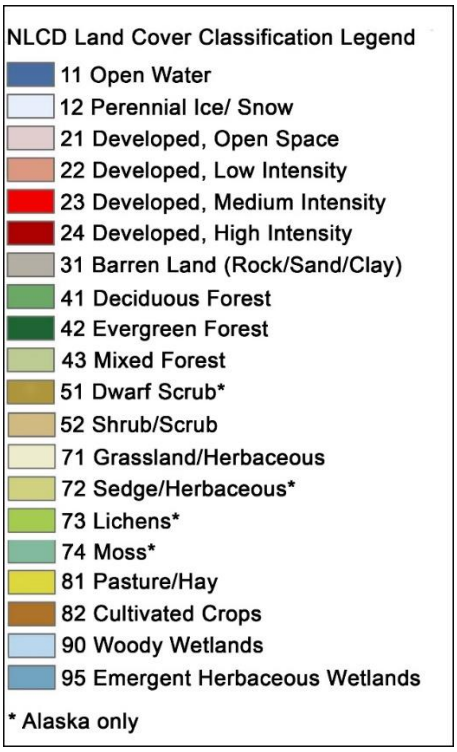

Figure 3.2: NLCD Land Cover Classification Legend (Source: MRLC 2015)

In addition to the NLCD, Bailey's ecoregions were obtained from DASC. Ecoregions serve as a spatial framework to understand ecosystem components in management strategies within the same geographical area (DASC 2015). The four levels in Bailey's ecoregions show a hierarchy of ecosystems. The first level, and largest ecosystems are domains which group related climates differentiated based on precipitation and temperature (NDGIS 2015). Each subsequent level defines ecoregions in further detail. Resource management is dependent on knowing the regional characteristics of the resource and the factors associated with change in the region and with the resource itself (Omernik 2014). The resilience and sustainability of

ecosystems and environmental resources vary regionally, making management decision difficult without understanding the geographic frameworks that are capable of recognizing regional difference at multiple scales or levels of detail (Omernik 2014).

Chapter 4 - Results

Watershed projects were designed with the intent to provide annual flood damage reduction benefits that would aid in protecting infrastructure, agricultural opportunities, and environmental conservation. With technical and financial support from federal, state and local agencies, watershed districts have proposed over 3,000 structures in the 62 years following the Kansas Watershed District Act. A total of 1,539 watershed structures were completed in the organized watershed districts that are active today, with funding agencies being identified as federal, state or other (Appendix A). Structures that were built by the watershed district or without the assistance of state and/or federal funding were considered "other." In 53 instances, a completion date was missing from the watershed structure data and as a result only 1,486 structures were used in the following analysis.

Interview and Surveys

Twenty-one watershed districts were represented in a series of 21 interviews over the course of nine months. In conjunction with the interviews, a questionnaire, developed by the State Association of Kansas Watersheds and their partners, was distributed to all 80 Kansas watershed districts. An initial survey was distributed at the end of 2014, followed up by phone calls and in-person visits from SAKW and state agency representatives. An analysis of 60 watershed district survey responses were conducted in an attempt to understand the effectiveness of watershed district boards and their self-identified challenges in understanding regulations, asking for and receiving funding and producing and filing proper documentation required by their district offices. Not all of the sixty questionnaires were answered in their entirety which accounts for differences in total responses to each question.

In addition to the interviews, the questionnaire developed by SAKW (Appendix C) was also coded for common themes. Coded themes were identified in both the interviews and surveys using *NVivo 10*. An analysis of the transcribed interviews and survey responses identified three major themes among Kansas watershed districts: economic hardships, perceptions of federal and state regulation challenges and aspects of the social capital of local stakeholders.

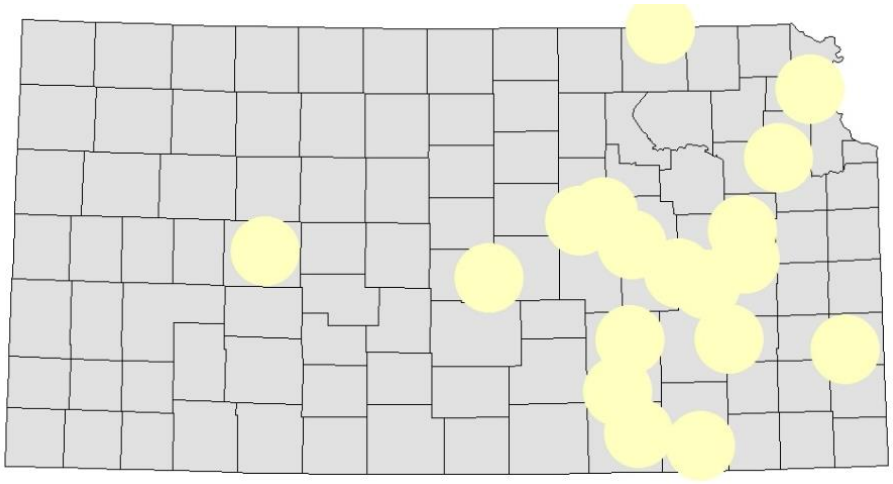

Figure 4.1: Kansas Watershed Districts: Interview Locations
(Source: Map created by author with data obtained from DASC)

Economic Variations and their Impact on Watershed District Efforts

Building Watershed Structures at Rising Costs

By 1965, nearly a decade after the enactment of the Kansas Watershed District Act, the federal government funded construction reached a peak, with the completion of 74 watershed structures within the 80 organized watershed structures of today (Figure 4.2). For the next 25 years, an average of approximately 22 watershed structures were constructed annually. A drop in watershed construction during the 1980's marked the beginning of declining funding by the federal government. A combination of declines in state funding that first became available in 1974 and an increasingly limited federal budget meant funding was no longer able to keep up with the demands for new construction proposed by Kansas watershed districts. From 1991-

2006, federally assisted watershed structures averaged less than 5 per year, until funding for new construction completely stopped in 2007. Even with the introduction of state funding, most funding declined during the beginning of the 21st century. Like the federal government, state funding has decreased significantly since 2011. Today, watershed districts are relying heavily on the monies collected from mill levies in their communities. Both the federal and state governments provided their peak construction support during different periods but have simultaneously displayed a lack of funding available for watershed districts over the last 8 years. (Figure 4.3)

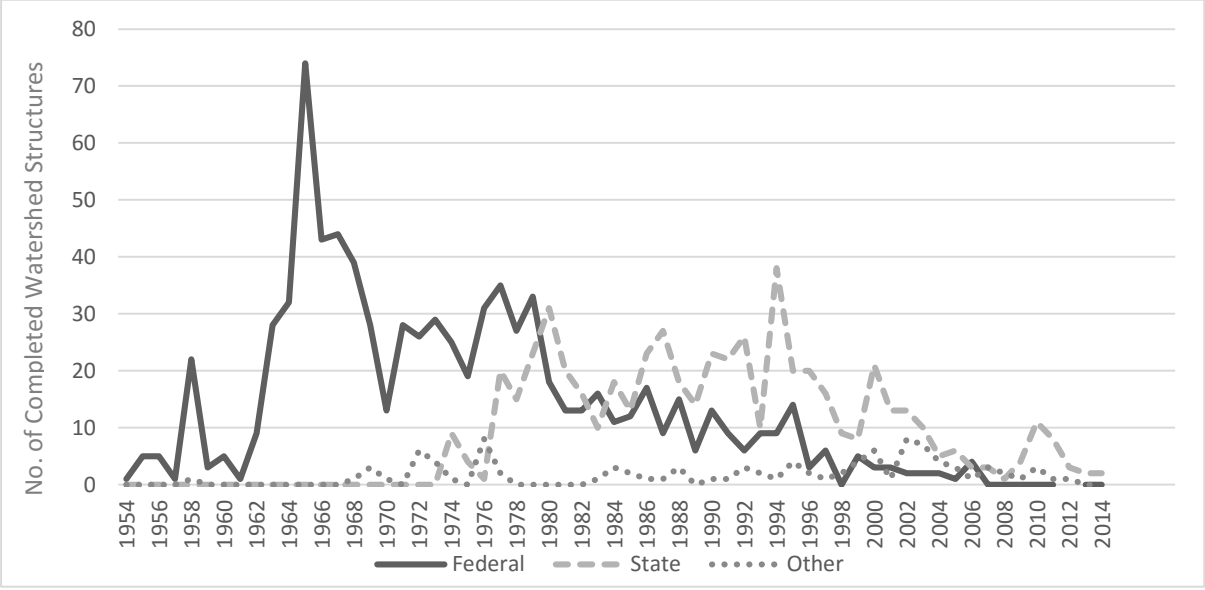

Figure 4.2: Trends in Watershed Construction Activities in Kansas Watershed Districts (Source: Graph by author; data from General Plans)

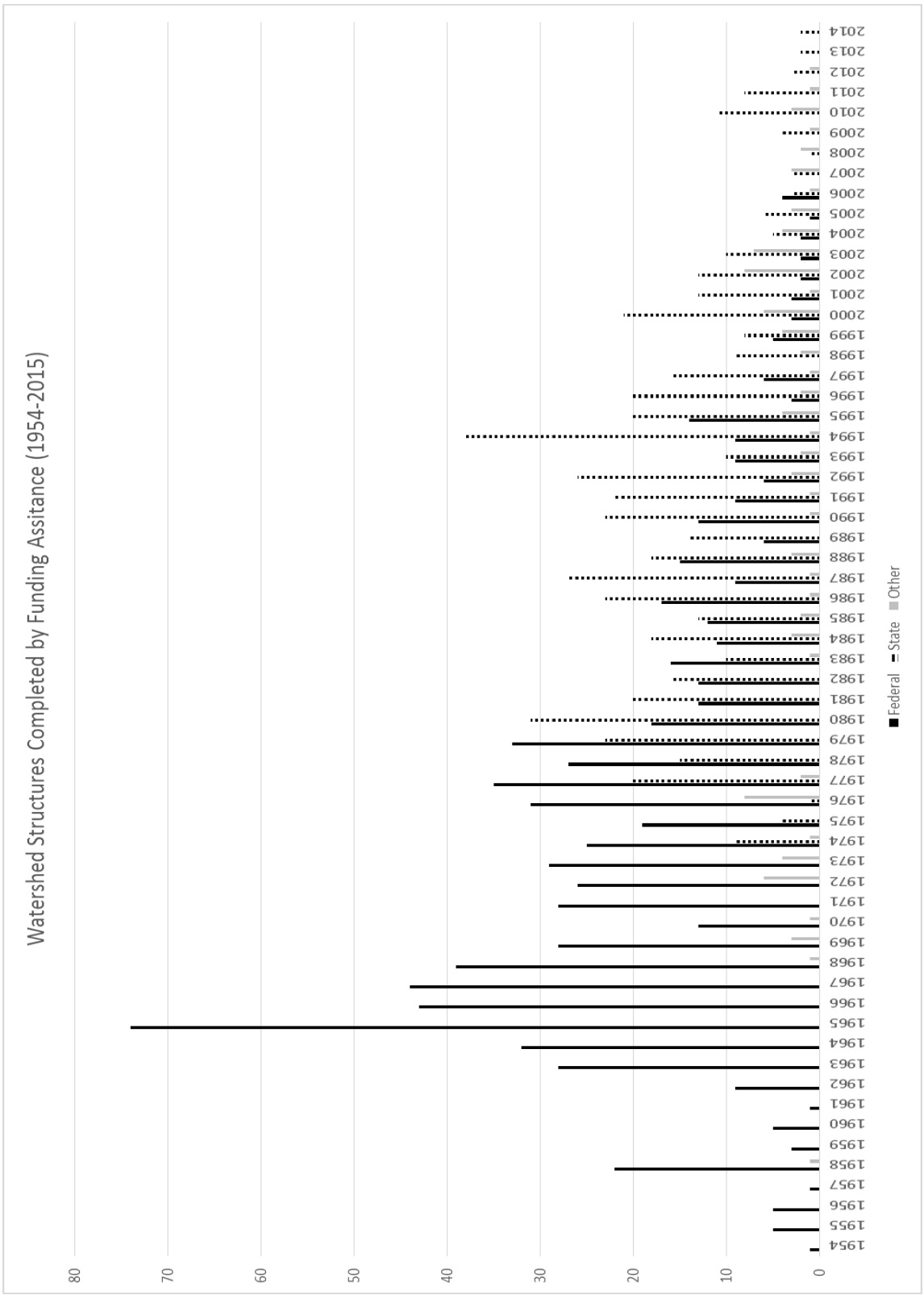

Figure 4.3: Number of Watershed Structures Completed by Funding Agency 1954-2015 (Source: Graph by author; data from Watershed Districts' General Plans)

Over 635 watershed structures were completed between the mid-1960s and the early 1980s when both state and federal agencies combined were funding the building an average of 40 structures each year. New construction for watershed structures has faced a declining trend since the late 1970s. Temporal variation exists within the last 3.5 decades with a minor peak in the mid-1990s. Figure 4.4 illustrates the number of watershed structures completed between 1954 and 2015, excluding the 53 watershed structures whose construction dates were not available.

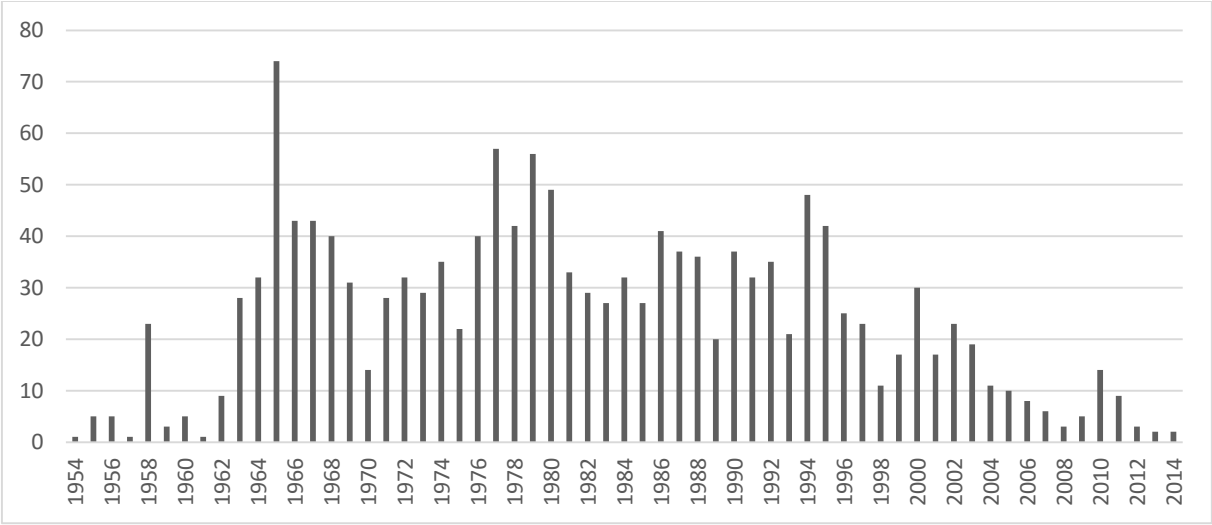

Figure 4.4: Number of Watershed Structures Completed by Year 1954-2015 (Source: Graph by author; data from Watershed Districts' General Plans)

Economic Stability and Safety of Kansans

Support from NRCS and DOC has continued to evolve with the needs of watershed districts, new programs now emphasize rehabilitation efforts over new construction. However, the real issue is available funding. Federal appropriations have declined significantly since 2003 and have become non-existent since 2010 (Figure 4.5). A major drop occurred in the mid-1990s as a result of the Emergency Watershed Program (EWP) that dealt with Flood Damage Recovery from the 1993 Midwest Floods. In July 1993, parts of the Midwestern states (Illinois, Iowa,

Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin) that were affected by the devastating rains, received more than 400% their normal average precipitation resulting in months of disaster and years of recovery time (Phillips 1994). Agriculture suffered greatly as soybean and corn production estimates throughout the Midwest declined by nearly 720 million bushels, combined (Phillips 1994). In 1993, eight of the nine states reported their wettest months since 1895, flooding covered 12.8 million acres of land and reports of $12 billion in flood damage occurred in the Midwest (Phillips 1994). Kansas required restoration on 3 million acres of cropland which required an estimated $11 million in small projects to remove debris and sediment. Funds that have previously been used for watershed districts were used to support the EWP; however, funding never returned to pre-flood levels (Phillips 1994).

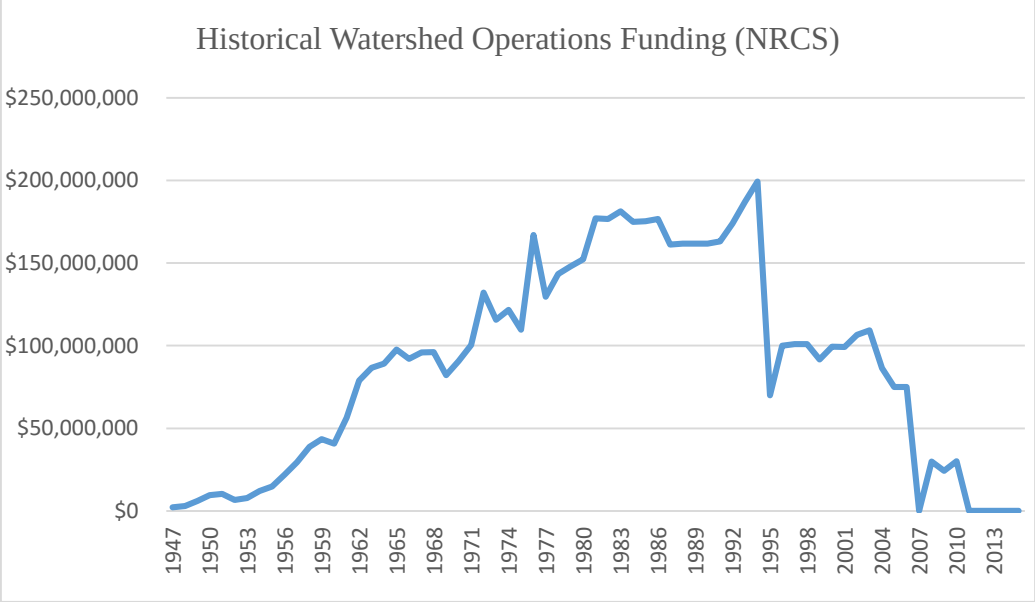

Figure 4.5: Federal Watershed Operations Funding (Source: NRCS 2011)

With over 94% of watershed districts' assistance being provided by either the state or federal government, it is evident that Kansas' dependency on government funding is essential for the continued safety of Kansas residents and their property within these watershed districts.

Rising construction costs and increased regulations have become major obstacles preventing watershed districts from fulfilling their general plans. The frustrations associated with those obstacles can be seen in the views of stakeholders across the state:

> It cost 400-and-some thousand dollars to build it and their board got so disgusted with it. And I took over in January 1st of 2011. The said no, we are not building anything, we're not rehabbing anything. It's the biggest pain in the ass we've ever dealt with in our life. We're done. They said if we could shut this thing down and give it to somebody else, we would. They cut the mil levy in half, said maintain it…and not mess with it anymore.
>
> – Contracting officer

> They run close to $200,000+ now, when you get engineering involved and the state, bless their heart, they give us $120,000 if we qualify. But then you're looking at, see you're looking at maybe the engineering maybe it cost $50-60,000. And the cost of the contractors has gone up considerably. They went from building a structure from 1.25 a yard to 5.00 for a quarter of a yard. That's not anybody's fault, I guess, except inflation.
>
> – Contracting officer

> If they wanted to build another one, I think they got – we would have to save at this rate. If we didn't spend any money, well, the money they get in now – we'd save for 10 years and plus the inflation. I don't know if we'd ever catch up to build another one. I don't think you could ever afford it. Then that would wipe out – well if you get 70% from the State. They could save for 5 years [and] if they got 70% matching from the state. No inflation rate. So it'd be pretty tough.
>
> – Board manager

> Well there is still a number of dams that could be built but money is a problem.
>
> – Board member

> Our tax money. It takes us about 5 or 6 years to develop enough tax money to even build a site. When we first started, we started with sites that cost us 250 - 300,000. The last ones, it has jumped too little over a million.
>
> – Board member

> I've heard that there are watersheds that make a lot of money. Huge watersheds. And we are barely scrapping by trying to maintain the maintenance we need. But there's other watershed that its big money and they don't know how to spend all the money they get.
>
> – Board president

"Maintenance-mode" and Rehabilitation Efforts

Still, 70 of 80 watershed districts remain committed to fulfilling their general plans. What seems improbable today will only become less likely as costs continue to rise each year. This transition in available funding has forced most watershed districts into a "maintenance mode," where the objective of the watershed district is to simply maintain their current number of watershed structures:

> Maintenance is an ever-growing thing. It's not only growing, as the structures get a little order, they need a little more maintenance physically. And that maintenance becomes more expensive. And that's true for all of the districts.
>
> – Board member

In 2000, the Watershed Rehabilitation Program (P.L. 106-472) was enacted, under administration of NRCS, to extend the service life of dams and provide assistance for dams in order to ensure safety and performance standards were being met. Watershed districts that had previously received federal funding, under programs such as P.L.-534, P.L.-566, the Pilot Watershed Program, and/or RC&D programs, were eligible to participate in the Watershed Rehabilitation Program. To date, 88 dam assessments and 3 rehabilitation projects have been completed under the cost-share program. The 2014 Farm Bill, otherwise known as the Agriculture Act of 2014, has provided for six future rehabilitation projects that have received federal funding under P.L.-566 (NRCS 2015).

Like the federal program, the state developed a Watershed Dam Rehabilitation Program to provide assistance, but did not require that the dam be state funded only. The state program, to extend the service life of a dam, is designed to provide a 70% cost-share and an additional 10% for engineering fees for any Kansas watershed structure in need of rehabilitation. At this time, the Kansas Watershed Dam Rehabilitation Program has provided over $2.5 million in cost-share assistance for the rehabilitation of 76 structures, since 2007.

Average Annual Benefits

Flood damage reduction benefits include reduced flooding and reduced erosion either directly or indirectly in an area. Monetary benefits are used to determine benefits/costs by taking into consideration the improvements made to grade stabilization, stream channelization and/or the construction of floodwater retarding structures and detention dams within the watershed district. Updated average annual benefits, which is a combination of flood damage reduction benefits and monetary benefits, suggest that the total number of structures has the potential to provide $115 million, in monetary and flood damage reduction benefits to the state of Kansas (calculations by author).

In order to understand who the beneficiaries of watershed structures are in Kansas, an overlay of the watershed district boundaries and data obtained from the Kansas Data Access and Support Center (DASC), was used to produce the maps created in Figures 4.6-4.9. Over 45,000 farms and 711,000 households are within the boundaries of the combined 80 organized watershed districts (DASC 2015). Watershed districts contain 32,390 miles of state and non-state roads, 2,343 miles of railroads and 5,868 state and local bridges (DASC 2015). Kansans use these transportation routes daily. Their dependency on this infrastructure is crucial to the economy and safety of the people who travel on a daily basis.

> If you live in the rural area, you have a township road or a county road. If you have an emergency and you cannot access the road; the mail man, the school bus, the fire truck cannot come there. You cannot put a price [on] only one house, [when] the road is flooded. A lot of people don't get that point. And if you drive on that road zipping in or out. You don't know notice. But if you look a mile or two out there, there is a structure. We call them the silent protectors. Hidden. Silent. There on the farm.
>
> – KDA Representative

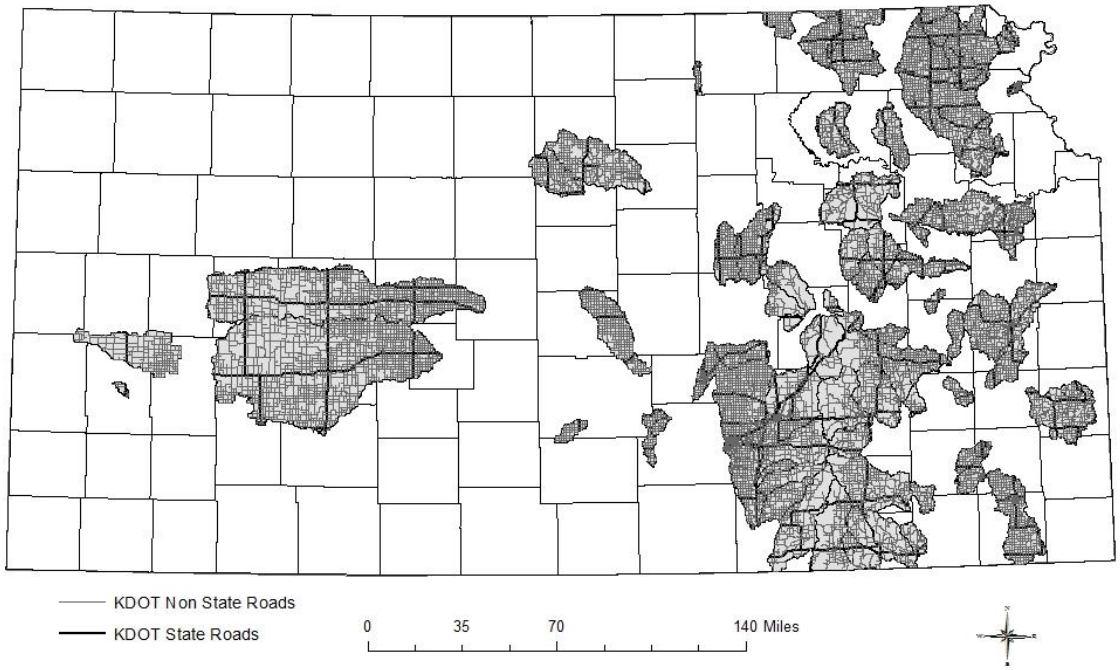

Figure 4.6: Kansas Watershed Districts: State and Local Roads
(Source: Map by author; data from General Plans and DASC)

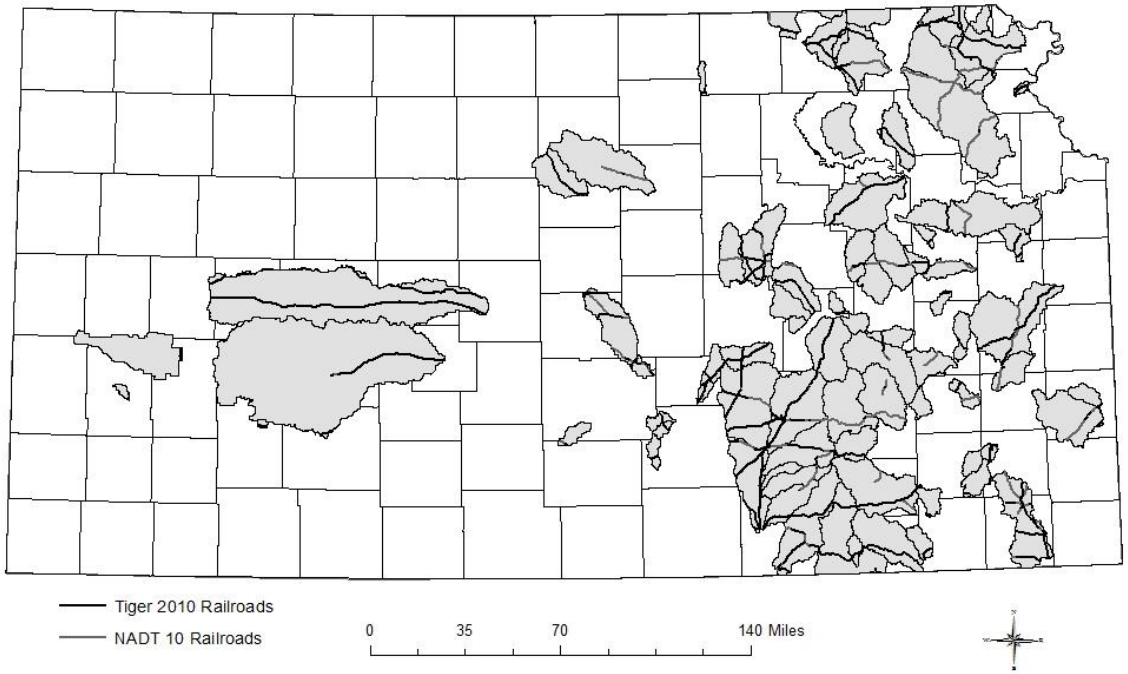

Figure 4.7: Kansas Watershed Districts: Railroads
(Source: Map by author; data from General Plans and DASC)

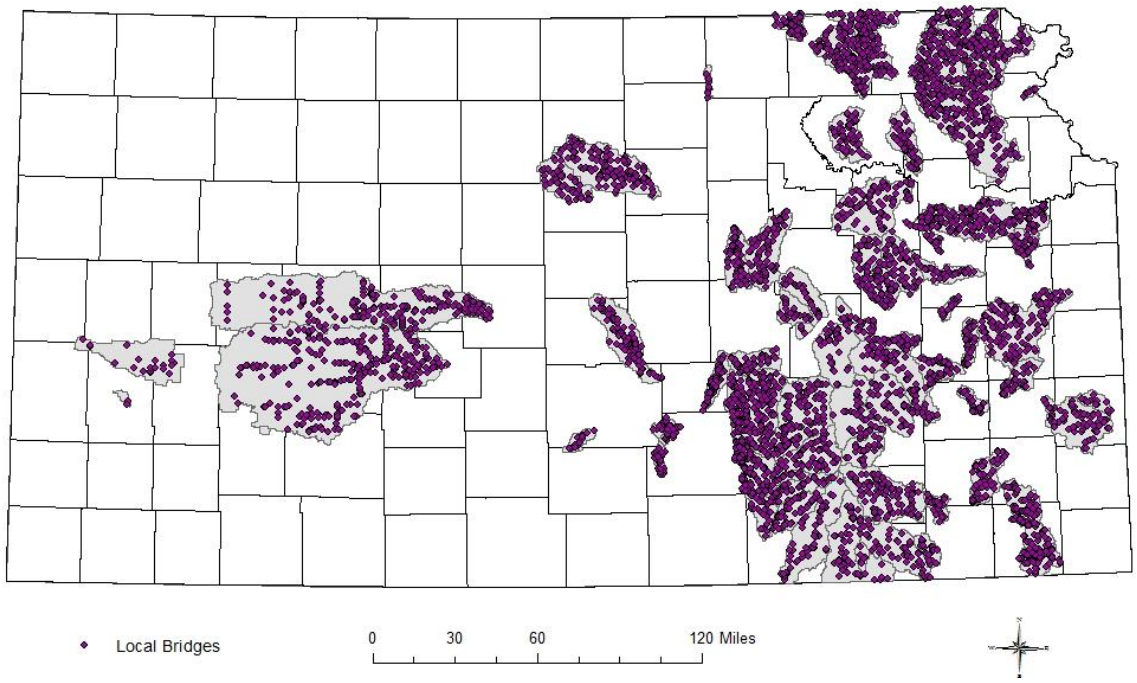

Figure 4.8: Kansas Watershed Districts: Local Bridges
(Source: Map by author; data from General Plans and DASC)

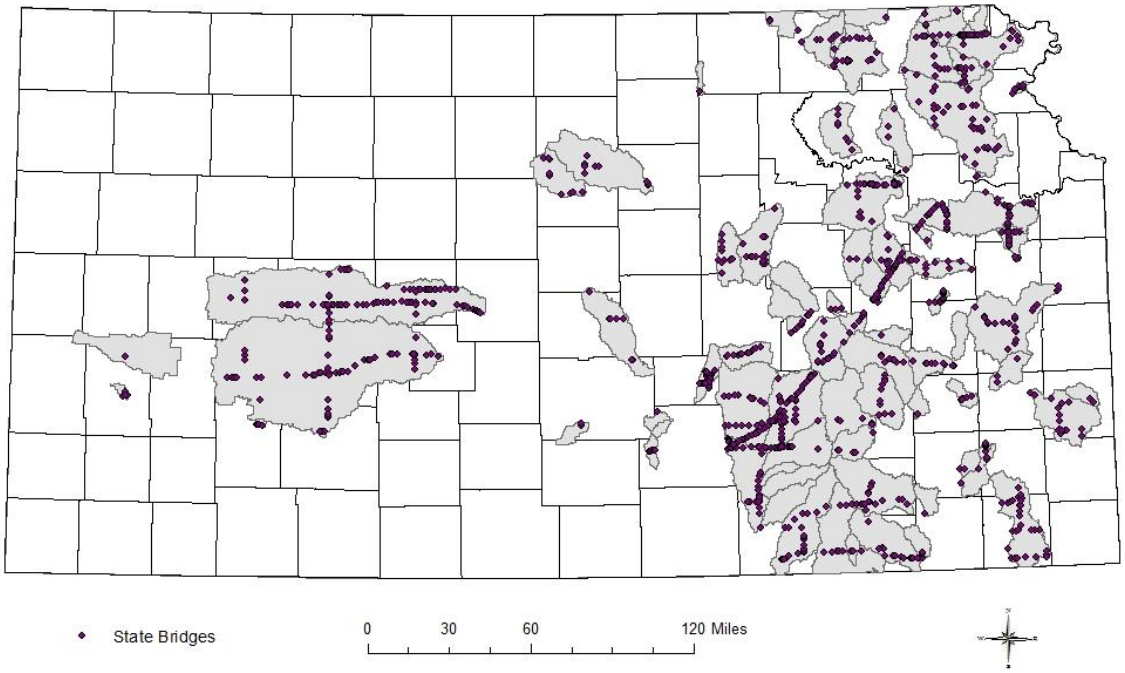

Figure 4.9: Kansas Watershed Districts: State Bridges
(Source: Map by author; data from General Plans and DASC)

Flood damage reduction benefits were determined based on the estimated amount of reduced flooding and reduced erosion within a watershed district. Reduced flooding is important in protecting crop and pastures, other agricultural areas, and transportation routes while reduced erosion efforts were important in terms of diminishing the sediment damage, gullying and swamping. Both reduced flooding and reduced erosion are considered primary benefits in watershed district general plans. Secondary benefits often include the reduced costs associated with transportation routes used to processes and market agriculture commodities. Landowners often reported on the differences watershed structures made in agricultural areas:

> "We have 150 acres of farm ground. When we were full tilling it, we plowed 8 inches deep, and I've seen that field washed off to the hardpan. How many tons of silt left that field, 2 or 3 times? We are no-tilling now."
>
> - Landowner

Agriculture is a key component in the state's economy. The role watershed districts play in attempting to protect that economy can be illustrated by the total flood reduction benefits expected if all watershed structures proposed in the general plans are completed. Nearly 80% of the flood damage reduction benefits are for to agriculture (Figure 4.10).

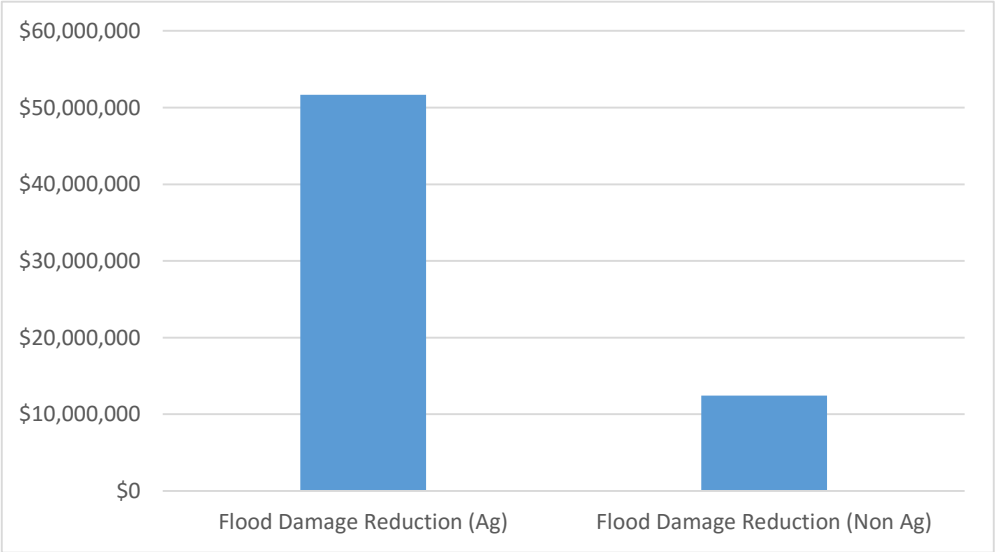

Figure 4.10: Estimated Flood Damage Reduction Benefits
(Source: Graph by author; data from General Plans and Economic Indices)

Monetary benefits are important in determining whether the benefits of a watershed project or structure outweigh the cost of installing that structure. Monetary benefits are also divided into agriculture and non-agriculture, to show an emphasis on the most critical areas of the Kansas economy. Completion of the proposed watershed structures will account for more than an estimated $50 million in benefits with nearly two-thirds of those benefits accrued to agriculture (Figure 4.11). The total average annual benefits for Kansas watershed districts combines the dollar values from flood damage reduction benefits and monetary benefits both separated into agriculture and non-agriculture contributions. If all of the proposed watershed structures were completed, Kansas would receive a total of more than $115 million in benefits annually with an overwhelming 73% of benefits accrued to agriculture (Figure 4.12).

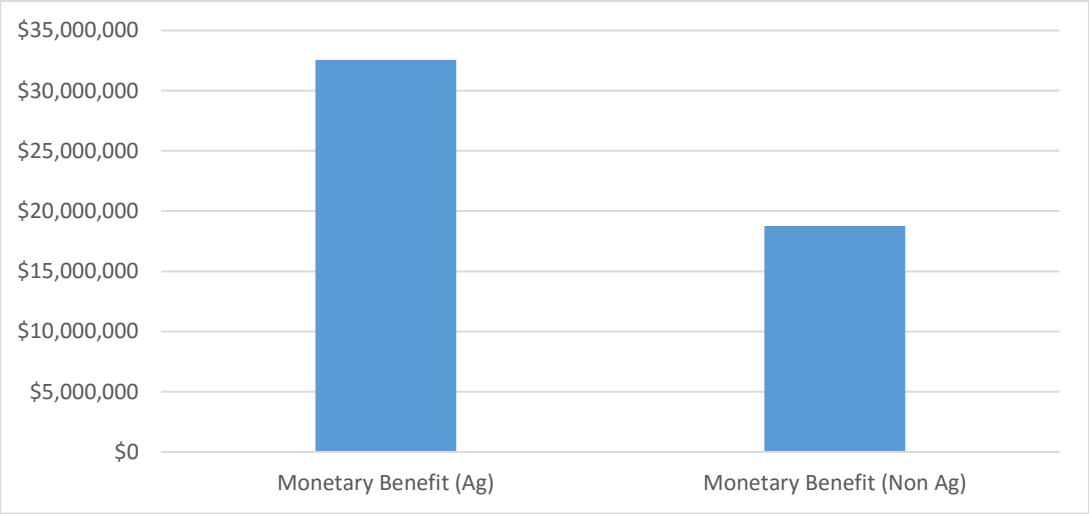

Figure 4.11: Estimated Monetary Benefits, Agriculture and Non-Agriculture for Watershed Structures Remaining to be Completed
(Source: Graph by author; data from General Plans and Economic Indices)

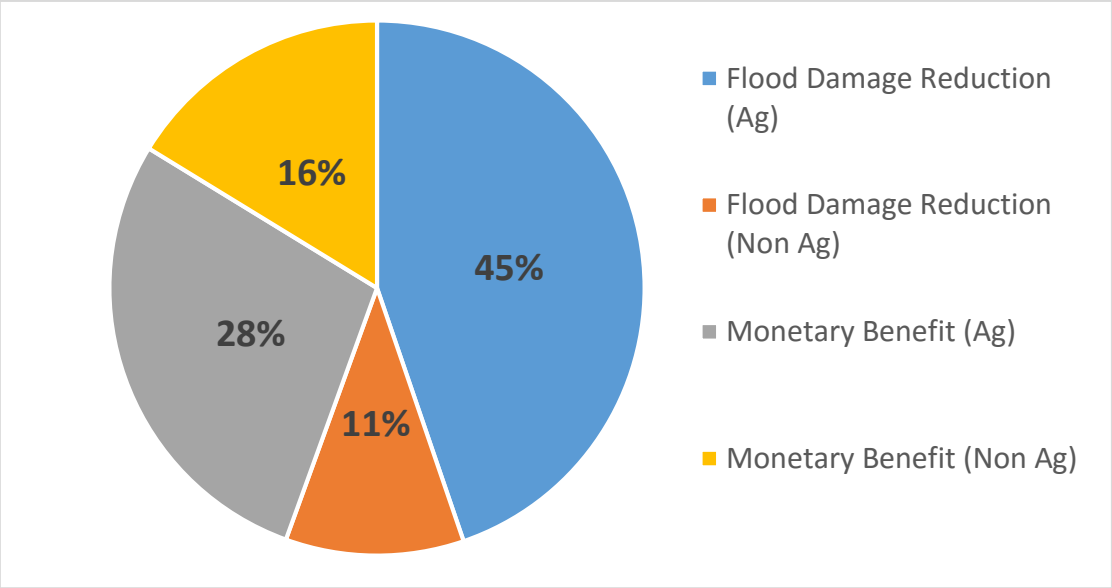

Figure 4.12: Average Annual Benefits by Percentage
(Source: Graph by author; data from General Plans and Economic Indices)

Over $100 million in estimated average annual benefits can be attributed to the financial assistance provided by both the state and federal government sources (Figure 4.13). This estimate is based on the information about the proposed watersheds at the time of the general

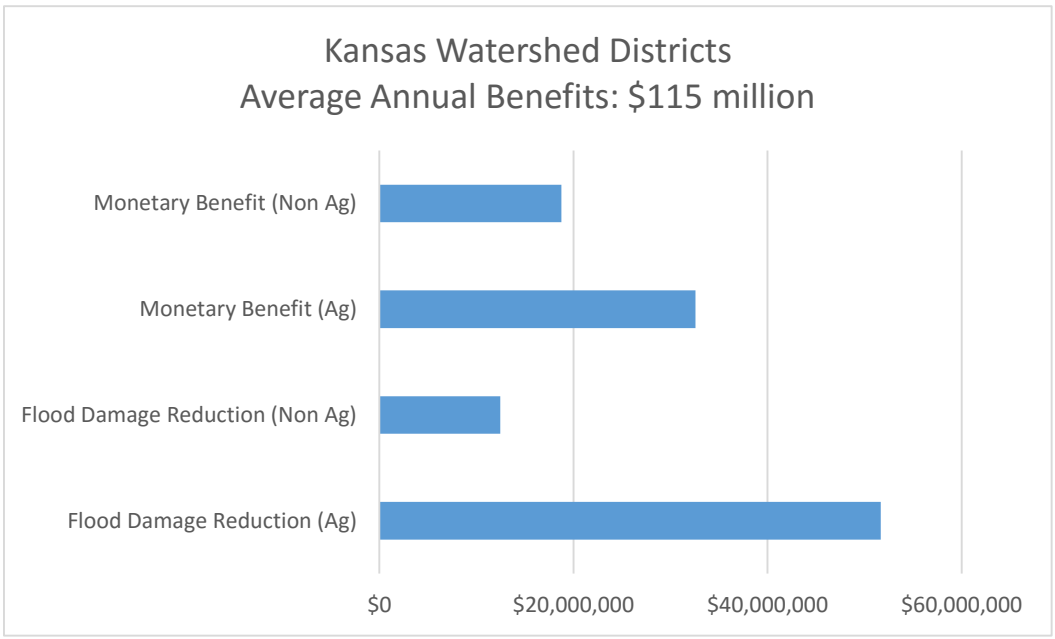

Figure 4.13: Average Annual Benefits by U.S. Dollar
(Source: Graph by author; data from General Plans and Economic Indices)

plan. Four categories were used to differentiate among agencies in order to determine where a majority of Kansas watersheds were receiving their funding. Based on which agency provided the majority of the funding for the district's completed structures, watershed districts were classified as either a) state, b) federal, c) combination or d) other. These classes are only relevant to the 80 organized watershed districts identified in this study, as there are watershed structures completed outside of the districts (Appendix A). Watershed districts with a majority of their dams completed under P.L. 566 or RC&D were considered to be "federal," while a district was considered "state" if the majority of the watershed district's structures were completed with state support. "Combination" districts were used as a class for districts which had completed an equal number of structures with a different agency. Watershed districts that did not fall into those categories were considered as "other." Districts classified as "other" received their funding from sources other than the state or federal government, such as taxpayer dollars and county grants. These classes were made by the author with technical assistance from SAKW, DWR, DOC and NRCS in order to differentiate between state and federal contributions to watershed districts. Figure 4.14 illustrates how the $115 million is divided by the agencies that provided financial assistance in the construction of watershed projects. As part of the total average annual benefits, federal funding is also responsible for over $27,000 in land treatment measures that contribute to flood control and erosion control. Based on these data, the watershed district with the highest value of monetary protection is Wolf River WJD No. 66 with over $12.4 million in estimated average annual benefits (calculations by author). The Wolf River Watershed covers portions of Brown, Doniphan and Atchison Counties in northeast Kansas. The location of the Wolf River Watershed along the Missouri River makes it one of the more highly erodible areas of the state (Wolf River WJD No. 66 General Plan 1980). The addition of floodwater retarding grade

stabilization dams and detention grade stabilization dams was estimated to reduce gully erosion by $3,694,200 in 1980 (Wolf River WJD No. 66 General Plan 1980) which would account for $11,489,139 (calculations by author) in 2014. As of 2015, only 19 of the 232 proposed watershed structures have been completed in the Wolf River Watershed.

The watershed district with the lowest value of monetary protection is Thompsonville WD No. 6 in Jefferson County, with approximately $65,000 in estimated average annual benefits. The updated average annual benefit is eight times the 1957 original of $7,362 (calculations by author). The Thompsonville Watershed District is the smallest watershed district in Kansas covering approximately 6.35 square miles (Thompsonville WD No. 6 General Plan 1958). All three of the proposed structures in the Thompsonville Watershed have been completed.

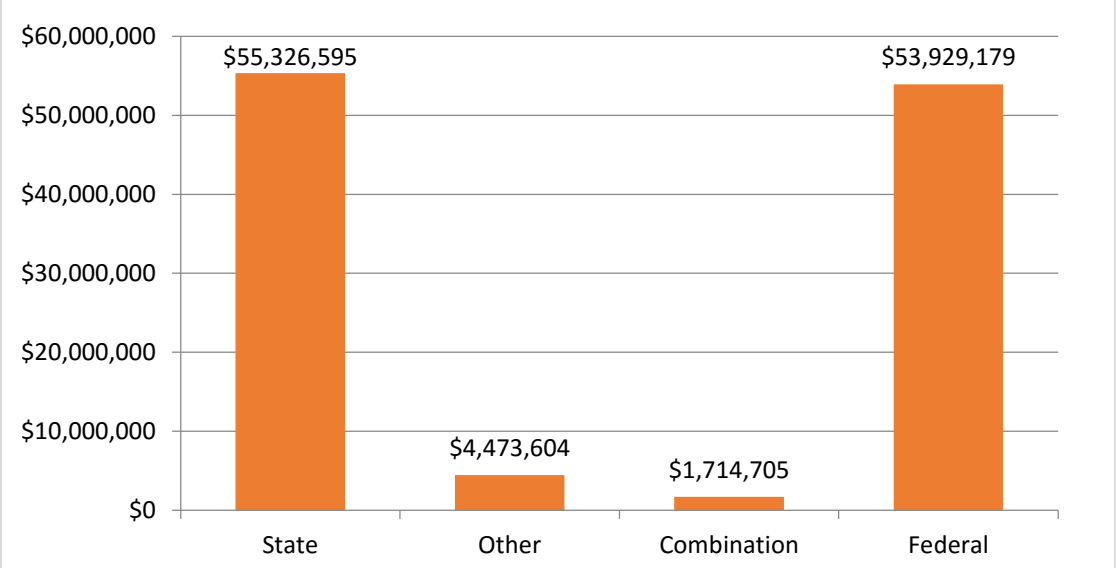

Figure 4.14: Average Annual Benefits by Agency (Source: Graph by author; data from General Plans and Economic Indices)

Risk Hazards from Incomplete Watershed Districts

Many watershed structures are rapidly approaching their design lives since many were constructed over three decades ago. The USDA estimates design life for watershed structures to

range from a minimum of 50 years to a maximum of 100 years based on the estimated sediment storage life of each structure (NWPM 2009). While variations in design, construction materials, and physical characteristics of the land, are crucial in determining the design life for each structure, frequency of major soil erosion events and land use change can impact the useful life of a structure. A total of 187 of watershed structures in Kansas watershed districts have already reached 50 years old (Figure 4.15).

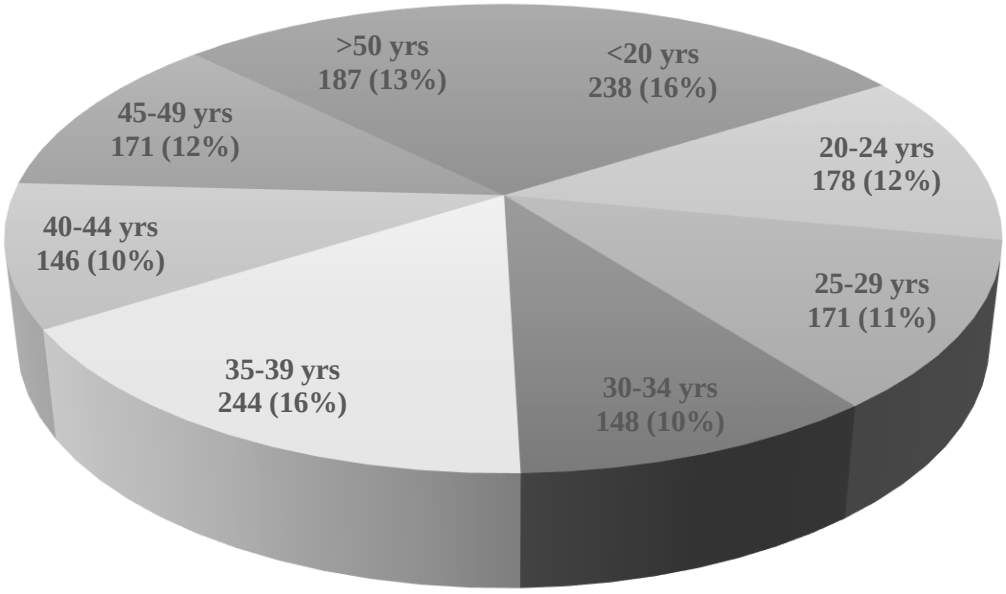

Figure 4.15: Number of Kansas Watershed Structure by Age in 2015
(Source: Graph by author; data from Watershed Districts' General Plans)

Within the next 10 years, close to 1/3 of the currently constructed dams will be over 50 years old, nearly tripling the number of dams over 50 years old (Figure 4.16). With over 500 dams over 50 years old in 2025, many of those watershed structures will no longer be able to retain the sediment behind the dam. Anticipated sediment yield from the watershed structures is necessary in determining the storage volume of the pond and inlet elevation of the principal spillway (NRCS 2012). The loss of available storage in the sediment pool will likely result in greater use of the principal spillway. The principal spillway is described by NRCS as a "pipe

conduit…where the rate and the duration on flow can be safely handled by a vegetated or earth spillway" (NRCS 2012). The principal spillway is designed to regulate flow discharge from the watershed structure as the primary outlet during heavy rain events and storm flows. Spillways release runoff exceeding the storage capacity of the reservoir safely past the embankment (Allen Creek No. 89 General Plan). A cross section of a typical structure is illustrated in Figure 4.17.

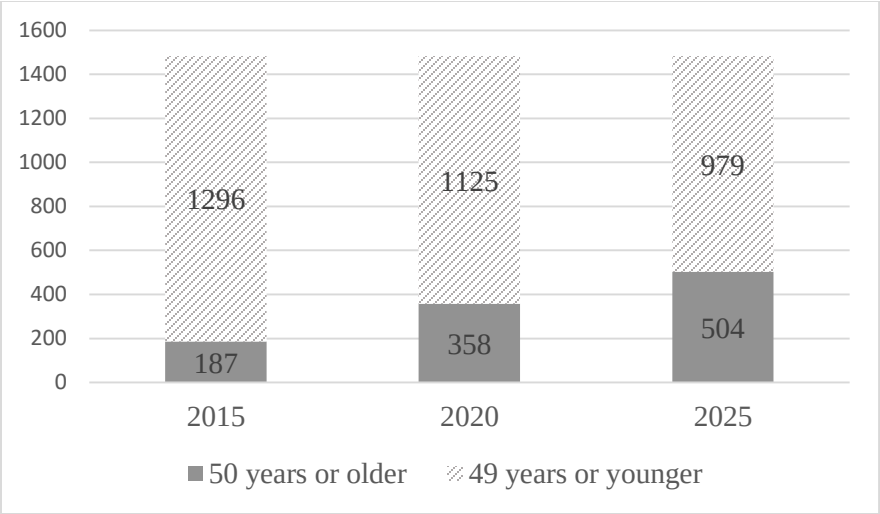

Figure 4.16: Number of Watershed Structures by Age of Structures 2015-2025 (Source: Graph by author; data from Watershed Districts' General Plans)

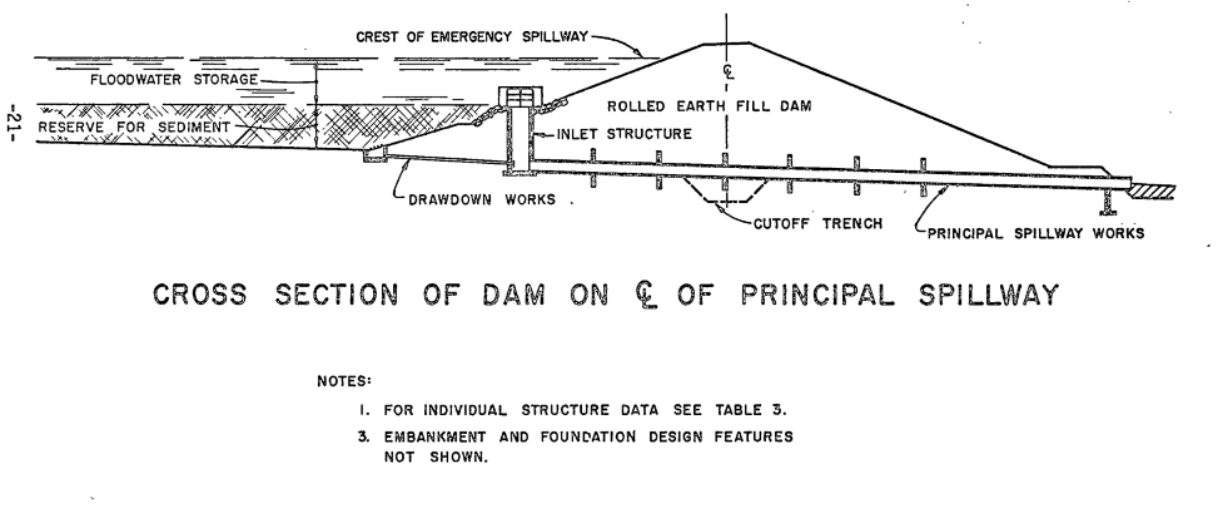

Figure 4.17: Typical Floodwater Retarding Structure Blueprint (Source: Allen Creek No. 89 General Plan)

Stakeholders Perceptions of State and Federal Policies

A basic analysis from the survey, suggested that nearly half (49%) of respondent felt that state and federal challenges were the biggest issue right now:

> Well right now, our biggest challenge is not being able to build any more dams because of the governmental red tape.
>
> – Board member

The most common federal and state regulations cited by respondents include third party easements, endangered species, Corps of Engineer 404 permitting, and mitigation. In 2008, the U.S. Army Corps of Engineers authorized the Compensatory Mitigation for Losses of Aquatic Resources (Mitigation Rule 33 CFR Parts 325 and 332). This required that third parties obtain a conservation easement which would be used to protect aquatic habitats, riparian areas and buffers, and uplands on projects involving private lands (USACE 2008).

> Well there is always the governmental problems through permitting.
>
> – District manager

> I've been on this board in excess of 20 years and when we first started the paper trail use to be very short. Now the paper trail has just got longer and longer with more permits. The thing that I see that has been the biggest detriment to the watersheds period in Kansas, is the third party easement. I was opposed to building any watersheds with the way the Corps [of Engineers] had it in place. We were saddling the taxpayers of the watershed with something that could last forever and there was no end to it. The people they were [introducing] as a third party easement, there was no control over, they were just like a private entity. There was no legislation or nothing. Whatever they said you better do. Something like that, that's opening your pocket book and putting a hole in the bottom of it.
>
> – Board member

> And if the Corps of Engineers says you got to do this, you got to do this, you got to do this. It took all that money just for us to do the mitigation.
>
> – Contracting officer

The second most prevalent challenge reported in surveys and verified in interviews was the impact of endangered species on watershed district efforts. Endangered species ranged from the Lesser Prairie Chicken in the western half of the state to 16 different types of minnows across Kansas. The Kansas Department of Wildlife, Parks and Tourism (KDWPT) website keeps an interactive listing of endangered species for the public to review. During new watershed construction, KDWPT must review a propose structure in order to eliminate any possible threat to endangered species habitat.

> The biggest issue now is the Topeka Shiner. Endangered Species is a major, major foothold. If we want to build a dam here, we can't because there is an endangered species here.
>
> – Board member

> They say that from basically Mid-Ness County all the way west is natural habitat for prairie chicken…That's a definite challenge right now...
>
> – Board member

> But there was also questions about sedimentation effecting the habitat of the Topeka Shiner and other things that may be species difficult to propagate, if there were watersheds dams there according to some of their studies. So, they were basically going to shut us down. We couldn't build another watershed dam.
>
> – Board member

The last major challenge reported by the majority of watershed districts in Kansas, was Section 404 of the U.S. EPA Clean Water Act, commonly referred to as a 404 permit. The Corps of Engineers implements Section 404 which requires that watershed districts obtain permits for construction or dredging in U.S. navigable waters. The Act also requires that third party agencies serve as legal protection for proposed mitigation sites. The recent passage of Kansas House Bill 2061, allowed DOC to serve as a third party agent in addition to the five other land trust companies: the Watershed Land Trust, the Sunflower Land Trust, the Midwest Mitigation Oversight Association, the Platte Land Trust and the Kansas Alliance for Wetlands and Streams

(Testimony on HB 2061, March 2015). It is hoped that the passing of HB 2061, will reduce the costs of permitting and constructing new watershed structures. As of July 1, 2015, the bill was enrolled as law, permitting the DOC in consultation with the State Conservation Commission, to take action necessary to "restore, establish, enhance, and protect natural resource with conservation easements for the purpose of compensatory mitigation required under Section 404 of the federal Clean Water Act in addition to other power and duties authorized by law" (Summary of Legislation on HB 2061, 1). The Conservation Easements for Watershed Districts; HB 2061, permits acquisitions of conservation easements on behalf of watershed districts for the purposes of protecting compensatory mitigation sites; restoring, establishing or enhancing natural resources; and establishing fees for the administration of conservation easements on behalf of watershed districts. (Summary of Legislation on HB 2061)

> …because of that issue and the 404 permit required because of stream mitigation, we have actually stopped working that project
>
> – Contracting officer

> That was just prior to when the new Kansas Streambank Guide came out. When the Corps of Engineers started being a lot more particular about mitigation. Mitigation has kind of always been there, but not as difficult to work through.
>
> – Contracting officer

> We're getting over-regulated really quick. I do want clean water but I also want to save our water too. When it goes down the river, it's gone forever.
>
> – Board member

> To address the permitting, the challenges that we have on the federal and state sites are going to take a political move. And those kind of moves can sometimes be costly.
>
> – District manager

> Well the mitigation situation with the Corps of Engineers having to take the lead on that from the EPA, is our greatest challenge. We are still trying to work out some common ground there, that we can live with. We are getting closer.
>
> – Board member

Even when a watershed district can overcome the financial burdens associated with new construction, the mitigation regulations can make dam construction less feasible in some districts. Like any other watershed project, the area needs to be protected until a site can be established. Often times, a fence is built around the area which limits the use of the land in the eyes of the landowner. Taking land from landowners is the quickest way to put a halt in watershed construction projects:

> Because we have to go out and we try and get easements from the private landowners with - he would be able to use some of the water in the dam, as far as livestock water and all of that. The Corps of Engineer comes along and says you have to fence it out, so the landowner says 'to hell with it, I don't want it
>
> – Board member

Awareness in Other Practices, State/Federal Cost Share Programs

Most watershed district boards were aware of practices other than flood control to address erosion, silt and land conservation issues. Only nine watershed districts were unaware of the ability for the watershed district to install other practices. Awareness of state cost share assistance was the most recognized program among 56 watershed districts.

Challenges of Watershed Districts

Respondents were asked to rate a series of 30 challenges for the district as either a significant challenge, a manageable challenge or no challenge at all. Forty out of 59 watershed districts reported having at least one significant challenge in their district, with an average of 4.25 challenges per district. Twenty-seven respondents indicated that state and federal regulations were a significant challenge for their watershed district, followed by funds for rehabilitation at 18, and challenges applying for federal cost-share programs at 15 (Table 4.1).

Table 4.1: Survey Responses to Significant Challenges of Watershed Districts

	Significant	Manageable	No Problem	Did Not Respond
State and Fed Regulations	27	18	10	25
Funds for Rehabilitation	18	14	23	24
Applying for Fed cost-share	15	18	19	26
Find new board members	9	31	18	22
Amending General Plan	9	14	32	25
Update a dam's EAP	9	19	24	27
Understand Insurance	7	15	36	22
Receiving assistance from DWR	7	10	39	24
Write a new EAP	7	22	22	28
Receiving assistance from DOC	6	13	38	23
Owner understands dam benefits	5	24	29	22
Asking for assistance from DOC	5	8	44	23
Applying for State cost-share	5	15	37	23
Review O&M agree with NRCS	5	15	27	30
Receiving assistance from SAKW	5	7	46	22
Owner supports WD efforts	4	24	30	22
Receiving assistance from NRCS	4	16	35	25
Asking for assistance from DWR	4	17	34	25
Understand O&M agree with NRCS	4	14	27	32
Asking for assistance from SAKW	4	7	47	22
Funds for O&M	3	22	33	21
Finding Dependable Help	2	28	29	21
O&M reports	2	12	44	22
Keeping minutes	2	6	51	21
Understand Finances	2	9	47	22
Asking for assistance from NRCS	2	8	46	24
O&M inspects	1	12	46	21
Keep board active	1	22	36	21
Run Productive Meeting	1	4	54	21
Retaining Board Members	0	24	35	21

The Role of Social Capital

Identified social capital issues for the local stakeholders included difficulties in managing watershed districts such as acquisitions of land rights, concerns about the stewardship and

importance of the land, and the lack of interest in board participation. Social capital issues were identified in both the interviews and the SAKW survey.

Perceptions of Management

Watershed districts have the ability to operate as a small governance, which includes the right to levy taxes and authorize eminent domain. With the variation in location, population, and number of watershed structures, watershed district boards are responsible in setting mill levies appropriate to their region. The gaps between profitable watershed districts and those that do not make enough to maintain their structures on an annual basis put an incredible amount of pressure on small-town communities. Some watershed districts struggle with maintaining the balance between neighborly relationships and the needs of the district:

> The other idea, the state says to raise your taxes. Well, we have raised the taxes several times, but you start to raise the taxes on 40 of your neighbors, they're starting to say you know "when is enough?
>
> – Board president

In very few cases, watershed districts have opted out of taxing through mill levies.

Despite the ability to authorize eminent domain, watershed districts rely heavily on their relationships with local landowners to accomplish the goals of the watershed district in terms of land acquisition. Landowners may not want to sacrifice productive crop or pasture land on their property, or may fear government intervention on their property. In addition to giving up land, landowners may also be asked to make a financial sacrifice for the addition of the watershed structure on their property. Landowners are typically asked to donate the easement but may also be asked to provide up to 10% of the construction cost for a new watershed structure. Helping landowners understand the benefits of watershed structures on their property is essential in

helping watershed districts meet the goals of their general plan. According to a contracting officer,

> They receive a deduction on their annual taxes of $2,000 - For 20 years for 2x of the donated easement. Like if they contribute an easement worth 50 acres, they will get 50 times 2: 100 acres tax deduction for 20 years.
>
> - Contracting officer

Local Knowledge and Community Awareness

An emphasis on education and awareness has presented itself, as board members identify the need to address the concerns of future watershed district boards:

> It's getting harder to find board members. And that goes back into the education, and getting people more involved.
>
> – District Manager

As the general public gets younger and the older generation who experienced the floods starts to fade away, the fear of today's board members is that the public will forget. They fear the public will forget the intensity of the floods that preceded these watershed structures or the importance the watershed districts plays in maintaining the safety of its downstream population.

> I would say it gets greater the younger they get. They are blind to what's happened in the past. They want this country like it was when it was settled, but it ain't going to be that way.
>
> – Board member

> It's an issue now. It's an issue with young farmer's period, you know? There is not very many young farmers out there.
>
> – Landowner

Place attachment among people in these watershed districts plays a major role in the connection of watershed efforts and the communities they have served since 1954.

> I think people have to feel that connection and that desire to honor what was given to them and what they are going to pass on. And I think that is what really motivates people to do things.
>
> – Board member

The Next Generation of Board Participation

Participation in watershed district boards has become a new challenge as watershed districts enter into a maintenance mode and board members don't feel like they are making a difference anymore. For over 60 years, Kansas residents have volunteered to serve on local watershed district boards to help improve their community.

The effectiveness of watershed districts was examined based on the number of active district members, participation in quarterly meetings to include proper reporting and submission to the Kansas Division of Conservation, of documents required to be kept on file by the watershed district office. Other factors included the district's awareness of installation measures beyond flood control dams, and potential assistance for funding on construction and rehabilitation projects provided by state and federal cost shares. According to DOC 2015 a "locally elected board of directors of three to fifteen members is responsible for administration of the district." Dry Creek Watershed District No. 57 did not meet the minimum requirement at only two members and Wakrusa Watershed District No. 35 exceeds the recommended number with 19 members (Table 4.2 and Figure 14.18). Out of 60 watershed districts that responded to the question, a total of 451 volunteers serve on a watershed district or drainage district board. An incomplete questionnaire received from Lyons Creek Watershed District No. 41, did not include the number of board members currently on their board but did indicate that they would not vote to change the number. Of the 60 questionnaires, 86% did not want to vote to change the number of board members (Figure 14.19). While the remaining 14% either wanted some sort of change or did not respond to the question. Thompsonville Watershed District No. 6, with a total of five members suggested a vote to increase board members, as well as Vermillion Watershed District No. 70 who currently has nine members. The following watershed districts indicated a

decrease from their current number of board members would be more effective: Deer Creek No. 55 (five members), Middle Creek No. 62 (six members), and Rock Creek No. 28 (five members).

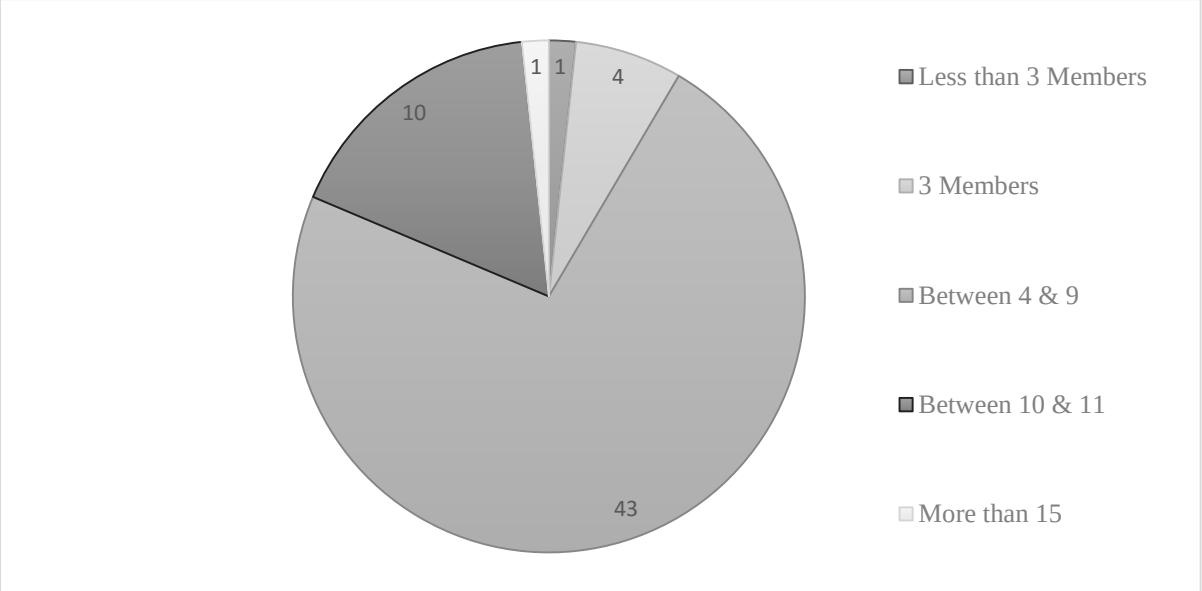

Figure 4.18: Survey Response: Board Membership per District
(Source: Graph by author; data from SAKW)

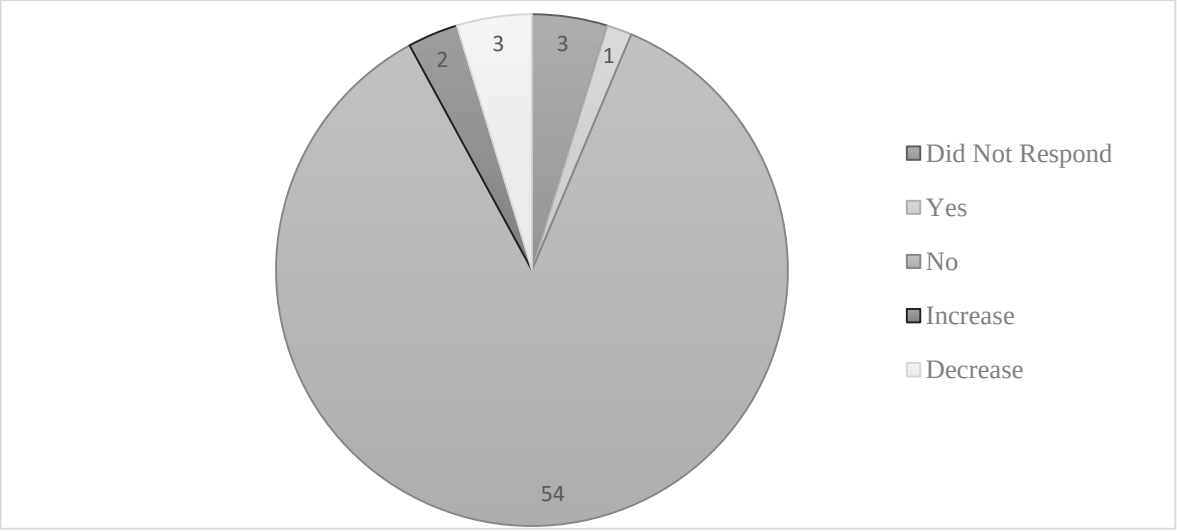

Figure 4.19: Survey Response: Desire to Vote to Change Number of Board Members
(Source: Graph by author; data from SAKW)

Table 4.2: Watershed District Board Participation
(Source: Table by author; data from SAKW)

Watershed District	Board Members	Vote to Change	Reason
Dry Creek # 57	2	N	
Cedar Creek # 56	3	N	
Cimarron # 3	3	N	
Marais des Cygnes DD # 1	3	N	
Mission Creek # 51	3	N	
Muddy Creek # 27	4	N	
Deer Creek # 55	5	Decrease	Not Indicated
Rock Creek # 28	5	Decrease	Not Indicated
Thompsonville # 6	5	Increase	Not Indicated
Bee Creek # 15	5	N	
Cedar Creek # 97	5	N	
Cherry-Plum Creek #17	5	N	
Grant Shanghai # 14	5	N	
Little Walnut-Hickory # 18	5	N	
Marmaton # 102	5	N	
Pottawatomie Cr # 90	5	N	
Snipe Creek # 69	5	N	
Spillman Creek # 43	5	N	
Tauy Creek # 82	5	N	
Wolf River # 66	5	N	1 vacancy
Middle Creek # 62	6	Decrease	5
Mill Creek # 98	6	N	
Cross Creek # 42	7	N	
Duck Creek # 59	7	N	
Horseshoe Creek # 110	7	N	
Jacob-Phenis Cr # 94	7	N	
Long-Scott Creeks # 93	7	N	
Mill Creek # 85	7	N	
Pony Creek # 78	7	N	
Turkey Creek # 103	7	N	
Turkey Creek # 109	7	N	
Nemaha-Brown # 7	8	N	
Salt Creek # 46	8	N	
Vermillion # 70	9	Increase	Not Indicated
Allen Creek # 89	9	N	
Doyle Creek # 86	9	N	
Eagle Creek # 77	9	N	
Elk River # 47	9	N	
Grouse-Silver Cr # 92	9	N	
Otter Creek # 83	9	N	
Pawnee # 81	9	N	
Rock Creek # 84	9	N	1 vacancy
Salt Creek # 104	9	N	
Sand Creek # 68	9	N	
South Fork # 76	9	N	

Walnut-West Cr # 72	9	N	
Wet Walnut Cr # 58	9	N	
Whitewater River # 22	9	N	
Little Delaware-Mission Creek # 5	10	N	
Delaware # 10	11	N	
Diamond Creek # 61	11	N	
Upper Little Arkansas River # 95	11	N	
Upper Marais des Cygnes # 101	11	N	
Upper Walnut # 33	11	N	
Rock Creek # 45	12	N	
Turkey Creek # 32	13	N	
Fall River # 21	13	Y	Not Indicated
Upper Black Vermillion # 37	15	N	
Wakarusa # 35	19	N	
Lyons Creek # 41	DNR	N	

Board meetings are fundamental to conducting watershed district business and should be held no less than one each quarter to take official action on plans, programs and functions of the district (SCC Watershed Handbook 2008). The number of board meetings varied between districts, where at least three met less than four times a year and 50 either met or exceed the recommended number of quarterly meetings (Figure 4.20). Three watershed district boards who participated in quarterly meetings, admitted to not participating in annual meetings. The purpose of the annual meeting is to replace elected directors whose terms have expired and to report on the financial status of activities of current projects (KDA 2015). Unlike a quarterly meeting, watershed districts are required to publish a public notice before conducting an annual meeting (SCC Watershed Handbook 2008).

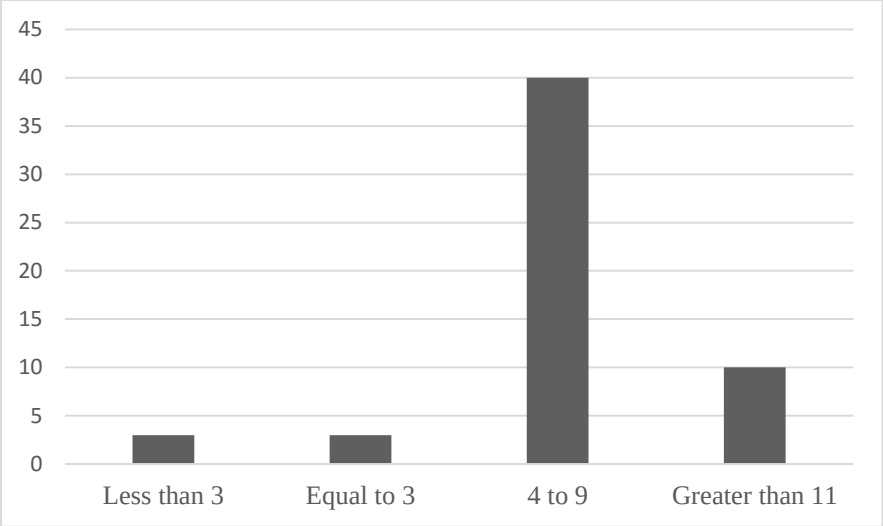

Figure 4.20: Survey Response: Board Meeting Participation (Number of Board Meetings per Year) (Source: Graph by author; data from SAKW)

For watershed board districts who struggle to keep the minimum number of board members or who do not conduct the number of meetings required by the state of Kansas, there is a concern of board health among Kansas watershed districts. An indication of strength among boards can be seen in their numbers and willingness to meet several times a year. The social capital issue of participation was addressed in interviews to address how board participation effects watershed districts. On one end of the spectrum, a strong sense of family heritage and stewardship toward the land made board members feel comfortable on the continued success of their watershed district. On the other end, the struggle to maintain a current board was the least of their concerns as board members spoke with concern about not knowing who would replace them.

A Family Tradition: Heritage and Stewardship

Some board members who were part of the original steering committee remain on the board for long periods of time:

> We had – our oldest board member, he got off this year. He was 93…He was one of the original people that got this started. He was on it for a while, then he got off, then he got back on. It was interesting for him. But at 93, it was time for him to keep off.
>
> – Board member

Other members have followed in the footsteps of their parents or grandparents who were originally involved in the formation of the watershed district:

> My dad was on the board, I don't know. He spent 10-15 years on the board. Almost at the very beginning. I remember when they voted to establish… I think I was 10 years old.
>
> – Board member

The Search for the Unknown: Replacing Board Members

The majority of these board members are now in retirement years, and so a new challenge will be finding a new generation of leaders.

> We don't know what's going to happen in the future. You got to keep a board together somehow to take care of the stuff that is there. We just hope we can keep finding people that are interested in it. It's been tough finding people to do it.
>
> - Board member

Spatial Aspects

ArcGIS and data obtained from the Kansas Data and Spatial Center were used to address research question 4: **What spatial factors exist among Kansas watershed districts?**

Spatial Distribution of Watershed Districts and their Structures over Time

The development of watershed districts varied over time and space, from the 1950s to present and from eastern to western Kansas. In some instances, a watershed district may contain structures older than the district itself. In these circumstances, a watershed district may have taken over watershed structures that had already been built, if they fell into the watershed area. A summary of the number of completed watershed structures within the districts is illustrated in Table 4.3. The largest periods of rapid construction occurred between the 1960s and 1980s when

over 300 watershed structures were being built each decade. Watershed districts that were actively involved in watershed construction was highest between the 1970s and early 2000s when over half the watershed districts were actively building new watershed structures. A further breakdown of the progress made by each watershed district per decade, beginning with 1950, is represented in Figures 4.21 – 4.27 and Tables 4.4 – 4.10).

Table 4.3: Distribution of Watershed Structures over Time (Source: Table by author; data from DWR and KWO)

Year	No. Watershed Structures	No. Watershed Districts
1950-1959	38	7
1960-1969	308	25
1970-1979	356	45
1980-1989	329	52
1990-1999	287	48
2000-2009	132	40
2010-2015	31	19
No completion date	58	

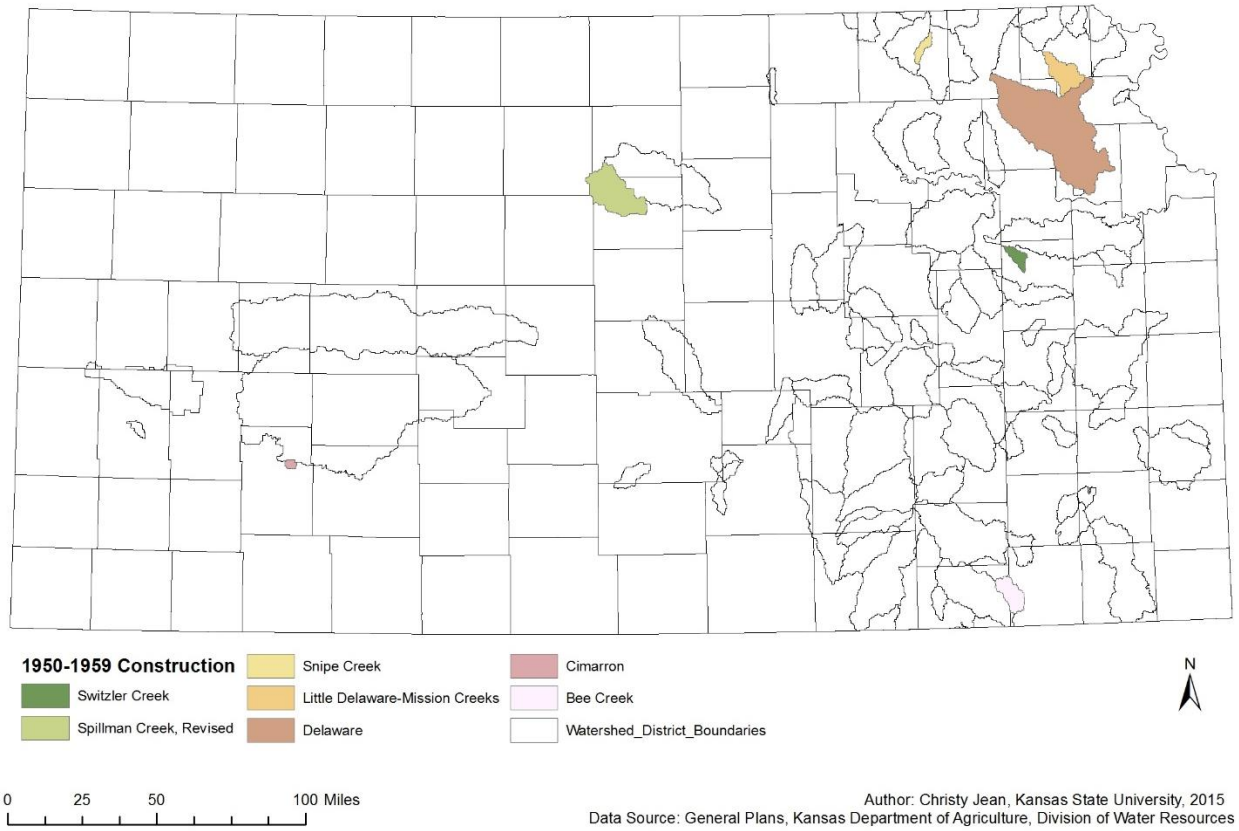

Figure 4.21: 1950-1959 Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.4: 1950-1959 Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plans)

Bee Creek WJD No. 15	1
Cimarron WD No. 3	3
Delaware WJD No. 10	1
Little Delaware-Mission Creeks WJD No. 5	22
Snipe Creek WD No. 69	6
Spillman Creek WJD No. 43	3
Switzler Creek WD No. 63	2
Total Number of Structures	**38**
Total Number of Districts	**7**

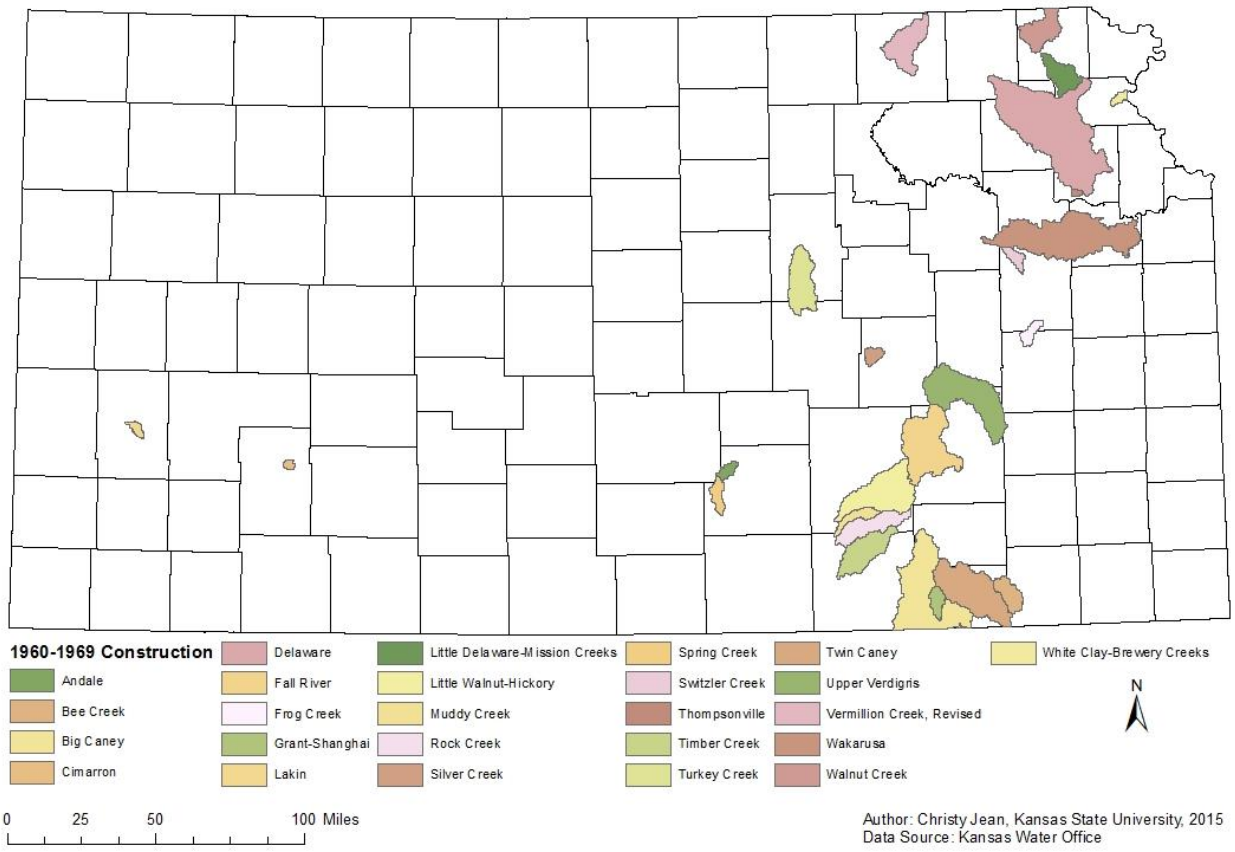

Figure 4.22: 1960-1969 Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.5: 1960-1969 Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plan)

Andale WJD No. 9	1
Bee Creek WJD No. 15	7
Big Caney WJD No. 31	24
Cimarron WD No. 3	1
Delaware WJD No. 10	3
Fall River WJD No. 21	26
Frog Creek WJD No. 19	7
Grant-Shanghai WD No. 14	6
Lakin WD No. 49	4
Little Delaware-Mission Creeks WJD No. 5	16
Little Walnut-Hickory WJD No. 18	37
Muddy Creek WJD No. 27	2
Rock Creek WJD No. 28	13
Silver Creek WD No. 25	6

Spring Creek WJD No. 16	3
Switzler Creek WD No. 63	2
Thompsonville WD No. 6	3
Timber Creek WJD No. 38	9
Turkey Creek WJD No. 32	3
Twin Caney WJD No. 34	29
Upper Verdigris WJD No. 24	34
Vermillion Creek WJD No. 70	2
Wakarusa WJD No. 35	1
Walnut Creek WD No. 1	44
White Clay Brewery WJD No. 26	25
Total Watershed Structures	**308**
Total Watershed Districts	**25**

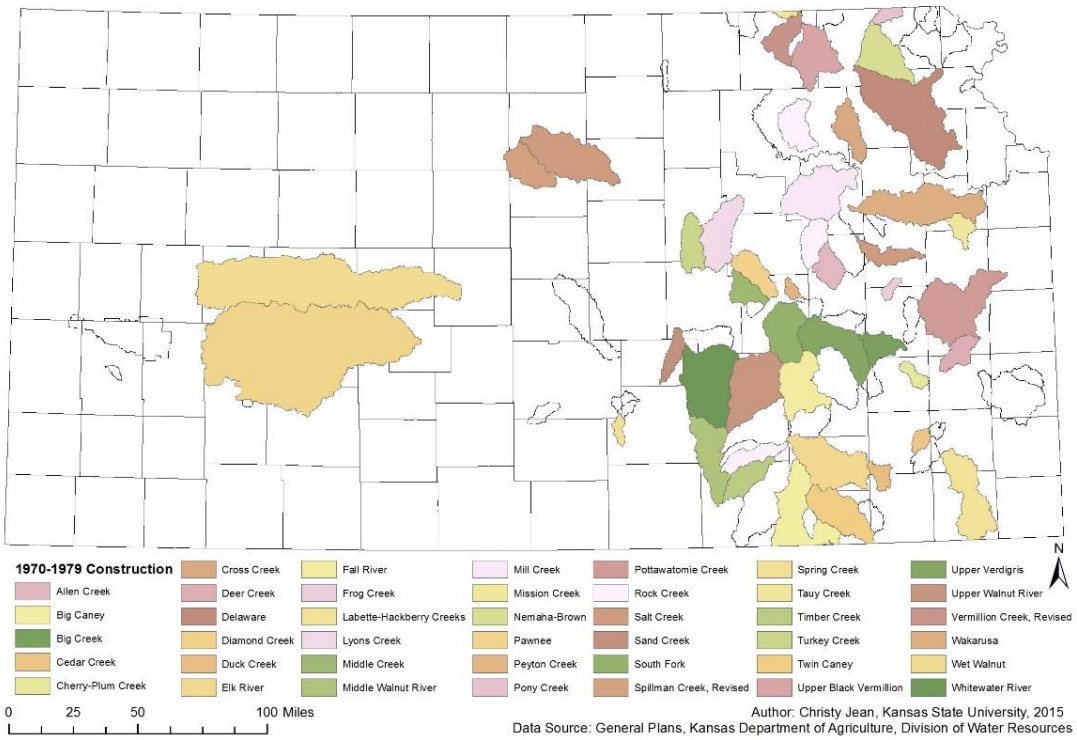

Figure 4.23: 1970-1979 Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.6: 1970-1979 Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plan)

Allen Creek WD No. 89	3	Pottawatomie Creek WJD No. 90	4
Big Caney WJD No. 31	8	Rock Creek WD No. 45	4
Big Creek WJD No. 48	6	Rock Creek WJD No. 28	9
Cedar Creek WJD No. 56	5	Rock Creek WJD No. 84	1
Cherry-Plum Creeks WJD No. 17	4	Salt Creek WJD No. 104	1
Cross Creek WJD No. 42	11	Salt Creek WJD No. 46	19
Deer Creek WJD No. 55	1	Sand Creek WJD No. 68	2
Delaware WJD No. 10	16	South Fork WJD No. 76	3
Diamond Creek WJD No. 61	4	Spillman Creek WJD No. 43	7
Duck Creek WJD No. 59	2	Spring Creek WJD No. 16	1
Elk River WJD No. 47	40	Tauy Creek WJD No. 82	2
Fall River WJD No. 21	1	Timber Creek WJD No. 38	22
Frog Creek WJD No. 19	1	Turkey Creek WJD No. 32	13
Labette-Hackberry C, WJD No. 96	4	Twin Caney WJD No. 34	1
Little Walnut-Hickory WJD No. 18	3	Upper Black Vermillion WJD No. 37	22
Lyons Creek WJD No. 41	10	Upper Verdigris WJD No. 24	4
Middle Creek WJD No. 62	2	Upper Walnut WJD No. 33	15
Middle Walnut WJD No. 60	3	Vermillion Creek WJD No. 70	34
Mill Creek WJD No. 85	1	Wakarusa WJD No. 35	20
Mission Creek WD No. 51	4	Wet Walnut Creek WJD No. 58	10
Nemaha-Brown WJD No. 7	1	Whitewater River WJD No 22	10
Pawnee WJD No. 81	17		
Peyton Creek WD No. 71	2	**Total Watershed Structures**	**356**
Pony Creek WJD No. 78	3	**Total Watershed Districts**	**45**

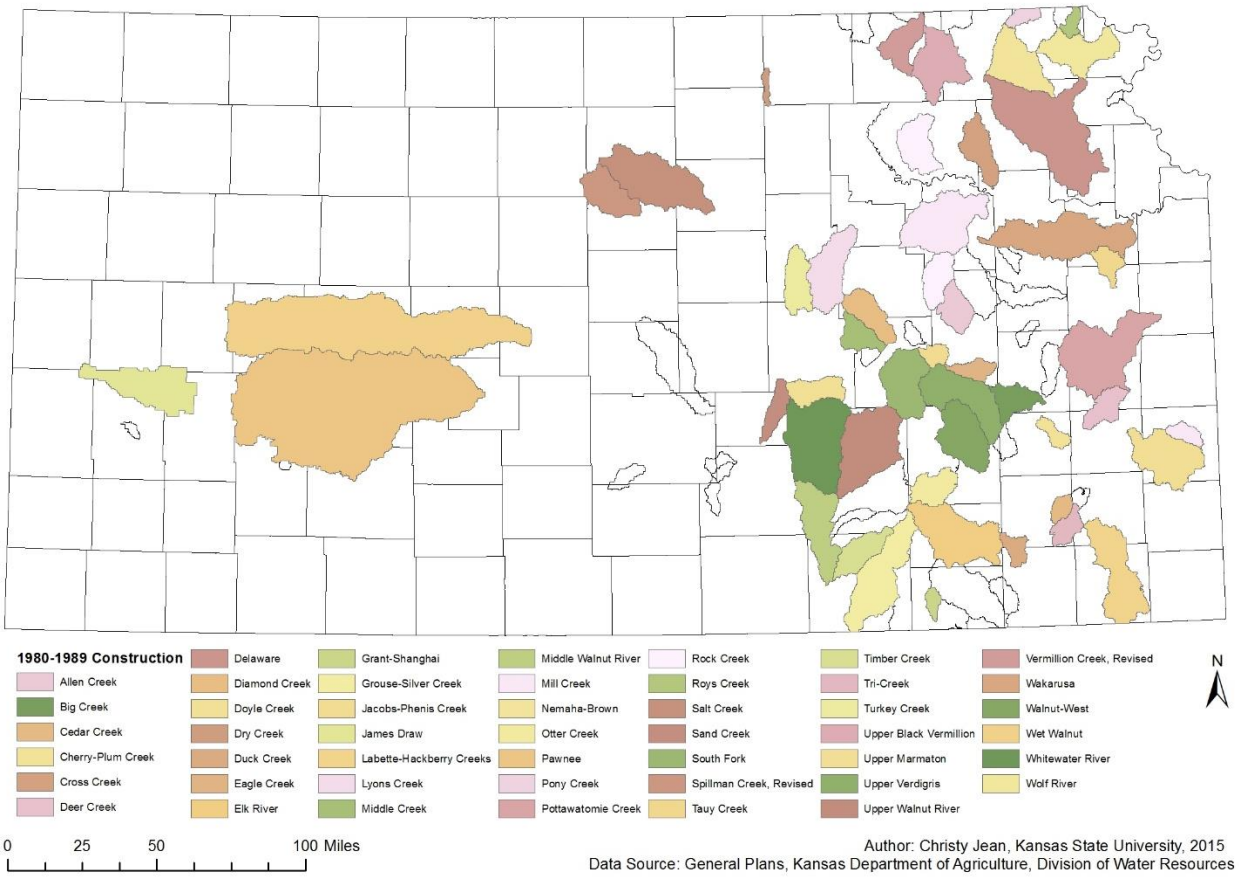

Figure 4.24: 1980-1989 Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.7: 1980-1989 Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plan)

Allen Creek WD No. 89	8		Peyton Creek WD No. 71	2
Big Creek WJD No. 48	4		Pony Creek WJD No. 78	8
Cedar Creek WJD No. 56	1		Pottawatomie Creek WJD No. 90	10
Cherry-Plum Creeks WJD No. 17	1		Rock Creek WD No. 45	3
Cross Creek WJD No. 42	3		Rock Creek WJD No. 84	4
Deer Creek WJD No. 55	2		Roy's Creek WD No. 75	6
Delaware WJD No. 10	46		Salt Creek WJD No. 46	23
Diamond Creek WJD No. 61	4		Sand Creek WJD No. 68	4
Doyle Creek WJD No. 86	3		South Fork WJD No. 76	4
Dry Creek WJD No. 57	2		Spillman Creek WJD No. 43	7
Duck Creek WJD No. 59	2		Tauy Creek WJD No. 82	3
Eagle Creek WD No. 77	3		Timber Creek WJD No. 38	2
Elk River WJD No. 47	3		Tri-Creek WJD No. 100	3
Grant-Shanghai WD No. 14	1		Turkey Creek WJD No. 32	2
Grouse-Silver Creeks WJD No. 92	4		Upper Black Vermillion WJD No. 37	4
Jacobs-Phenis Creeks WJD No. 94	5		Upper Little Arkansas WJD No. 95	3
James Draw WJD No. 87	1		U. Marais des Cygnes WJD No. 101	4
Labette-Hackberry C. WJD No. 96	3		Upper Verdigris WJD No. 24	1
Lyons Creek WJD No. 41	2		Upper Walnut WJD No. 33	8
Marmaton WJD No. 102	1		Vermillion Creek WJD No. 70	7
Middle Creek WJD No. 62	8		Wakarusa WJD No. 35	6
Middle Walnut WJD No. 60	11		Walnut-West Creeks WD No. 72	6
Mill Creek WJD No. 85	4		Wet Walnut Creek WJD No. 58	27
Mill Creek WJD No. 98	2		Whitewater River WJD No 22	7
Mount Hope WJD No. 54	1		Wolf River WJD No. 66	4
Nemaha-Brown WJD No. 7	27		Marais Des Cygnes DD No. 1	4
Otter Creek WJD No. 83	2			
Pawnee WJD No. 81	13		**Total Watershed Structures**	**329**
			Total Watershed Districts	**52**

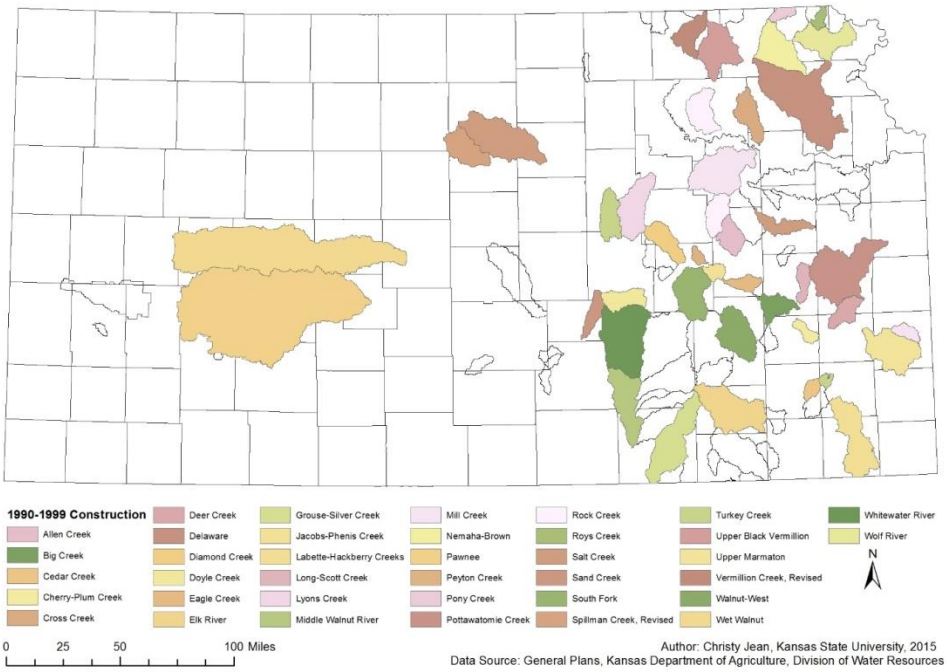

Figure 4.25: 1990-1999 Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.8: 1990-1999 Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plan)

Allen Creek WD No. 89	4
Big Creek WJD No. 48	2
Cedar Creek WJD No. 56	2
Cherry-Plum Creeks WJD No. 17	2
Cross Creek WJD No. 42	12
Deer Creek WJD No. 55	3
Delaware WJD No. 10	51
Diamond Creek WJD No. 61	3
Doyle Creek WJD No. 86	2
Eagle Creek WD No. 77	3
Elk River WJD No. 47	3
Grouse-Silver Creeks WJD No. 92	1
Jacobs-Phenis Creeks WJD No. 94	2
Labette-Hackberry Creek WJD No. 96	2
Long-Scott Creeks WD No. 93	5
Lyons Creek WJD No. 41	1
Marmaton WJD No. 102	5
Middle Creek WJD No. 62	2
Middle Walnut WJD No. 60	4
Mill Creek WJD No. 85	9
Mill Creek WD No. 98	6
Nemaha-Brown WJD No. 7	19
Pawnee WJD No. 81	8
Peyton Creek WD No. 71	2
Pony Creek WJD No. 78	6
Pottawatomie Creek WJD No. 90	4

Rock Creek WD No. 45	13
Rock Creek WJD No. 84	3
Roy's Creek WD No. 75	4
Salt Creek WJD No. 104	3
Salt Creek WJD No. 46	4
Sand Creek WJD No. 68	1
South Fork WJD No. 76	9
Spillman Creek WJD No. 43	2
Tauy Creek WJD No. 82	7
Tri-Creek WJD No. 100	2
Turkey Creek WJD No. 32	1
Turkey Creek WJD No. 103	1
Upper Black Vermillion WJD No. 37	2
Upper Little Arkansas WJD No. 95	5
Upper Marais des Cygnes WJD No. 101	5
Upper Walnut WJD No. 33	4
Vermillion Creek WJD No. 70	20
Wakarusa WJD No. 35	4
Walnut-West Creeks WD No. 72	4
Wet Walnut Creek WJD No. 58	16
Whitewater River WJD No 22	5
Wolf River WJD No. 66	8
Marais Des Cygnes DD No. 1	1
Total Watershed Structures	**287**
Total Watershed Districts	**48**

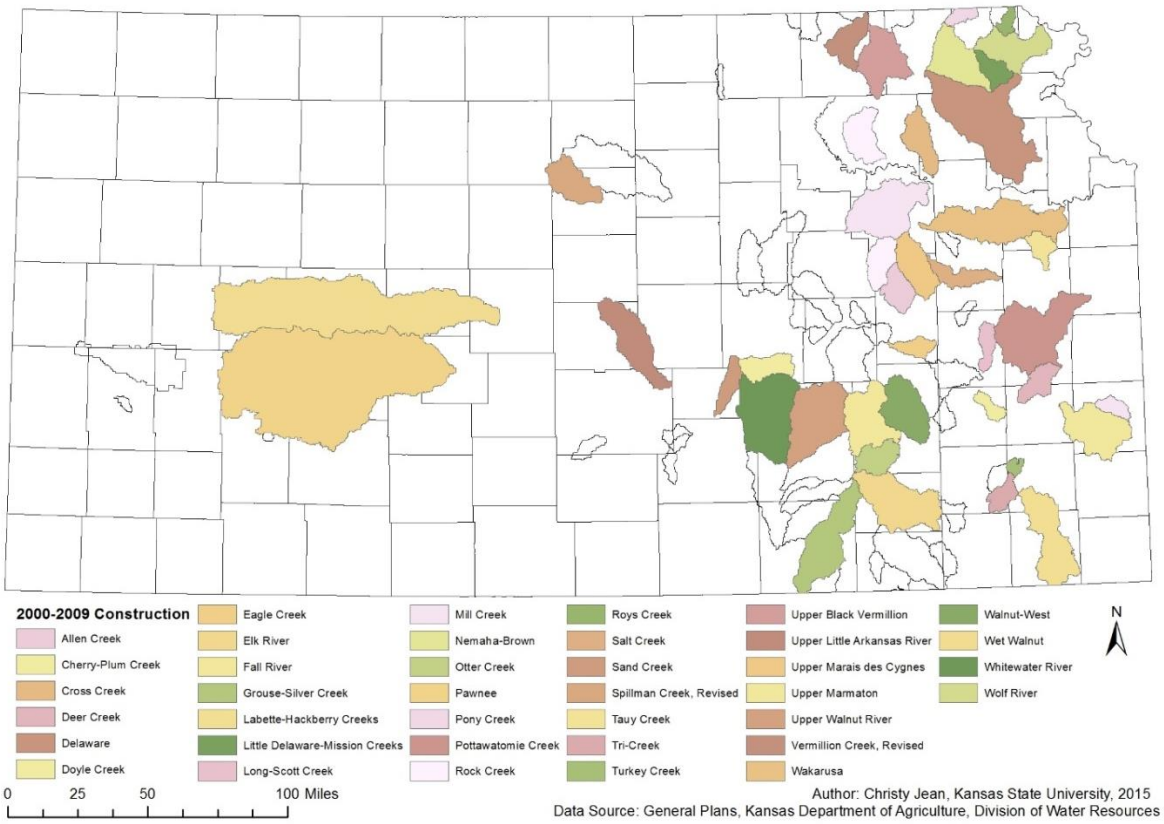

Figure 4.26: 2000-2009 Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.9: 2000-2009 Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plan)

Allen Creek WD No. 89	4
Cherry-Plum Creeks WJD No. 17	1
Cross Creek WJD No. 42	5
Deer Creek WJD No. 55	1
Delaware WJD No. 10	18
Doyle Creek WJD No. 86	1
Eagle Creek WD No. 77	1
Elk River WJD No. 47	1
Fall River WJD No. 21	2
Grouse-Silver Creeks WJD No. 92	1
Labette-Hackberry Creek WJD No. 96	1
Little Delaware-Mission Creeks WJD No. 5	1
Long-Scott Creeks WD No. 93	3
Marmaton WJD No. 102	12
Mill Creek WJD No. 85	11
Mill Creek WD No. 98	4
Nemaha-Brown WJD No. 7	3
Otter Creek WJD No. 83	1
Pawnee WJD No. 81	3
Pony Creek WJD No. 78	5
Pottawatomie Creek WJD No. 90	1
Rock Creek WD No. 45	3

Rock Creek WJD No. 84	3
Roy's Creek WD No. 75	1
Salt Creek WJD No. 104	3
Sand Creek WJD No. 68	1
Spillman Creek WJD No. 43	2
Tauy Creek WJD No. 82	4
Tri-Creek WJD No. 100	2
Turkey Creek WJD No. 103	1
Upper Black Vermillion WJD No. 37	6
Upper Little Arkansas WJD No. 95	1
Upper Marais des Cygnes WJD No. 101	1
Upper Walnut WJD No. 33	3
Vermillion Creek WJD No. 70	4
Wakarusa WJD No. 35	3
Walnut-West Creeks WD No. 72	2
Wet Walnut Creek WJD No. 58	2
Whitewater River WJD No 22	3
Wolf River WJD No. 66	7
Total Watershed Structures	**83**
Total Watershed Districts	**40**

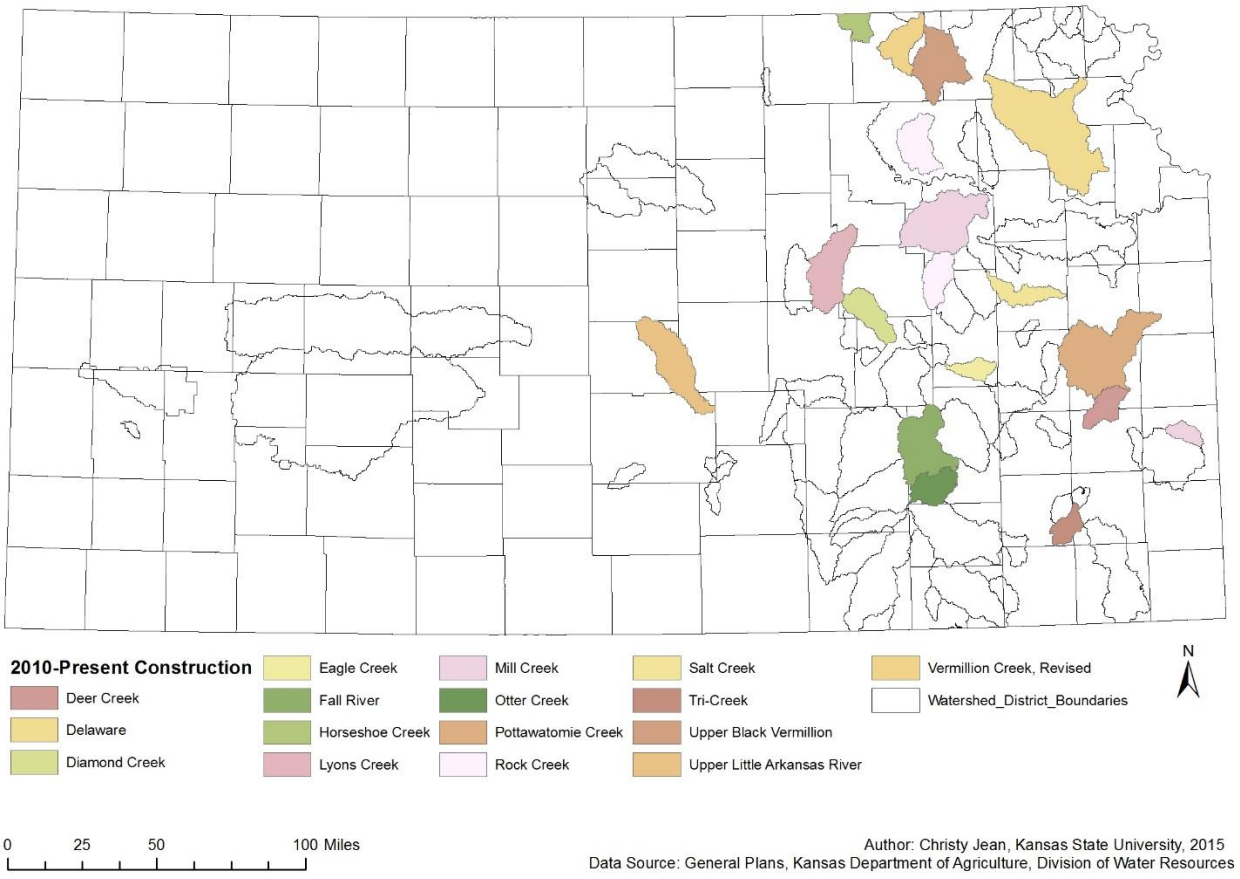

Figure 4.27: 2010-Present Completed Watershed Structures
(Source: Map by author; data from Watershed Districts' General Plans)

Table 4.10: 2010-Present Completed Watershed Structures per Watershed District
(Source: Table by author; data from Watershed Districts' General Plan)

Deer Creek WJD No. 55	1
Delaware WJD No. 10	4
Diamond Creek WJD No. 61	1
Eagle Creek WD No. 77	1
Fall River WJD No. 21	1
Horseshoe Creek WJD No. 110	4
Lyons Creek WJD No. 41	1
Marmaton WJD No. 102	5
Mill Creek WJD No. 85	1
Mill Creek WD No. 98	1
Otter Creek WJD No. 83	2

Pottawatomie Creek WJD No. 90	1
Rock Creek WD No. 45	2
Rock Creek WJD No. 84	1
Salt Creek WJD No. 104	1
Tri-Creek WJD No. 100	1
Upper Black Vermillion WJD No. 37	1
Upper Little Arkansas WJD No. 95	1
Vermillion Creek WJD No. 70	1
Total Watershed Structures	31
Total Watershed Districts	19

The spatial distribution of watershed structure construction over time, reflect the peak years identified in Chapter 3. Watershed districts also vary by size across the state, with the largest districts by acreage located in western Kansas and the largest number of watershed districts by number based in eastern Kansas (Figure 4.28).

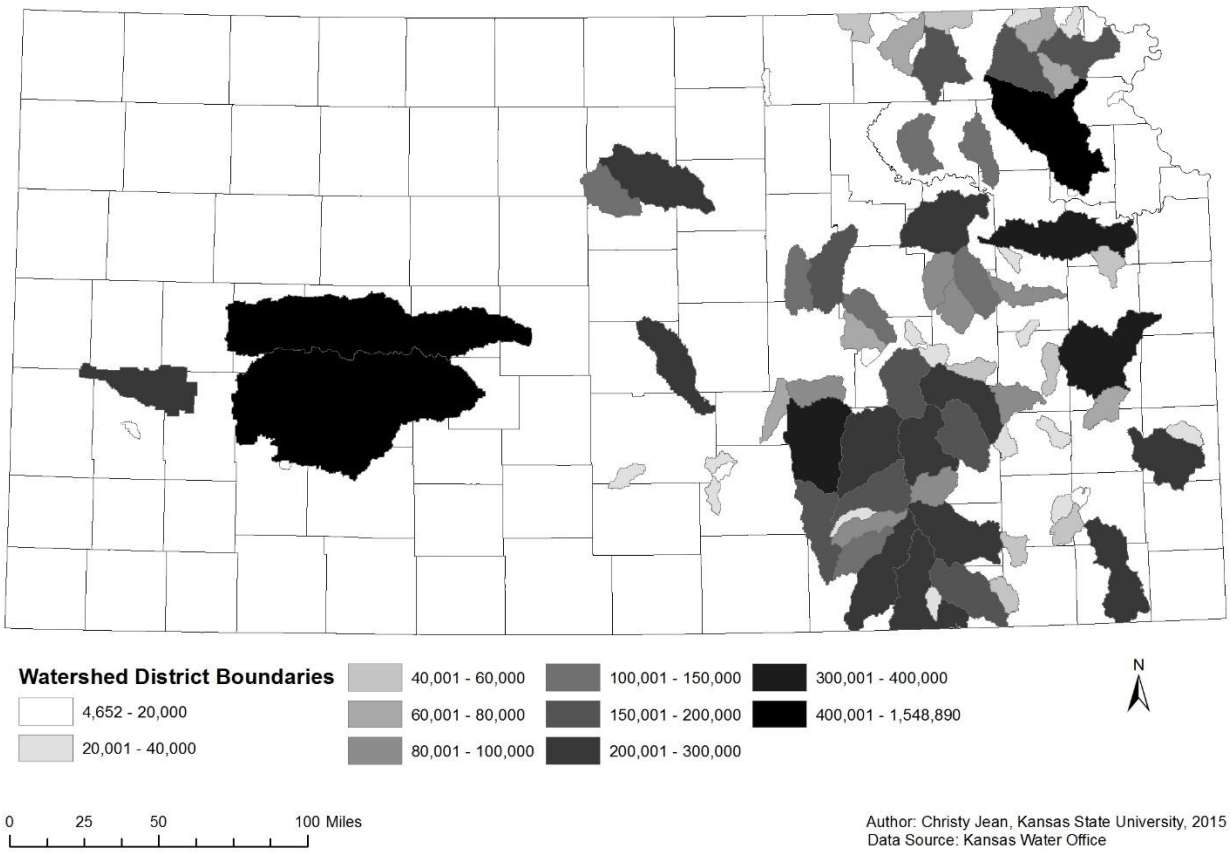

Figure 4.28: Watershed District Size by Acres
(Source: Map by author; data from Kansas Water Office)

Despite the large amount of area covered in the western half of the state, there are very few watershed districts that make up that area. The largest watershed district in the state, Pawnee Watershed Joint District No. 81, occupies 1,584,890 acres of western Kansas and could easily fit over 46 of the smaller watershed districts that exist in the west within its borders. Although the western Kansas has two of the largest watershed districts in the state, there is a

significant difference between the largest district and the smallest district: Cimarron Watershed District No. 3 which only covers 6,412 acres. Watershed districts on the eastern side of the state tend to be smaller but more similar in size with an average of 220,671 acres among all 62. The largest watershed district in eastern Kansas is Delaware Watershed Joint District No. 10 at 489,705 acres and the smallest district which also happens to be the smallest watershed district in Kansas is Thompsonville Watershed District No. 6 with 4,652 acres.

By removing the three largest watershed districts, Delaware Watershed Joint District No. 10, Wet Walnut Watershed Joint District No. 58, and Pawnee Watershed Joint District No 81, there is a distinct pattern in the way watershed structures have been completed throughout time given the size of the watershed district (Figure 4.29). This also illustrates the need to focus on watershed districts that are greater in size, but have a low number of watershed structures. For example, James Draw WJD No. 87, which is situated on close to 250,000 acres currently only has one completed structure. Similar cases exist for Grouse-Silver Creek WJD No. 92, Upper Little Arkansas River WJD No. 95, and Labette Hackberry Creek WJD No. 96.

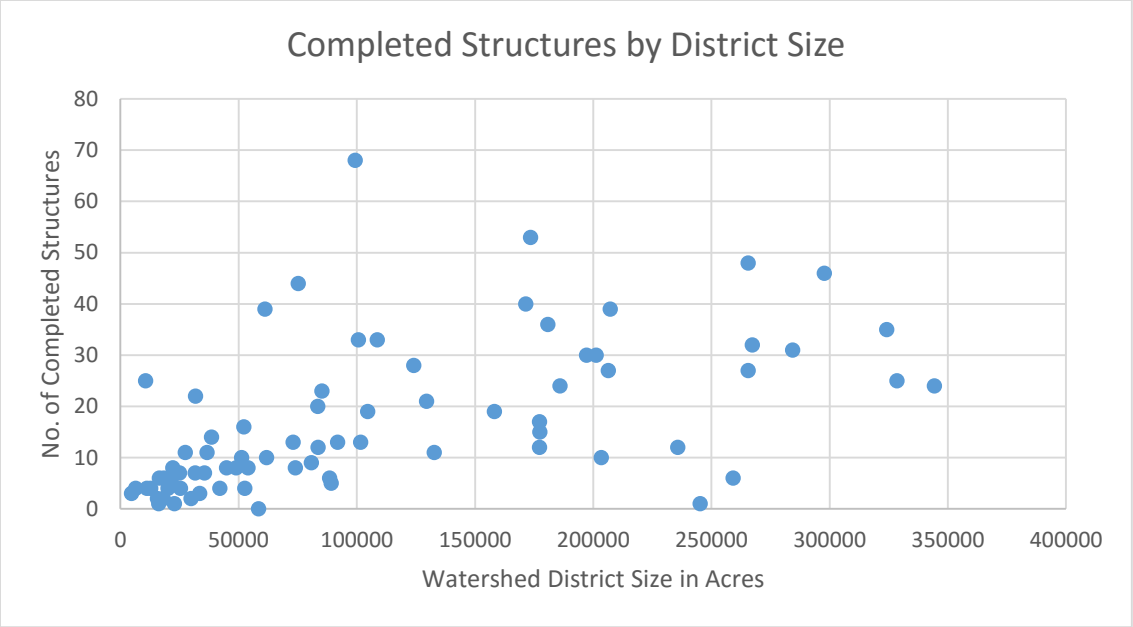

Figure 4.29: Number of Completed Structures per District (by size in acres) (Source: Graph by author; data from Kansas Water Office)

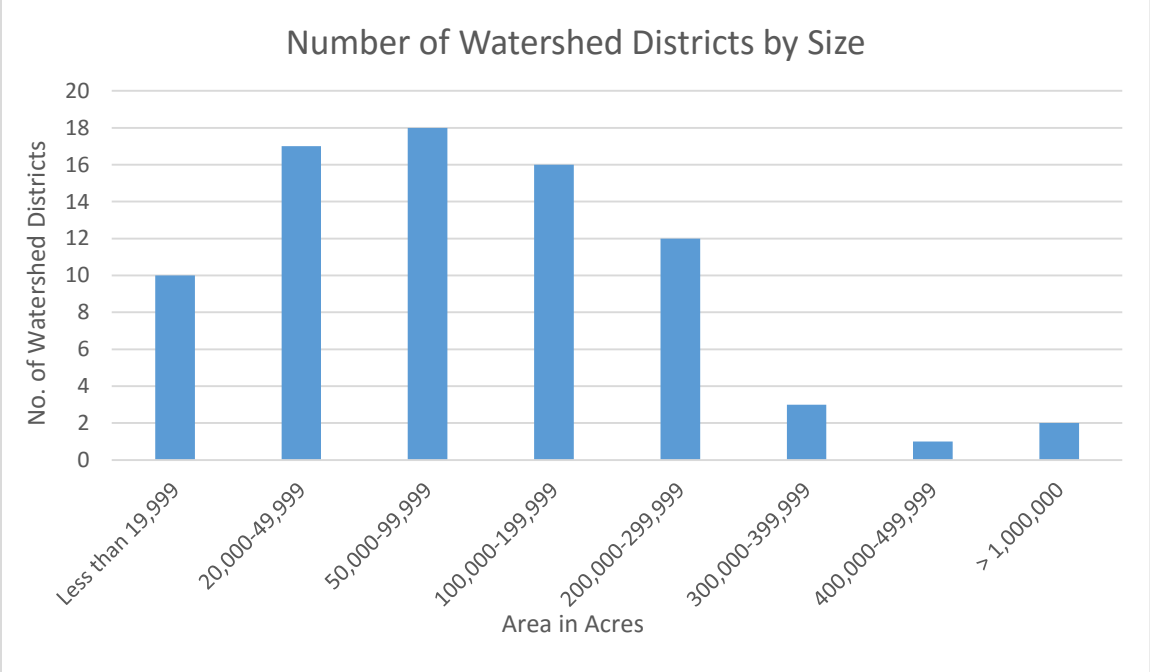

Figure 4.30: Number of Watershed Districts by Size (acres) (Source: Graph by authors; data from Kansas Water Office)

Precipitation, Ecoregions and Land Use

Ecoregions identified in Figures 4.15-4.17 are an indication of the precipitation and ecosystem variations Kansas watershed districts experience. Low precipitation values on the western half of the state, account for at least 7 watershed districts who receive less than 19" a year. The eastern part of Kansas, and in particular the south eastern corner of Kansas experience the greatest amount of precipitation across the state.

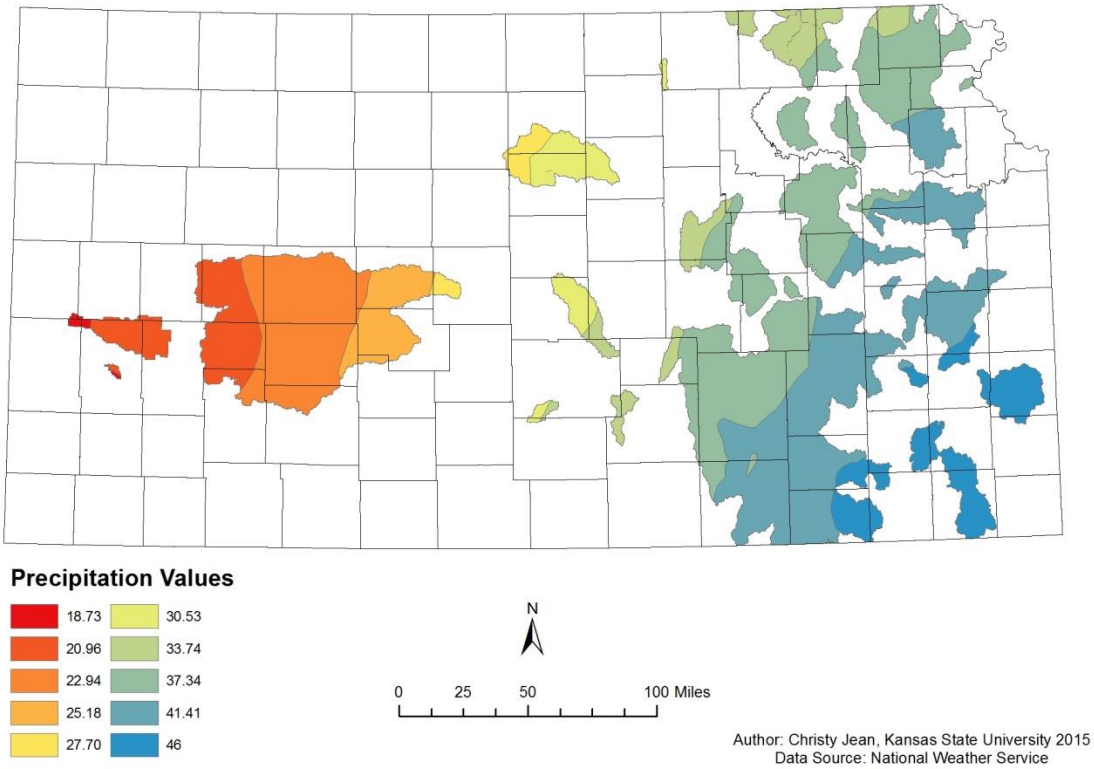

Figure 4.31: Kansas Watershed Districts: Precipitation
(Source: Map by author; data from National Weather Service)

Using Bailey's ecoregions to identify the spatial aspects of watershed districts across the state, it is evident that there is sharp divide between the ecosystems that divide Kansas in half. Fourteen of the 80 watershed districts have boundaries that exist entirely within the dry domain region, accounting for over 3,670,704 acres of western Kansas. Lyons Creek, Doyle Creek, Whitewater River, and Middle Walnut watershed districts are divided by dry domain and humid

temperate domain ecoregions which makes up 780,197 acres of shared space. The remaining 62 watershed districts that exist entirely in the humid temperate zone cover 6,951,153 acres of eastern Kansas (Figure 4.32). Tropical and polar air masses contribute to the climate of the Humid Temperate Domain which experiences pronounced season with strong annual cycles of temperate and precipitation (EOEarth 2009). The Dry Domain which makes up the western half of the state differs from the humid temperate domain, in that its rate of evaporation exceeds the annual water gains from precipitation (EOEarth 2009). Low precipitation rates in conjunction high evaporation rates due to high temperatures prevent permanent streams from originating in dry climate zones (EOEarth 2009).

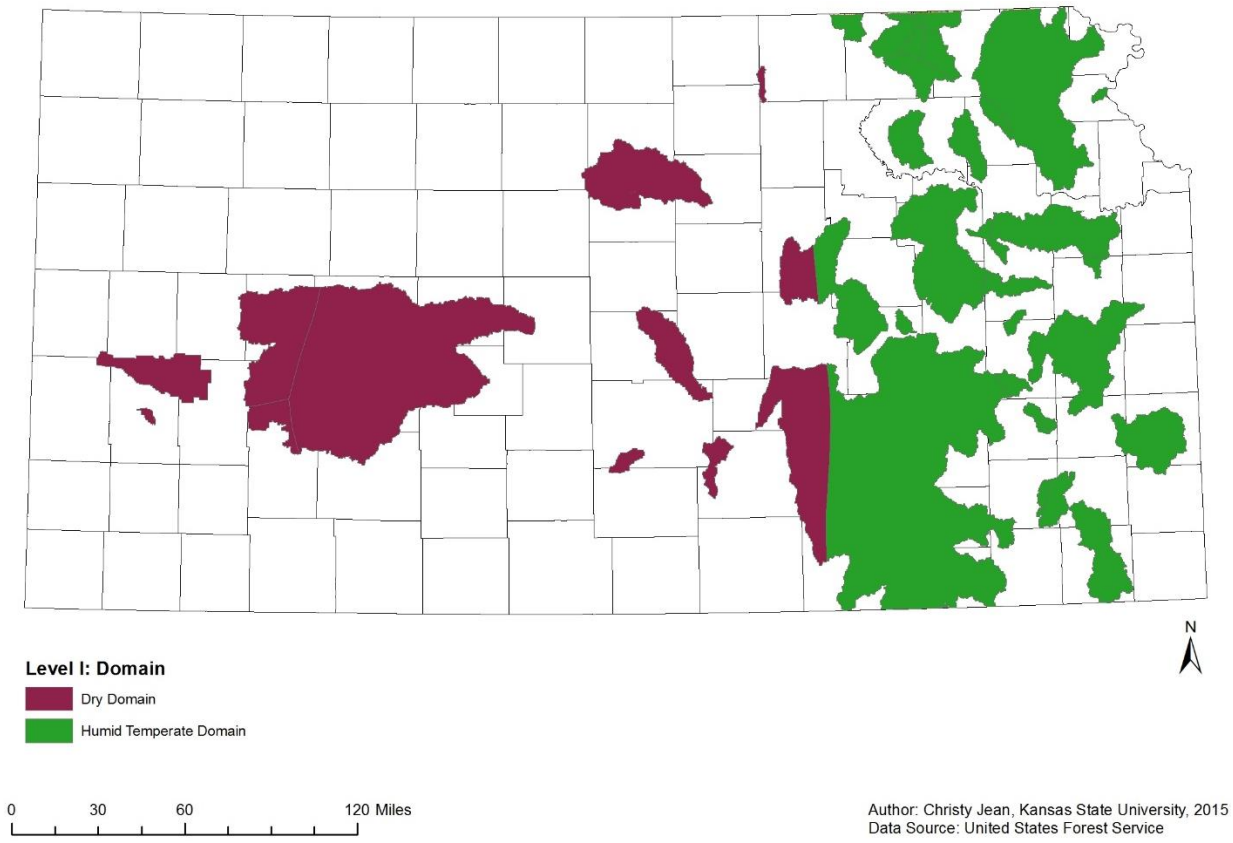

Figure 4.32: Kansas Watershed Districts: Baileys Ecoregions Level I (Source: Map by author; data from United States Forest Service)

In western Kansas, both Wet Walnut Creek WJD No. 58 and Pawnee Creek WJD No. 81 experience variations in temperature and perception according to Baily's ecoregions. The drier western half of Wet Walnut WJD No. 58 and Pawnee WJD No. 81 is considered to be in the Dry Domain, Temperate Steppe Division, Great Plains-Palouse Dry Steppe Province (Figure 4.33).

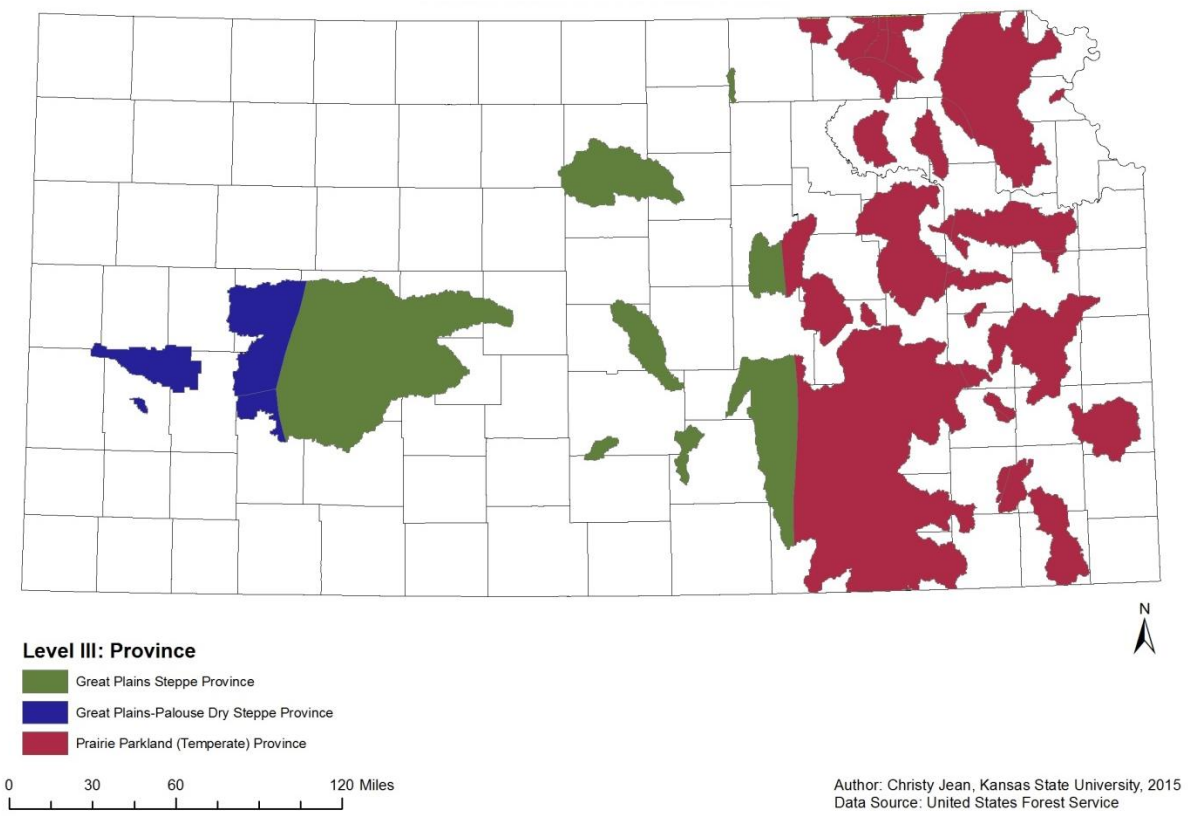

Figure 4.33:Watershed District Boundaries: Baileys Ecoregions Level III (Source: Map by author, data from United States Forest Service)

Characteristics of this ecoregion are described as rolling plains and tableland with moderate relief from 5,500 ft on its eastern extent to 2,500 ft on the western extent (EOEarth 2009). The region lies in the rain shadow of the Cascade Range and Rocky Mountains contributing to its semiarid continental regime, with an average annual temperature of 45˚F and precipitation ranges from 10 inches to 25 inches (EOEarth 2009). Summer precipitation is usually exceeded by evaporation rates resulting in a low supply of moisture (EOEarth 2009).

Moving eastward through Wet Walnut and Pawnee watershed districts, the region transitions the Great Plains Steppe Province with a relief less than 300 feet characterized by flat and rolling plains (EOEarth 2009). The average annual precipitation gradually starts to increase resulting in less severe drought periods (EOEarth 2009). The eastern half of the state is classified as Prairie Parkland (Temperate) Province, and covers a majority of the watershed districts in Kansas. The climate in this area is described as hot summers and cold winter with an average annual precipitation of 20-40 inches, falling mainly during the growing season (EOEarth 2009). Favorable climate and soil conditions have allowed most of this area to be cultivated leaving little of the original dominant prairie vegetation (EOEarth 2009). Further subdivisions of ecoregion classification, to include landforms are included in the fourth level of Bailey's ecoregions entitled 'sections' (Figure 4.34)

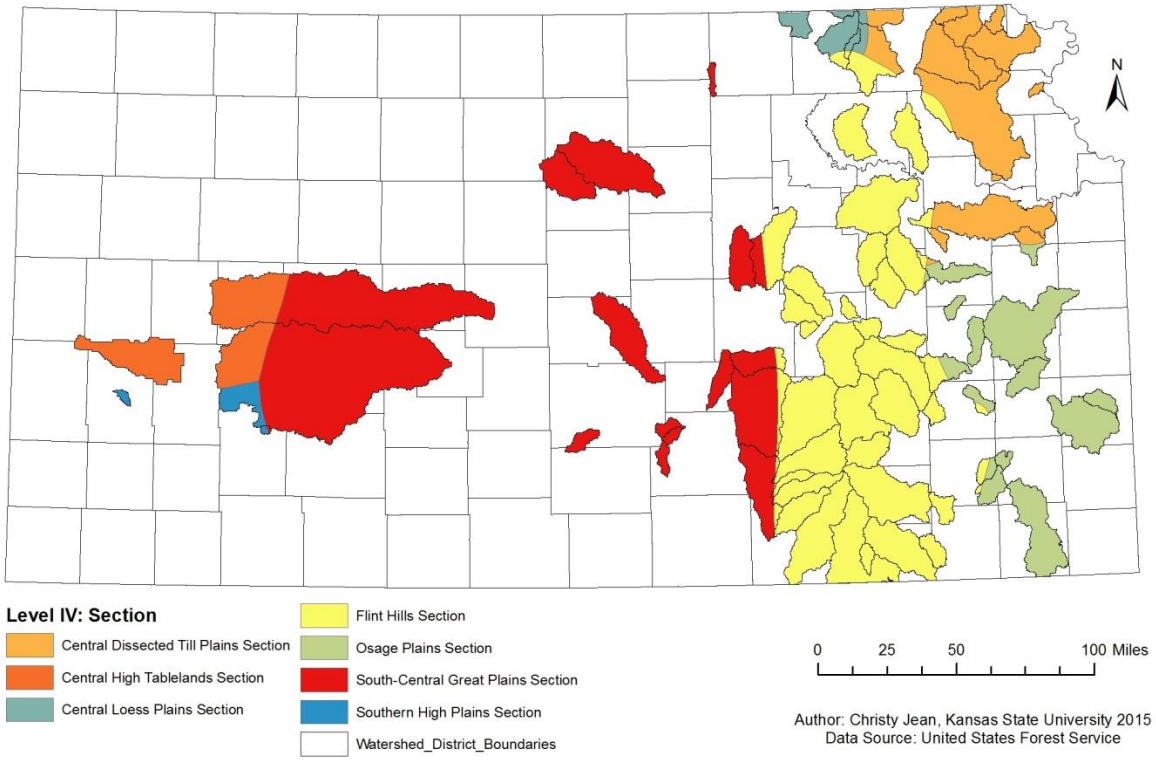

Figure 4.34: Watershed District Boundaries: Baileys Ecoregions Level IV (Source: Map by author, data from United States Forest Service)

Not only do the differences in ecosystems vary across the state, the type of land use associated with each watershed district plays an influential role on the successes and challenges of their watershed structures. Land use in the western half of the state is dominated by cultivated crops and grasslands while the eastern half of the state experiences more grassland coverage and land use towards pasture and hay production (Figure 4.35). Examining precipitation, ecoregions and land use/land cover within the watershed districts can provide a better indication of where and why watersheds districts and structures exist where they do.

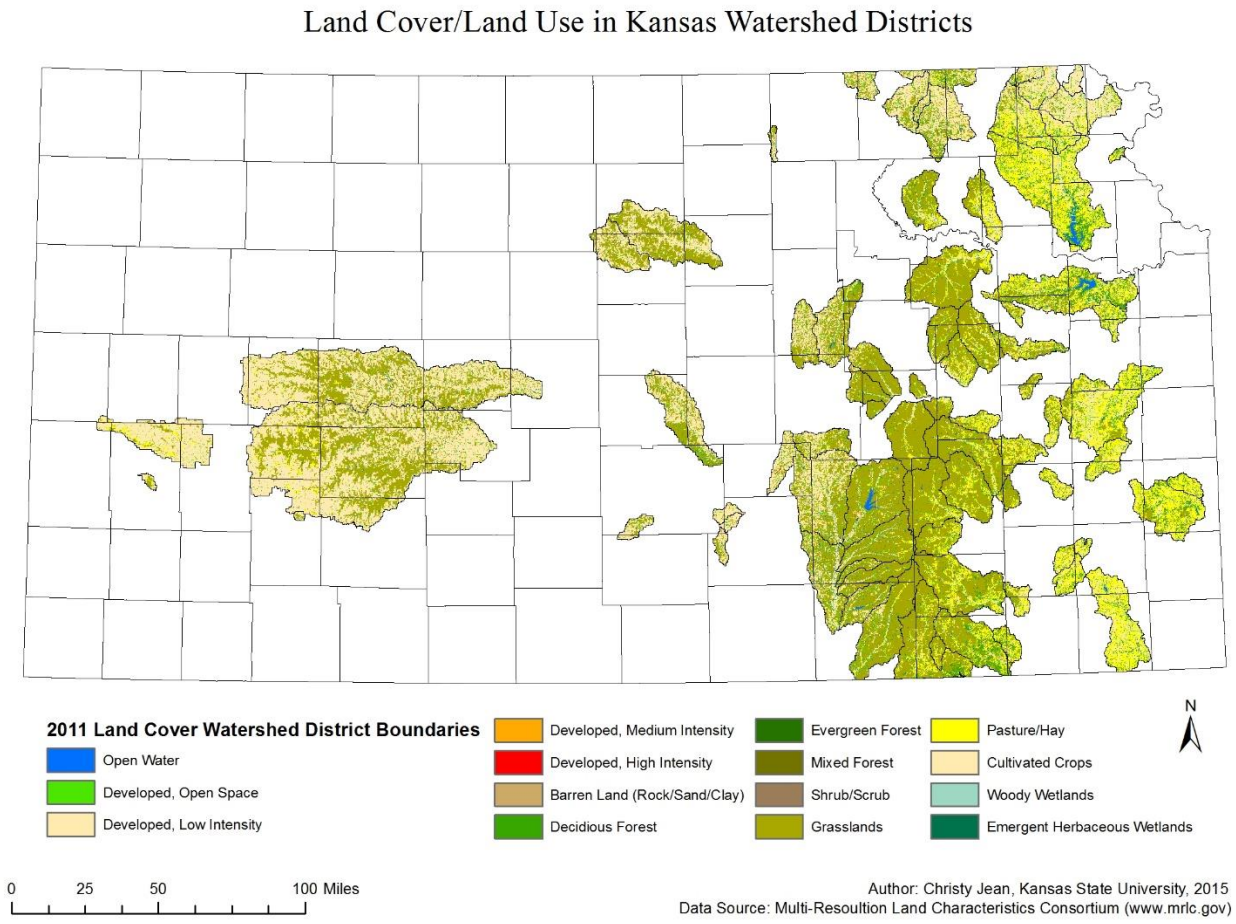

Figure 4.35: Kansas Land Use Land Cover within Watershed District Boundaries (Source: Map by author; data from General Plans and DASC)

Chapter 5 - Conclusions

As watershed structures continue to age, the land use changes around them, and population numbers change across Kansas, so, too, do the benefits associated with watershed districts. For the past 60 years, average annual benefits have been based on the original state of the area given the completion of all of the proposed watershed structures. Most watershed districts organized between 1950 and the mid 1980's calculate the average annual benefit for the entire watershed district. In the latter part of the mid 1980's general plans were restructured to indicate the benefit/cost ratio per watershed structure. This new method would allow calculations to enable a more comparable benefit/cost calculation however, that scale of analysis is beyond the time constraints of this project.

Summary

A set of four factors – economic, political, social, and geographical – help explain how watershed district management can vary across the state. Understanding both the big picture of Kansas Watershed Districts, and the individual story of a watershed district is crucial to telling an accurate story of how these factors impact and influence watershed management goals.

From an economic standpoint, the story of Kansas watershed districts is a work in progress. In total, the number of proposed watershed projects, based on the last amended general plans, has the potential of providing over $115 million in annual benefits (2014 dollars) through monetary and flood damage reduction efforts. Maintaining and rehabilitating aging infrastructure is already a key challenge given the current financial limitations of most watershed districts in Kansas. With the increase in construction and engineering costs, what seems infeasible today will most likely be unattainable in the next decade. In order to maintain or improve upon an annual average benefit of $115 million, watershed districts will need funding

assistance in order to pursue new construction, to maintain current watershed structures, and to rehabilitate those which are in danger of meeting their life span sooner than predicted.

Still, there are significant political challenges that Kansas watershed districts face: the increase in federal and state regulations. State and federal agencies have been essential in creating watershed districts. At one time, Kansas was among the top three states leading the nation in the number of constructed dams. Government assistance tends to take the sting out of regulations when there is enough funding to aid watershed districts in meeting their flood control goals. However it is the decrease in funding and increase in regulations, which has created a negative perspective of the government agencies. This negative perspective is particularly true of federal agencies and programs that have continued to blockade new watershed construction in Kansas. Regulations have not only put a standstill to the efforts proposed by watershed districts, but it is quickly demoralizing the volunteers who sacrifice their time and energy to be a part of this local resource management institution.

Social capital is in danger as a lack of participation and a decline in the desire to continue will impact the health of watershed district boards. Boards will struggle to maintain a sufficient number of board members if these issues are not addressed. Without board members, operations and maintenance will decline, land acquisition will become next to impossible, and rehabilitation efforts will fall to the wayside. These challenges have grown to the level of exasperation over the past few decades and without intervention conditions will continue to worsen as time goes on.

A tie that brings economy, policy and social capital together is the ability to see the spatial and temporal distribution over time through the use of geospatial techniques. Over time, the economic support has peaked, declined, plateaued and eventually became almost non-

existent. This can be seen in the spatial distribution of watershed structures being completed by decade (Figures 4.21-4.4.27). Between the 1970s and the 1990s, watershed construction occupied the greater portion of the state, keeping an average of 75% of the watershed districts busy building new flood control dams. Politically, these watershed boundaries are defining new geographic areas, and creating new communities which also play into building the social capital of Kansas watershed districts. Here, we can see that watershed district boundaries in Kansas tend to be bigger in the west but more abundant in the east. Visual depictions of these findings are useful as policy makers, and the public gain a greater understanding of the uniqueness of and differences among watershed districts across the state.

Suggestions for Further Work

Further research is needed in several areas regarding the information stored in watershed district general plans. The time constraints of this study prevented a complete assessment of the goldmine of data contained in the watershed district general plans. The real value of understanding watershed benefits, is understanding what services they provide based on the structures that are already in place. The three main suggestions following this research address reevaluating the current benefits existing structures, increasing public awareness and education on the benefits of watershed structures, and identifying high priority sites for new construction.

Each general plan provides an average annual benefit for the watershed district based on the completion of all watershed structures in the general plan. The benefit takes into account the amount of flood damage reduction benefits and monetary benefits that were proposed during the original plan. General plans detailed out the land use/land cover, precipitation and population numbers at the time of the general plans enactment, however those numbers are extremely

outdated. Data on the aforementioned topics should be updated and used as a component into a more relevant analysis.

Examining and analyzing the ways in which watershed structures built prior to the 1980s provide benefits for the area would be crucial in readjusting to the needs of the watershed district. Amendments made to general plans that might include updated benefit information do not take into consideration the benefits of all of the structures in the watershed district. While there are differences among watershed districts in the ways in which amortization costs and benefit/cost ratios were figured, this is still a critical component of understanding watershed benefits. Minimum changes in population and land use are still more than enough to affect the actual benefits of a watershed structure. There needs to be a reevaluation of the potential benefits of watershed structures separating existing and proposed structures to get a better grasp on the actual benefits currently provided. Further research into sediment reduction and floodwater reduction would provide more accurate estimates of average annual benefits. On the ground inspections may be necessary to understand the life expectancy of a watershed structure and determine whether or not they are still providing the same intended benefits given their current sediment and flood retention capabilities. These inspections could help target limited government funds so that they do the most good.

There is also a need to create an increase in public awareness and education regarding watershed districts and their structures. An interactive web database that allows Kansas residents to see the purpose and efficacy of the dams their tax dollars pay for would provide limited but useful data on the location of constructed and proposed watershed structures through one outlet. This educational information could discuss the environmental service the structures provide.

In states like Oklahoma, the DamWatch program initiated by U.S. Engineering Solutions (USES) has been created to give real time updates of dam conditions. USES uses real-time monitoring of bridges, dams, levels and other infrastructure to aid key personnel in managing human and financial resources during critical events. The program, piloted by NRCS, can update users on whether or not the capacity of a dam will be exceeded based on the predicted amount of rainfall in any given area. DamWatch is a web-based interface that provides geospatial information on real time dam events that may led to hazardous, costly and/or potentially catastrophic events (USES 2015). DamWatch allows 24/7 web-based accessibility to environmental conditions by providing geographical and situational awareness to dam owners so that they can identify and prepare for potentially destructive events (USES 2015). Integrating DamWatch with parties that are concerned with flash flooding, such as the National Weather Service, would provide valuable information on forecasting potentially catastrophic events. The addition of a national service would address concerns about dam safety and failures. Kansas would benefit tremendously from this type of information and interaction with the public. In addition to general public awareness, it is also important for the board members and local stakeholders to be able to make educated decisions within their watershed districts. Activities to improve local knowledge might include educational workshops that cover the expectations, requirements and opportunities available to watershed districts.

The last suggestion is more of a call to action. With over half the proposed watershed structures still in need of construction, there is a need to identify priority sites for new watershed construction across the state. In the absence of political, economically and social factors, a priority site map was constructed to show where new watershed structures sites would be most beneficial (Figure 5.1). The following map takes into consideration: digital elevation model,

population, precipitation and land use/land cover. All of the data was obtained from DASC and input into ArcGIS 10.1.3. Each data layer was reclassified to assign values which would indicate high priority sites. Sites with greater slopes, high population, high precipitation and developed land use were given priority. Justification for this geographic model was used by overlaying current watershed structures over the high priority map. Figure 5.1 indicates that the highest priority area covers nearly 16 watershed districts located in the Flint Hills ecoregion.

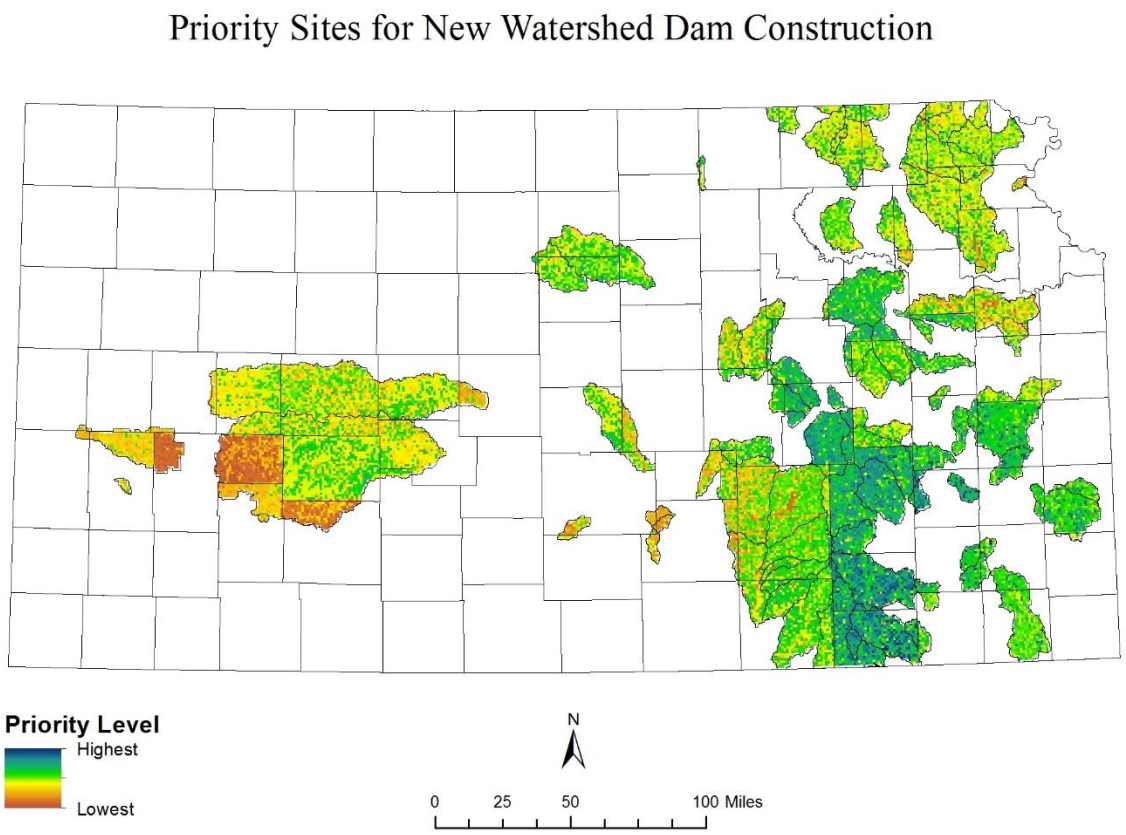

Figure 5.1: Priority Sites for New Watershed Dam Construction (Source: Map by author; data from DASC)

Figure 5.2 provides a good example of how the spatial pattern of existing watershed structures correspond with the high priority areas. The priority sites map provides some justification for the installation of new watershed structures, but other factors (economic, political and social) will impact watershed district decisions. However, this new map is a start in

addressing how GIS models can contribute to the overall goals of Kansas watershed districts. Continued development of a model similar to this, with the input from SAKW, DWR, DOC, and NRCS would be beneficial in meeting general plan objectives.

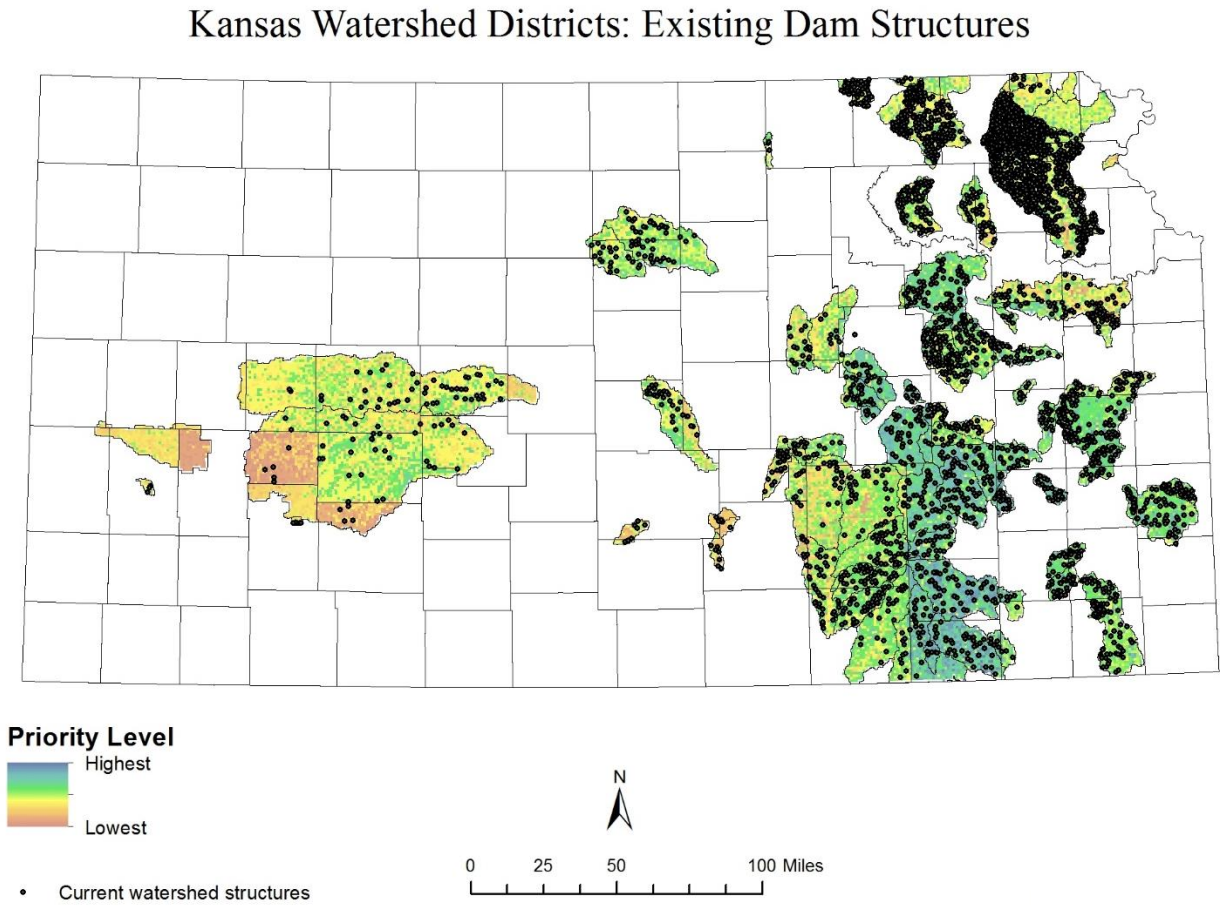

Figure 5.2: Existing Dams in Priority Sites
(Source: Map by author; data from DWR, KWO, and DASC)

Discussion

The story continues to be written as Kansas watershed districts adapt to address flood control and erosion control issues in different ways and take on other new challenges.

The changing story of watershed districts will continue to be a topic for discussion, as new funding becomes available, new objectives are met, and new obstacles are overcome. With the passing of HB 2016, allowing DOC to become a third party easement, watershed district

boards are hopeful that new watershed construction is on the horizon. Of course, this is just a small step in the 'right' direction for these boards. The increasing prices of construction and engineering will continue to be a detriment for new dams until more funding comes available for both state and federal agencies to provide state-cost share assistance to these local governances. On top of funding, land acquisition will be the next hurdle districts must overcome. Watershed district boards are in an uphill battle to convince landowners to put watershed structures on their property, especially now with the increased government regulations. Many farmers fear regulations put out by the EPA and United States Army Corps of Engineers (Corps) that water sources may become property or manageable by the government if the watercourse is deemed as a navigable stream. Incentives meant to entice landowners such as increased property value and tax exemptions are still not enough to encourage some landowners to put dams on their property. KSA 79-201g allows a 20 year tax exemption for any lands contiguous to or donated in connection with the erection of a dam or reservoir (KSA 79-201g). If dams are meant to last at minimum of 50 years, why does the tax break only last 20 years?

Policy is important in the watershed story in at least two ways. A first is understanding how local stakeholders perceive policy and a second is understanding how policy impacts watershed district efforts. Social capital issues are important in addressing policy perceptions and can be interpreted through a mixed methods research approach. For over sixty years, watershed districts have been formed by volunteers in Kansas that had a desire to reduce flood damages, keep transportation routes open and active and to provide a better and more sustainable future for the next generation. For the volunteers who commit their time, energy, and knowledge to these watershed districts, and for the structures they promise to maintain in order to protect Kansans, the story won't change very much. These volunteers will do what they have always

done. They will sacrifice their time for the benefit of the community, they will tell their story to the younger generations, and they will continue to be the backbone of what makes the Kansas Watershed District Story.

Districts' Interaction with State and Federal Agencies

Throughout this study, it was evident that there were differences in the ways watershed districts were interacting with state and federal agencies. For both governmental bodies, the relevant employees want to help watershed districts do the best job possible. A major difference between state and federal agencies is their specific requirements for cost-share assistance, construction, and maintenance of structures. Additional funding for rehabilitation measures can only be received by NRCS if the structure was completed with NRCS funds, through PL-566, RC&D and other like programs. Whereas state-cost share assistance may be applied for by any watershed district for any watershed structure. In fact, applying for federal cost-shares was reported as a significant challenge by 15 out of 60 watershed districts who responded to the SAKW survey (Table 4.1). NRCS also requires that operation and maintenance (O&M) reports be sent to them quarterly updating the status of NRCS structures, whether they are in an all federal or combined watershed district. Both NRCS and DWR define significance levels for risk differently and therefore NRCS might require an emergency action plan (EPA) when the state would not require one. Still, there was a clear divide between watershed districts who had received either all state or all federal funding. A sense of loyalty seemed to emerge as federal only districts praised the efforts of NRCS with little regard to state assistance:

> Our dams are over 50 years old so they changed hands from the federal, NRCS, to state control. The state is starting to demand a lot of stuff like engineering inspections and things like that, that we are trying to keep up with.
>
> – Board president

> A lot of the stuff that the Division of Water Resources is doing is trying to, in my opinion; undermine the engineers who designed the dam. The state is trying to regulate everything and it's a little more than I deem necessary.
>
> – Board president

Nonetheless, there was still a strong sense of support for state agencies among most watershed districts. The more lenient requirements made of the state, usually casted them in a good light. When comparing the perceptions of how stakeholders were regarding state and federal agencies differently, a general trend towards state favorability emerged. Statements about state involvement were usually in comparison to the involvement of federal agencies.

> Tell you what. Most of the state: DWR, DOC. We really have no problems with them. They've been very cooperative with us. I guess the one we fight the most is wildlife and parks.
>
> – Board member

> They've put the brakes on us. The state, not so much, but the federal has.
>
> – Board member

Recommendations for New Watershed Districts

A proposal of new watershed districts in Kansas will face a number of opportunities but not without challenges. The efforts by SAKW, NRCS, DOC and DWR to understand the challenges within watershed districts means they are actively trying to pursue watershed districts that may not have had the successes of some of their counterparts. Identifying watershed districts that experience challenges in maintaining board members, performing maintenance operations, applying for funding and understanding the resources available to expanding their knowledge on watershed activities is essential in creating successful boards. New watershed districts will have the opportunity to enter into a group of state agencies who continually strive to improve watershed districts goals. Unfortunately, the current state agencies involved are

understaffed and underfunded. A combination of those factors will most likely to lead to frustrations, something that new watershed districts will need to be prepared for:

> On the federal level, we got the EPA and Corps of Engineers that have put so much restriction on what we can and can't do. On the stateside, a lot of it is staffing I believe. DWR, DOC are understaffed. They need more help I think. Somebody leaves, somebody retires, they won't replace them.
>
> – Board manager

The next step by SAKW, NRCS, DOC and DWR will be to bring awareness of watershed efforts through educational programs and increased communication between state agencies and local watershed districts. The first target audience should be watershed district board members and the second audience the general public. Volunteers who participate in watershed district boards should understand the responsibilities and requirements of their district. Watershed district boards have access to the Watershed District Handbook assembled by the State Conservation Commission as a "source of information in carrying out governmental responsibilities as they relate to state program assistance" (SCC Watershed District Handbook 2008, i-1) . The handbook includes information on watershed district administration, financial guidelines, board meetings, cost-share assistance, construction, rehabilitation, inundation mapping, and watershed district law. While most boards have a paper copy of the handbook, there still seems to be a lack of in-house knowledge on the expected role of watershed district boards. The problem with creating a handbook is that it can be put on a shelf and forgotten. Using a monthly or quarterly newsletter, both electronic and paper versions, which remind watershed districts of resources available to them, would be useful in keeping watershed district boards engaged in new challenges and familiar expectations. Topics that could easily be addressed include updated state and federal policies, standard operating procedures for the district, and assistance in completing paperwork required by the state.

In addition to ensuring a well-educated watershed district board, an increase in public awareness is essential. Greater community support will develop as watershed districts become more transparent with their flood control goals and the values provided. Wet Walnut Watershed Joint District No. 58 is a great example of increasing public awareness in western Kansas. They participate in local festivals, provide a scholarship program for high school graduates, and are currently seeking the chance to work with local middle schools to educate 6th graders on the purposes and effects of flood control in their area. There is also a need to educate landowners who now have to deal with the responsibilities of maintaining a dam on their property. Landowners, who have inherited land or have purchased land with a dam on it, will benefit from contact with a supporting agency, a detailed listing or a brochure on their responsibilities.

Different Approaches in Research and Methods

The goal of this study was to identify the economic, political, social and geographical factors associated with Kansas watershed districts. Despite addressing each research question, a question remains: *what could/should have been done differently?*

This study was done in conjunction with a research project for the State Association of Kansas Watersheds. It was evident that two different agendas were trying to be met: application and theoretical. The application side was necessary for SAKW to gain a greater understanding of the challenges that Kansas watershed districts were currently facing and how state agencies might address those issues. In 9 months, SAKW wanted to examine the past, present and future of watershed districts by covering topics necessary to convey the history of the federal and state programs involved, update average annual benefits to the current dollar value, identify challenges experienced by the districts and to reiterate the success stories of local watershed districts through interviews and archival research. Nine months was a short window to

accomplish an extraordinary goal. In terms of the archival research used for SAKW, I would have rescanned the pdf versions of the general plans into searchable text so that going through the general plans would have been more time efficient.

The interview questions developed by the primary investigator were intended to draw out success stories from different watershed districts, but there were some shortcomings in getting that information from board members. It would have been more effective to have asked the participant to give an example of a success story within their area instead of basically repeating questions about the formation and development of the watershed district. There was also a set of questions that asked about the useful life of watershed districts and how long flood control projects should be maintained and what the useful life of flood control projects should be. These questions were confusing to the participant and they would answer both the same way. A lot of interview questions could have been avoided if there would have been a pre-test of the interviews so that changes could have been made after these discrepancies were identified. On the scholarly or theoretical side, which was intended specifically for identifying and evaluating how economic, political, social and geographical aspects were influencing watershed district management, I would have changed the interview questions to speak more towards understanding those perceptions.

The short 9 month period that these interviews were conducted, overlapped harvest and planting seasons. Watershed district boards in general, have a large representation of volunteers who have agriculture-based jobs. This constraint significantly cut down the actual time I was able to conduct interviews because there were less participants available during harvest or planting. Extending the time available for interviews to occur over a year would allow the use of more gaps between agriculture seasons which may have resulted in a larger sample. Ideally, I

would have liked to speak with each watershed district to get a better idea of the challenges and perceptions experienced across the state. There were several watershed district boards that were not interested in meeting for an interview. A second survey focusing more on board members perceptions would have made a greater contribution to the study.

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Appendix A - Watershed Districts Classified by Funding Agency

Watershed Districts Separated by Highest Percentage of Funded Sites

Federal

Andale WJD No. 9
Bee Creek WJD No. 15
Big Caney WJD No. 31
Cimarron WD No. 3
Cross Creek WJD No. 42
Dry Creek WJD No. 57
Duck Creek WJD No. 59
Elk River WJD No. 47
Fall River WJD No. 21
Frog Creek WJD No. 19
Grant-Shanghai WD No. 14
Jacobs-Phenis Creeks WJD No. 94
Lakin WD No. 49
Little Delaware-Mission Creeks WJD No. 5
Little Walnut-Hickory WJD No. 18
Lyons Creek WJD No. 41
Middle Creek WJD No. 62
Mission Creek WD No. 51
Muddy Creek WJD No. 27
Rock Creek WJD No. 28
Salt Creek WJD No. 46
Silver Creek WD No. 25
Snipe Creek WD No. 69
South Fork WJD No. 76
Spillman Creek WJD No. 43
Spring Creek WJD No. 16
Switzler Creek WD No. 63
Thompsonville WD No. 6
Timber Creek WJD No. 38
Turkey Creek WJD No. 32
Twin Caney WJD No. 34
Upper Black Vermillion WJD No. 37
Upper Verdigris WJD No. 24
Upper Walnut WJD No. 33
Vermillion Creek WJD No. 70
Wakarusa WJD No. 35
Walnut Creek WD No. 1
Wet Walnut Creek WJD No. 58
White Clay Brewery, Whiskey Creeks WJD No. 26
Whitewater River WJD No 22

State

Allen Creek WD No. 89
Cedar Creek WJD No. 56
Deer Creek WJD No. 55
Delaware WJD No. 10
Diamond Creek WJD No. 61
Doyle Creek WJD No. 86
Eagle Creek WD No. 77
Grouse-Silver Creeks WJD No. 92
Horseshoe Creek WJD No. 110
James Draw WJD No. 87
Labette-Hackberry Creek WJD No. 96
Marais Des Cygnes DD 1
Marmaton WJD No. 102
Mill Creek WD No. 98
Mill Creek WJD No. 85
Mount Hope WJD No. 54
Nemaha-Brown WJD No. 7
Otter Creek WJD No. 83
Pony Creek WJD No. 78
Pottawatomie Creek WJD No. 90
Rock Creek WD No. 45
Rock Creek WJD No. 84
Roy's Creek WD No. 75
Salt Creek WJD No. 104
Tauy Creek WJD No. 82
Tri-Creek WJD No. 100
Upper Little Arkansas WJD No. 95
Upper Marais des Cygnes WJD No. 101
Walnut-West Creeks WD No. 72
Wolf River WJD No. 66

Combination

Long-Scott Creeks WD No. 93 (State/Other)
Turkey Creek WJD No. 103 (State/Other)
Big Creek WJD No. 48 (State/Fed)
Peyton Creek WD No. 71 (State/Fed)

Other

Cedar Creek WJD No. 56
Cherry-Plum Creeks WJD No. 17
Middle Walnut WJD No. 60
Pawnee WJD No. 81
Sand Creek WJD No. 68
Turkey Creek WJD No. 109

Appendix B - Informed Consent Form

KANSAS STATE UNIVERSITY INFORMED CONSENT

PROJECT TITLE: Kansas Watersheds: Past, Present, and Future

APPROVAL DATE OF PROJECT: **EXPIRATION DATE OF PROJECT:**

PRINCIPAL INVESTIGATOR: Matthew R. Sanderson, PI; John Harrington

CO-INVESTIGATOR(S): Christy Jean

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS:
Matthew R. Sanderson, 785-532-4969

IRB CHAIR CONTACT/PHONE INFORMATION*:*
Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

SPONSOR OF THE PROJECT: State Association of Kansas Watersheds

PURPOSE OF THE RESEARCH: This research project is designed to better understand: (a) the benefits of watershed planning to the citizens of Kansas; and (b) the historical development of watershed planning and management efforts in Kansas

PROCEDURES OR METHODS TO BE USED: We will interview you to learn more about your thoughts regarding past and present watershed planning efforts as they pertain to Kansas, and future challenges and opportunities for watershed management in Kansas

LENGTH OF STUDY: Approximately 30 minutes

RISKS OR DISCOMFORTS ANTICIPATED: We do not anticipate any known risks from your participation in this research.

BENEFITS ANTICIPATED: By participating in this research, you will help contribute to a better understanding of how watershed planning and management has benefited citizens in the state of Kansas.

EXTENT OF CONFIDENTIALITY: Participation in this research is strictly voluntary. Any questions that make you uncomfortable can be skipped. You can request to stop the interview at any time.

Appendix C - Economic Indices

Year	**PPPI** (Producer Prices Paid Index) **1.**	**PPRI** (Producer Prices Received Index) **1.**	**PPPI** (Producer Prices Paid Index) **1.**	**PPRI** (Producer Prices Received Index) **1.**	**CCI** (ENR's Construction Cost Index) **2.**	**CPI** (Consumer Price Index) **3.**
	2011 Index	**2011 Index**	**1990-92 Index**	**1990-92 Index**	**1913 Index**	
1908					97.00	
1909					91.00	
1910					96.00	
1911					93.00	
1912					91.00	
1913					100.00	9.90
1914					89.00	10.00
1915					93.00	10.10
1916					130.00	10.90
1917					181.00	12.80
1918					189.00	15.10
1919					198.00	17.30
1920					251.00	20.00
1921					202.00	17.90
1922					174.00	16.80
1923					214.00	17.10
1924					215.00	17.10
1925					207.00	17.50
1926					208.00	17.70
1927					206.00	17.40
1928					207.00	17.10
1929					207.00	17.10
1930					203.00	16.70
1931					181.00	15.20
1932					157.00	13.70
1933					170.00	13.00
1934					198.00	13.40
1935					196.00	13.70
1936					206.00	13.90
1937					235.00	14.40
1938					236.00	14.10

1939					236.00	13.90
1940					242.00	14.00
1941					258.00	14.70
1942					276.00	16.30
1943					290.00	17.30
1944					299.00	17.60
1945					308.00	18.00
1946					346.00	19.50
1947					413.00	22.30
1948					461.00	24.10
1949					477.00	23.80
1950					510.00	24.10
1951					543.00	26.00
1952					569.00	26.50
1953					600.00	26.70
1954			25.57	37.24	628.00	26.90
1955			25.00	35.17	660.00	26.80
1956			25.00	34.48	692.00	27.20
1957			25.86	35.17	724.00	28.10
1958			26.44	37.93	759.00	28.90
1959			26.72	36.55	797.00	29.10
1960			26.44	35.86	824.00	29.60
1961			26.72	36.55	847.00	29.90
1962			27.01	36.55	872.00	30.20
1963			27.30	36.55	901.00	30.60
1964			27.01	35.86	936.00	31.00
1965			27.59	37.24	971.00	31.50
1966			28.45	40.00	1019.00	32.40
1967			28.74	37.93	1074.00	33.40
1968			28.74	38.62	1155.00	34.80
1969			29.89	40.69	1269.00	36.70
1970			31.03	41.38	1381.00	38.80
1971			32.47	42.76	1581.00	40.50
1972			35.06	47.59	1753.00	41.80
1973			41.95	67.59	1895.00	44.40
1974			47.70	72.41	2020.00	49.30
1975			52.30	69.66	2212.00	53.80
1976			55.75	70.34	2401.00	56.90
1977			57.47	68.97	2576.00	60.60
1978			62.07	79.31	2776.00	65.20
1979			71.84	91.03	3003.00	72.60
1980			79.31	92.41	3237.00	82.40
1981			85.06	95.17	3535.00	90.90

1982			87.93	91.72	3825.00	96.50
1983			87.36	93.10	4066.00	99.60
1984			89.08	97.93	4146.00	103.90
1985			86.78	88.28	4195.00	107.60
1986			82.76	84.83	4295.00	109.60
1987			84.48	87.59	4406.00	113.60
1988			90.23	95.17	4519.00	118.30
1989			95.98	101.38	4615.00	124.00
1990			99	104	4732.00	130.70
1991			100	100	4835.00	136.20
1992			101	98	4985.00	140.30
1993			104	101	5210.00	144.50
1994			106	100	5408.00	148.20
1995			109	102	5471.00	152.40
1996			115	112	5620.00	156.90
1997			118	107	5826.00	160.50
1998			115	102	5920.00	163.00
1999			115	95	6059.00	166.60
2000			120	96	6221.00	172.20
2001			123	102	6334.00	177.07
2002			124	98	6538.00	179.88
2003			128	107	6694.64	183.96
2004			133	111	7114.89	188.90
2005			143	114	7445.98	195.30
2006			148	121	7887.62	201.60
2007			158	138	8551.32	207.34
2008			177	133	8549.06	215.303
2009			183	137	8660.08	214.537
2010		90	191	160	8952.40	219.179
2011		100	205	179	9171.73	225.672
2012		106	217	201	9412.25	229.601
2013		105	213	180	9667.77	233.049
2014		**111**	**225**	**173**	**9936.44**	**236.151**
2015						
Report Dates		December, 2014	December, 2014	December, 2014	December, 2014	December, 2014	November, 2014

Data Sources:

1. Prices paid and Received by Farmers, ERS/NASS data provided through Cornell University.
http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1002
http://www.nass.usda.gov/Charts_and_Maps/graphics/data/pitw.txt
Note: The Limited Resource Farmer index is based on the October, 2004 PPPI of 125.

2. Engineering News Review, Construction Cost Index History
http://enr.construction.com/economics/default.asp
The ENR website only provides the current month CCI. History of CCI available to members.
The December (end of year) ENR CCI index is provided

3. Consumer Price Index-All Urban Consumers
http://inflationdata.com/Inflation/Consumer_Price_Index/CurrentCPI.asp
The annual average CPI is reported.

4. FY Plan Formulation Rate For Federal Water Projects, updated annually in early October
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/cntsc/?&cid=nrcs143_009685

5. OMB Circ. A-94 10-Year Nominal Discount Rate, Updated annually in January
http://www.whitehouse.gov/omb/circulars/a094/a094.html

Updated since 1997 by David Buland
Update dates given at the bottom of the column.
Format Created by Madalene Ransom, 1996, Last Updated

Appendix D - Economic Index: Land Use

Year	Period	Geo Level	State	Commodity	Data Item	Value
1950	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	66
1951	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	73
1952	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	80
1953	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	81
1954	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	79
1955	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	81
1956	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	84
1957	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	87
1958	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	93
1959	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	98
1960	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	101
1961	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	102
1962	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	107
1963	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	112
1964	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	115
1965	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	123
1966	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	135
1967	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	144
1968	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	156
1969	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	162
1970	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	159
1971	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	162
1972	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	174
1973	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	199
1974	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	253
1975	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	296
1976	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	342
1977	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	398
1978	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	418
1979	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	501
1980	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	587
1981	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	619
1982	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	628
1983	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	601
1984	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	597
1985	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	488
1986	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	415
1987	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	373
1988	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	413
1989	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	429
1990	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	450
1991	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	449
1992	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	460
1993	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	463
1994	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	503
1995	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	535
1996	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	553
1997	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	565
1998	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	577
1999	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	600
2000	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	625
2001	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	645
2002	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	665
2003	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	685
2004	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	700
2005	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	810
2006	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	870
2007	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	980
2008	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	1,020
2009	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	1,010
2010	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	1,060
2011	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	1,240
2012	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	1,510
2013	YEAR	STATE	KANSAS	AG LAND	AG LAND, INCL BUILDINGS - ASSET VALUE, MEASURED IN $ / ACRE	1,750
2014	YEAR	STATE	KANSAS	AG LAND	AG LAND, PASTURELAND - ASSET VALUE, MEASURED IN $ / ACRE	1,300

Appendix E - Updated Monetary Benefits

Allen Creek WD 89, Kansas

Item	Price Base 1978	Index	1978 Value	2014 Value	Index from 1978	Updated Benefits
Crop and Pasture	$109,100	REC	79.31	173.00	2.18	$237,980.30
Other Agricultural	$6,900	PPF	62.07	225.00	3.63	$25,012.50
Road, Railroad & Bridge	$22,600	ENR	2776.00	9936.44	3.58	$80,894.65
Floodplain Land Damage	$700	LV	418.00	1300.00	3.11	$2,177.03
Indirect	$15,200	CPI	65.20	236.15	3.62	$55,053.37
More Intensive Land Use	$18,100	LV	418.00	1300.00	3.11	$56,291.87
Sediment Storage	$100	ENR	2776.00	9936.44	3.58	$357.94
Secondary	$143,100	CPI	65.20	236.15	3.62	$518,298.54
Off-Project-Mainstream Neosho River	$1,600	CPI	65.20	236.15	3.62	$5,795.09
Total	$317,400					$981,861.30

Andale WJD 9 , Kansas

Item	Price Base 1960	Index	1960 Value	2014 Value	Index from 1960	Updated Benefits
Crop and Pasture	$7,465	REC	36.55	173.00	4.73	$35,333.65
Other Agricultural	$671	PPF	26.72	225.00	8.42	$5,650.26
Road and Bridge	$4,620	ENR	847.00	9936.44	11.73	$54,198.76
Railroad	$1,444	ENR	847.00	9936.44	11.73	$16,940.05
Andale City	$5,088	CPI	29.90	236.15	7.90	$40,184.99
Indirect Damage	$1,929	CPI	29.90	236.15	7.90	$15,235.23
Intensified Land Use	$14,548	LV	101.00	1300.00	12.87	$187,251.49
Total All Benefits	$35,765					$354,794.43

Bee Creek WJD 15, Kansas

Item	Price Base 1961	Index	1961 Value	2014 Value	Index from 1961	Updated Benefits
Crop	$62,300	REC	26.72	173.00	6.47	$403,364.52
Other Agricultural	$3,400	PPF	26.72	225.00	8.42	$28,630.24
Road and Bridge	$7,700	ENR	847.00	9936.44	11.73	$90,331.27
Sediment Overbank Deposition	$200	ENR	847.00	9936.44	11.73	$2,346.27
Erosion Floodplain Scour	$5,100	ENR	847.00	9936.44	11.73	$59,829.80
Indirect	$8,100	CPI	29.90	236.15	7.90	$63,973.75
Total-On Project	$86,800					$648,475.85
Off Project - Twin Caney Floodwater						
Crop	$1,150	CPI	29.90	236.15	7.90	$9,082.69
Other Agricultural	$200	PPF	26.72	225.00	8.42	$1,684.13
Road and Bridge	$50	ENR	847.00	9936.44	11.73	$586.57
Railroad	$50	ENR	847.00	9936.44	11.73	$586.57
Subtotal	$1,450					
Erosion Floodplain Scour	$300	ENR	847.00	9936.44	11.73	$3,519.40
Indirect	$150	CPI	29.90	236.15	7.90	$1,184.70
Total-Off Project	$1,900					$16,644.06
Total Damage Reduction	$88,700					
More Intensive Land Use	$8,300	LV	102.00	1300.00	12.75	$105,784.31
Changed Land Use Agr.	$6,000	LV	102.00	1300.00	12.75	$76,470.59
Grand Total	$103,000					$847,374.81

Big Caney Watershed WJD 31, Kansas

Item	Price Base 1962	Index	1962 Value	2014 Value	Index from 1962	Updated Benefits

Crop and Pasture	$99,500	REC	36.55	173.00	4.73	$470,957.59
Other Agricultural	$19,200	PPF	27.01	225.00	8.33	$159,940.76
Road and Bridge	$12,800	ENR	872.00	9936.44	11.40	$145,856.00
Railroad	$1,300	ENR	872.00	9936.44	11.40	$14,813.50
Erosion Floodplain Scour	$39,800	LV		1300.00		
Indirect	$14,000	CPI	30.20	236.15	7.82	$109,473.51
Benefits Outside Watershed	$20,300	CPI	30.20	236.15	7.82	$158,736.59
Benefits to Hulah Reservoir	$26,200	CPI	30.20	236.15	7.82	$204,871.85
Benefits to Hulah Reservoir Take Area	$17,900	CPI	30.20	236.15	7.82	$139,969.70
Total	$251,000					
Benefits to Secondary	$25,700	CPI	30.20	236.15	7.82	$200,962.09
Incidental Recreation	$24,000	CPI	30.20	236.15	7.82	$187,668.87
More Intensive Land Use	$18,300	LV		1300.00		
Grand Total	$294,800					$1,793,250.47

Flood Damage Reduction Benefits: 26700, annually

*No price base listed. General plan approved in 1963

Big Creek WJD 48, Kansas

Item	Price Base 1969	Index	1969 Value	2014 Value	Index from 1969	Updated Benefits
Crop and Pasture	$41,700	REC	40.69	173.00	4.25	$177,294.18
Other Agricultural	$2,700	PPF	29.89	225.00	7.53	$20,324.52
Road and Bridge	$3,900	ENR	1269.00	9936.44	7.83	$30,537.52
Erosion Floodplain Scour	$5,700	LV	162.00	1300.00	8.02	$45,740.74
Indirect	$5,600	CPI	36.70	236.15	6.43	$36,033.79
Total On Project	$59,600					$309,930.75
Crop	$1,900	REC	40.69	173.00	4.25	$8,078.15
Other Agricultural	$100	PPF	29.89	225.00	7.53	$752.76
Erosion Floodplain Scour	$400	LV	162.00	1300.00	8.02	$3,209.88
Indirect	$200	CPI	36.70	236.15	6.43	$1,286.92
More Intensive Land Use	$4,100	LV	162.00	1300.00	8.02	$32,901.23
Changed Land Use	$400	LV	162.00	1300.00	8.02	$3,209.88
Total-Off Project	$7,100					$49,438.82
Stock Water	$500	CPI	36.70	236.15	6.43	$3,217.30
Incidental Recreation	$5,300	CPI	36.70	236.15	6.43	$34,103.41
Secondary	$10,300	CPI	36.70	236.15	6.43	$66,276.43
Total Damage Reduction	$55,300					$103,597.14
More Intensive Land Use	$12,000	LV	162.00	1300.00	8.02	$96,296.30
Changed Land Use	$1,900	LV	162.00	1300.00	8.02	$15,246.91
Grand Total	$92,400					$574,509.92

Cedar Creek WJD 56, Kansas

Item	Price Base 1973	Index	1973 Value	2014 Value	Index from 1973	Updated Benefits
Crop and Pasture	$15,900	REC	67.59	173.00	2.56	$40,696.85
Other Agricultural	$1,300	PPF	41.95	225.00	5.36	$6,972.59
Road and Bridge	$2,500	ENR	1895.00	9936.44	5.24	$13,108.76
Floodplain Scour	$3,100	LV	199.00	1300.00	6.53	$20,251.26
Indirect	$2,500	CPI	44.40	236.15	5.32	$13,296.73
Stockwater (Incidental)	$600	CPI	44.40	236.15	5.32	$3,191.22
More Intensive Land Use	$2,200	LV	199.00	1300.00	6.53	$14,371.86
Changed Land Use	$700	LV	199.00	1300.00	6.53	$4,572.86
Recreation (Incidental)	$2,600	CPI	44.40	236.15	5.32	$13,828.60
Secondary	$5,100	CPI	44.40	236.15	5.32	$27,125.34
Total	$36,500					$157,416.07

Cedar Creek WJD 97, Kansas

Item	Price Base 1980	Index	1980 Value	2014 Value	Index from 1980	Updated Benefits
Flood Damage Reduction	$61,170	CPI	82.40	236.15	2.87	$175,306.98
Incidental Recreation	$28,950	CPI	82.40	236.15	2.87	$82,967.75
Off Project	$13,000	CPI	82.40	236.15	2.87	$37,256.67
Total Benefits	$103,520					$295,531.41

Cherry Plum Creek WJD 17

Item	Price Base 1992	Index	1992 Value	2014 Value	Index from 1992	Updated Benefits
Flood Damage Reduction	$56,140	CPI	140.30	236.15	1.68	$94,493.66
Secondary	$8,420	CPI	140.30	236.15	1.68	$14,172.37
Water Quality	$4,480	CPI	140.30	236.15	1.68	$7,540.64
Incidental Recreation	$13,580	CPI	140.30	236.15	1.68	$22,857.57
Subtotal - Within District	$86,620					
Flood Damage Reduction	$6,180	CPI	140.30	236.15	1.68	$10,402.05
Secondary	$930	CPI	140.30	236.15	1.68	$1,565.36
Water Quality	$1,800	CPI	140.30	236.15	1.68	$3,029.72
Incidental Recreation	$0	CPI	140.30	236.15	1.68	$0.00
Subtotal - Below District Boundary	$8,910					
Flood Damage Reduction	$62,320	CPI	140.30	236.15	1.68	$104,895.71
Secondary	$9,350	CPI	140.30	236.15	1.68	$15,737.72
Water Quality	$6,280	CPI	140.30	236.15	1.68	$10,570.36
Incidental Recreation	$13,580	CPI	140.30	236.15	1.68	$22,857.57
Total	$91,530					$308,122.73

Cimarron WD 3

Item	Price Base 1954	Index	1954 Value	2014 Value	Index from 1954	Updated Benefits
Floodwater Damage Reduction	$3,074	CPI	26.90	236.15	8.78	$26,986.06
Sediment	$449	ENR	628.00	9936.44	15.82	$7,104.24
Indirect	$465	CPI	26.90	236.15	8.78	$4,082.15
Changed use of Land	$3,693	LV	79.00	1300.00	16.46	$60,770.89
Total Flood Prevention Benefits	$7,681					$98,943.33

Cross Creek WJD 42

Item	Price Base 1965	Index	1965 Value	2014 Value	Index from 1965	Updated Benefits
Crop and Pasture	$84,700	REC	37.24	173.00	4.65	$393,477.44
Other Agricultural	$12,100	PPF	27.59	225.00	8.16	$98,677.06
Road and Bridge	$11,400	ENR	971.00	9936.44	10.23	$116,658.51
Railroad	$2,100	ENR	971.00	9936.44	10.23	$21,489.73
Damage Reduction Not Specified	$14,800	CPI	31.50	236.15	7.50	$110,953.02
More Intensive Use	$14,200	LV	123.00	1300.00	10.57	$150,081.30
Changed Land Use	$7,300	LV	123.00	1300.00	10.57	$77,154.47
Benefits Outside Watershed	$4,400	CPI	31.50	236.15	7.50	$32,986.03
Secondary	$17,500	CPI	31.50	236.15	7.50	$131,194.44
Total	$168,500					$1,132,672.00
Urban	$2,100	CPI	31.50	236.15	7.50	$15,743.33
Sediment Overbank Deposition	$1,100	ENR	971.00	9936.44	10.23	$11,256.52
Erosion Flood Plain Scour	$6,200	LV	123.00	1300.00		
Indirect	$13,200	CPI	31.50	236.15	7.50	$98,958.10

Deer Creek WJD 55

Item	Price Base 1974	Index	1974 Value	2014 Value	Index from 1974	Updated Benefits
Crop and Pasture	$146,800	REC	72.41	173.00	2.39	$350,730.56
Other Agriculture	$7,400	PPF	47.70	225.00	4.72	$34,905.66

Flood Plain Land	$9,800	LV	253.00	1300.00	5.14	$50,355.73
Road and Bridge	$28,900	ENR	2020.00	9936.44	4.92	$142,159.96
Railroad	$500	ENR	2020.00	9936.44	4.92	$2,459.51
Oil Tank	$17,100	CPI	49.30	236.15	4.79	$81,910.04
Indirect Benefits	$22,000	CPI	49.30	236.15	4.79	$105,381.34
More Intense Use of Land	$12,200	LV	253.00	1300.00	5.14	$62,687.75
Secondary Benefits	$29,400	CPI	49.30	236.15	4.79	$140,827.79
Total	$274,100					$971,418.34

Delaware WJD 10

Item	Price Base	Index	2014 Value	Index from 2014	Updated Benefits
Crop and Pasture	$2,971,734	REC	173.00		$2,971,734.00
Other Agricultural	$26,134	PPF	225.00		$26,134.00
Floodplain Scour	$19,392	LV	1300.00		$19,392.00
Road and Bridge	$138,819	ENR	9936.44		$138,819.00
Indirect	$125,011	CPI	236.15		$125,011.00
Secondary	$350,990	CPI	236.15		$350,990.00
Siltation Reduction into Perry Reservoir	$30,541	ENR	9936.44		$30,541.00
More Intensive Use of Land	$47,234	LV	1300.00		$47,234.00
Recreational, Environment Enhancement	$103,712	CPI	236.15		$103,712.00
Municipal and Industrial Water Supply	$316,000	CPI			$316,000.00
Total	$4,129,567				$4,129,567.00

*The last amendment to the general plan made by the watershed district used this price base.

Diamond Creek WJD 61

Item	Price Base 2000	Index	2000 Value	2014 Value	Index from 2000	Updated Benefits
Crop and Pasture	$116,800	REC	96.00	173.00	1.80	$210,483.33
Other Agricultural	$13,200	PPF	120.00	225.00	1.88	$24,750.00
Road and Bridge	$1,800	ENR	6221.00	9936.44	1.60	$2,875.03
Railroad	$8,900	ENR	6221.00	9936.44	1.60	$14,215.45
Erosion Flood Plain Scour	$8,700	LV	625.00	1300.00	2.08	$18,096.00
Subtotal	$149,400					$270,419.82
DRB to Cottonwood River Properties						
Crop and Pasture	$29,400	REC	96.00	173.00	1.80	$52,981.25
Other Agricultural	$1,300	PPF	120.00	225.00	1.88	$2,437.50
Road and Bridge	$5,400	ENR	6221.00	9936.44	1.60	$8,625.10
Railroad	$1,500	ENR	6221.00	9936.44	1.60	$2,395.86
Subtotal	$37,600					$66,439.72
Total	$187,000					$336,859.54

Doyle Creek WJD 86

Item	Price Base 1990	Index	1990 Value	2014 Value	Index from 1990	Updated Benefits
Crop and Pasture	$39,400	REC	104.00	173.00	1.66	$65,540.38
Other Agricultural	$18,100	PPF	99.00	225.00	2.27	$41,136.36
Road and Bridge	$1,800	ENR	4732.00	9936.44	2.10	$3,779.71
Railroad	$6,000	ENR	4732.00	9936.44	2.10	$12,599.04
Urban	$6,100	CPI	130.70	236.15	1.81	$11,021.54
Erosion Flood Plain Scour	$1,600	LV	450.00	1300.00	2.89	$4,622.22
More Intensive Use	$6,700	LV	450.00	1300.00	2.89	$19,355.56
Stream Fishery	$5,100	CPI	130.70	236.15	1.81	$9,214.73
Forestry Land Treatment	-	LV	450.00	1300.00	2.89	-
Crop and Pasture	$84,400	REC	104.00	173.00	1.66	$140,396.15
Other Agricultural	$9,700	PPF	99.00	225.00	2.27	$22,045.45
Road and Bridge	$21,500	ENR	4732.00	9936.44	2.10	$45,146.55
Railroad	$7,800	ENR	4732.00	9936.44	2.10	$16,378.75

Urban	$27,400	CPI	130.70	236.15	1.81	$49,506.58
Scour	$8,700	LV	450.00	1300.00	2.89	$25,133.33
Traffic Interruption	$0	CPI	130.70	236.15	1.81	$0.00
Sediment Depositing	$19,500	ENR	4732.00	9936.44	2.10	$40,946.87
Total	$263,800					$506,823.22

*No monetary value on Forestry Land Treatment listed

Dry Creek WJD 57

Item	Price Base 1978	Index	1978 Value	2014 Value	Index from 1978	Updated Benefits
Crop and Pasture	$17,200	REC	37.24	173.00	4.65	$79,903.33
Other Agricultural	$400	PPF	25.57	225.00	8.80	$3,519.75
Road and Bridge	$2,600	ENR	628.00	9936.44	15.82	$41,138.13
Railroad	$1,500	ENR	628.00	9936.44	15.82	$23,733.54
Subtotal	$25,300					
Erosion Flood Plain Scour	$400	LV	418.00	1300.00	3.11	$1,244.02
Indirect	$2,800	CPI	628.00	236.15	0.38	$1,052.90
On Project - Subtotal	$28,500					$150,591.66
Crop and Pasture	$16,500	REC	37.24	173.00	4.65	$76,651.45
Other Agricultural	$1,000	PPF	25.57	225.00	8.80	$8,799.37
Subtotal	$17,500					
Indirect	$1,700	CPI	628.00	236.15	0.38	$639.26
Off Project - Subtotal	$19,200					$86,090.08
More Intensive Land Use	$4,700	LV	418.00	1300.00	3.11	$14,617.22
Total	$52,400					$236,681.74

Duck Creek WJD 59

Item	Price Base 1968	Index	1968 Value	2014 Value	Index from 1968	Updated Benefits
Crop	$24,800	REC	38.62	173.00	4.48	$111,092.70
Other Agricultural	$1,900	PPF	28.74	225.00	7.83	$14,874.74
Road and Bridge	$2,200	ENR	1155.00	9936.44	8.60	$18,926.55
Erosion Flood Plain Scour	$800	LV	156.00	1300.00	8.33	$6,666.67
Indirect	$3,000	CPI	34.80	236.15	6.79	$20,357.76
More Intensive Land Use	$4,200	LV	156.00	1300.00	8.33	$35,000.00
Changed Land Use	$500	LV	156.00	1300.00	8.33	$4,166.67
Secondary	$3,900	CPI	34.80	236.15	6.79	$26,465.09
Off Project	$5,900	CPI	34.80	236.15	6.79	$40,036.93
Total	$47,200					$277,587.09

Eagle Creek WD 77

Item	Price Base 1994	Index	1994 Value	2014 Value	Index from 1994	Updated Benefits
Crop and Pasture	$133,300	REC	100.00	173.00	1.73	$230,609.00
Other Agricultural	$9,100	PPF	106.00	225.00	2.12	$19,316.04
Road and Bridge	$37,100	ENR	5408.00	9936.44	1.84	$68,166.04
Floodplain Land Damage	$9,700	LV	503.00	1300.00	2.58	$25,069.58
Indirect	$20,800	CPI	148.20	236.15	1.59	$33,143.86
More Intensive Land Use	$21,400	LV	503.00	1300.00	2.58	$55,308.15
Secondary	$24,400	CPI	148.20	236.15	1.59	$38,880.30
Off Project	$2,500	CPI	148.20	236.15	1.59	$3,983.64
Domestic and Livestock Water	$27,400	CPI	148.20	236.15	1.59	$43,660.66
Rural Fire Protection	$15,300	CPI	148.20	236.15	1.59	$24,379.86
Water Based Recreation	$21,200	CPI	148.20	236.15	1.59	$33,781.24
Total	$322,300					$576,298.36

Elk River WJD 47

Item	Price Base 1966	Index	1966 Value	2014 Value	Index from 1966	Updated Benefits
Crop	$181,900	REC	40.00	173.00	4.33	$786,717.50
Other Agricultural	$30,000	PPF	28.45	225.00	7.91	$237,258.35
Road and Bridge	$40,000	ENR	1019.00	9936.44	9.75	$390,046.71
Oil Field	$400	CPI	32.40	236.15	7.29	$2,915.43
Urban	$2,000	CPI	32.40	236.15	7.29	$14,577.16
Sediment Overbank Deposition	$4,600	ENR	1019.00	9936.44	9.75	$44,855.37
Erosion Flood Plain Scour	$20,000	LV	135.00	1300.00	9.63	$192,592.59
Indirect	$30,100	CPI	32.40	236.15	7.29	$219,386.27
Total Damage Reduction On-Project	$30,900					
More Intensive Land Use	$44,700	LV	135.00	1300.00	9.63	$430,444.44
Changed Land Use	$28,900	LV	135.00	1300.00	9.63	$278,296.30
Secondary	$63,100	CPI	32.40	236.15	7.29	$459,909.41
Total Damage Reduction Off Project	$91,300					$1,168,650.15
Total	$537,000					$1,168,650.15

Fall River WJD 21

Item	Price Base 1997	Index	1997 Value	2014 Value	Index from 1997	Updated Benefits
27 Completed Dams						
Flood Damage Reduction	$153,446	CPI	160.50	236.15	1.47	$225,771.17
Sediment Deposition Floodplain Scour	$28,423	LV	565.00	1300.00	2.30	$65,398.05
Indirect Land Use Change	$30,470	CPI	160.50	236.15	1.47	$44,831.72
Municipal Water	$13,018	CPI	160.50	236.15	1.47	$19,153.90
Total Benefits	$225,357					$355,154.84
Fall River WJD 21, Continued						
9 Proposed Dams						
Flood Damage Reduction	$76,161	CPI	160.50	236.15	1.47	$112,058.69
Water Quality and Sediment Reduction in Federal Reservoir	$13,560	CPI	160.50	236.15	1.47	$19,951.36
Recreation	$10,143	CPI	160.50	236.15	1.47	$14,923.80
Stock Water	$3,600	CPI	160.50	236.15	1.47	$5,296.82
Total Benefits	$103,464					$152,230.68
Total	$328,821					$507,385.52

Frog Creek WJD 19

Item	Price Base 1957	Index	1957 Value	2014 Value	Index from 1957	Updated Benefits
Crop	$7,194	REC	35.17	173.00	4.92	$35,387.03
Other Agricultural	$1,140	PPF	25.86	225.00	8.70	$9,918.79
Non-agricultural	$2,931	CPI	28.10	236.15	8.40	$24,631.87
Erosion Damage Floodplain Scour	$1,402	LV	87.00	1300.00	14.94	$20,949.43
Indirect	$909	CPI	28.10	236.15	8.40	$7,639.16
Total Damage on Project	$13,576					
Benefits from Changed Use	$3,798	LV	87.00	1300.00	14.94	$56,751.72
Crop	$1,954	REC	35.17	173.00	4.92	$9,611.66
Other Agricultural	$0	PPF	25.86	225.00	8.70	$0.44
Non-agricultural	$1,634	CPI	28.10	236.15	8.40	$13,732.00
Erosion Damage Floodplain Scour	$209	LV	87.00	1300.00	14.94	$3,122.99
Indirect	$276	CPI	28.10	236.15	8.40	$2,319.48
Total Damage Off Project	$4,378					
Benefits from Changed Use	$128	LV	87.00	1300.00	14.94	$1,912.64
Total Flood Prevention Benefits	$21,880					$185,977.21

Grant-Shanghai WD 14

Item	Price Base 1961	Index	1961 Value	2014 Value	Index from 1961	Updated Benefits

Crop	$9,000	REC	36.55	173.00	4.73	$42,599.18
Other Agricultural	$3,200	PPF	26.72	225.00	8.42	$26,946.11
Road and Bridge	$1,600	ENR	847.00	9936.44	11.73	$18,770.13
Erosion Damage Floodplain Scour	$5,200	LV	102.00	1300.00	12.75	$66,274.51
Indirect	$1,500	CPI	29.90	236.15	7.90	$11,846.99
Subtotal On Project	$20,500					
Benefits from Outside the Watershed - Private Lands	$1,300	CPI	29.90	236.15	7.90	$10,267.39
Benefits to Hulah Reservoir	$1,800	CPI	29.90	236.15	7.90	$14,216.39
Benefits to the take area of Hulah Reservoir	$1,200	LV	102.00	1300.00	12.75	$15,294.12
Total	$24,800					$206,214.82
Damage Reduction	$22,100					$342,884.35
More Intensive Land Use	$1,600	LV	102.00	1300.00	12.75	$20,392.16
Changed Land Use	$700	LV	102.00	1300.00	12.75	$8,921.57
Secondary	$2,500	CPI	29.90	236.15	7.90	$19,744.98
Incidental Recreation	$1,600	CPI	29.90	236.15	7.90	$12,636.79
Total	$28,500					$404,579.85

Grouse-Silver Creek WJD 92

Item	Price Base 1976	Index	1976 Value	2014 Value	Index from 1976	Updated Benefits
Crop and Pasture	$235,929	REC	70.34	173.00	2.46	$580,263.25
Other Agricultural	$27,118	PPF	55.75	225.00	4.04	$109,444.84
Road and Bridge	$34,092	ENR	2401.00	9936.44	4.14	$141,088.34
Railroad	$18,208	ENR	2401.00	9936.44	4.14	$75,353.06
Urban	-	CPI				
Floodplain Scour	$34,092	LV	342.00	1300.00	3.80	$129,589.47
Indirect	$35,641	CPI	56.90	236.15	4.15	$147,919.55
Other damage	$2,324	CPI	56.90	236.15	4.15	$9,645.21
TOTAL	$387,404					$1,193,303.73

Horseshoe Creek

Item	Price Base 1997	Index	1997 Value	2014 Value	Index from 1997	Updated Benefits
Crop and Pasture	$268,400	REC	107.00	173.00	1.62	$433,955.14
Other Agricultural	$23,700	PPF	118.00	225.00	1.91	$45,190.68
Road and Bridge	$20,100	ENR	5826.00	9936.44	1.71	$34,281.23
Scour	$13,400	LV	565.00	1300.00	2.30	$30,831.86
Other Direct	$26,800	CPI	160.50	236.15	1.47	$39,431.90
Grade Stabilization	$61,800	ENR	5826.00	9936.44	1.71	$105,401.99
Water Conservation	$108,100	CPI	160.50	236.15	1.47	$159,051.81
Water Quality	$63,400	CPI	160.50	236.15	1.47	$93,282.93
Erosion	$13,500	LV	565.00	1300.00	2.30	$31,061.95
TOTAL	$599,200					$972,489.48

Jacob-Phenis WJD 94

Item	Price Base 1976	Index	1976 Value	2014 Value	Index from 1976	Updated Benefits
Crop and Pasture	$30,800	REC	70.34	173.00	2.46	$75,752.06
Other Agricultural	$2,100	PPF	55.75	225.00	4.04	$8,475.34
Road, Railroad and Bridge	$5,000	ENR	2401.00	9936.44	4.14	$20,692.29
Floodplain Land Damage	$1,700	LV	342.00	1300.00	3.80	$6,461.99
Indirect	$4,200	CPI	56.90	236.15	4.15	$17,431.11
More Intensive Land Use	$3,800	LV	342.00	1300.00	3.80	$14,444.44
Sediment Storage	$100	ENR	2401.00	9936.44	4.14	$413.85
Secondary	$39,300	CPI	56.90	236.15	4.15	$163,105.36
Off Project Mainstem Cottonwood and Neosho Rivers	$700	CPI	56.90	236.15	4.15	$2,905.18
TOTAL	$87,700					$309,681.62

James Draw WJD 87

Item	Price Base 1966	Index	1966 Value	2014 Value	Index from 1966	Updated Benefits
Agriculture, Flood Prevention, Damage Red	$219,800	CPI	32.40	236.15	7.29	$1,602,029.94
Agriculture, Land Enhancement	$49,200	LV	135.00	1300.00	9.63	$473,777.78
Transportation	$14,300	CPI	32.40	236.15	7.29	$104,226.70
Recreation	$21,900	CPI	32.40	236.15	7.29	$159,619.91
Local Secondary	$27,400	CPI	32.40	236.15	7.29	$199,707.10
Total	$332,600					$2,539,361.42

Land treatment measures would provide additional agricultural benefits of 57,300 annually.

Labette-Hackberry Creek WJD 96

Item	Price Base 1996	Index	1996 Value	2014 Value	Index from 1996	Updated Benefits
Crop and Pasture	$310,271	REC	112.00	173.00	1.54	$479,257.88
Other Agricultural	$35,790	REC	115.00	225.00	1.96	$70,023.91
Road, Railroad and Bridge	$59,346	ENR	5620.00	9936.44	1.77	$104,926.68
Floodplain Land Damage	$69,776	LV	553.00	1300.00	2.35	$164,030.38
Urban	$298,663	CPI	156.90	236.15	1.51	$449,517.32
Indirect	$39,145	CPI	156.90	236.15	1.51	$58,917.09
More Intensive Land Use	$85,274	LV	553.00	1300.00	2.35	$200,463.29
Water Quality	$33,810	CPI	156.90	236.15	1.51	$50,887.39
Secondary	$89,826	CPI	156.90	236.15	1.51	$135,197.00
TOTAL	$1,021,900					$1,713,220.96

Lakin WD 49

Item	Price Base 1964	Index	1964 Value	2014 Value	Index from 1964	Updated Benefits
Crop and Pasture	$10,400	REC	35.86	173.00	4.82	$50,172.89
Other Agricultural	$6,300	PPF	27.01	225.00	8.33	$52,480.56
Road and Bridge	$300	ENR	936.00	9936.44	10.62	$3,184.76
Urban	$19,800	CPI	31.00	236.15	7.62	$150,831.29
Subtotal	$36,800					
Erosion, Flood Plain Scour	$1,500	LV	115.00	1300.00	11.30	$16,956.52
Erosion, Flood Plain Sediment	$4,000	LV	115.00	1300.00	11.30	$45,217.39
Indirect	$4,600	CPI	31.00	236.15	7.62	$35,041.61
Total	$46,900					
From Outside the Watershed	$2,400	CPI	31.00	236.15	7.62	$18,282.58
TOTAL	$49,300					
Secondary	$4,000	CPI	31.00	236.15	7.62	$30,470.97
Total	$53,300					$402,638.58

Little Delaware-Mission Creeks and Trib WJD 5

Item	Price Base 1964	Index	1964 Value	2014 Value	Index from 1964	Updated Benefits
Crop and Pasture	$2,500	REC	35.86	173.00	4.82	$12,060.79
Road and Bridge	$300	ENR	936.00	9936.44	10.62	$3,184.76
Subtotal	$2,800					
Erosion, Gullies	$78,200	LV	115.00	1300.00	11.30	$884,000.00
TOTAL	$81,000					
Comb Grade Stabilization and FRS						
Damage Reduction	$58,300	CPI	31.00	236.15	7.62	$444,114.35
Secondary	$8,700	CPI	31.00	236.15	7.62	$66,274.35
Total	$67,500					$510,388.71

Little Walnut-Hickory WJD 18

Item	Price Base 1962	Index	1962 Value	2014 Value	Index from 1962	Updated Benefits

Crop and Pasture	$98,800	REC	36.55	173.00	4.73	$467,644.32
Other Agricultural	$14,800	PPF	27.01	225.00	8.33	$123,287.67
Road and Bridge	$15,700	ENR	872.00	9936.44	11.40	$178,901.50
Subtotal	$129,300					
Erosion, Floodplain Scour	$10,100	LV	107.00	1300.00	12.15	$122,710.28
Indirect	$13,700	CPI	30.20	236.15	7.82	$107,127.65
Total	$153,100					
Benefits from outside the watershed	$15,400	CPI	30.20	236.15	7.82	$120,420.86
Grand Total	$168,500					$1,120,092.28
Damage Reduction	$163,300	CPI	30.20	236.15	7.82	$1,276,930.30
More Intensive Land Use	$1,300	LV	107.00	1300.00	12.15	$15,794.39
Changed Land use	$15,800	LV	107.00	1300.00	12.15	$191,962.62
Total	$192,100					$1,484,687.31

Long Scott Creeks WD 93

Item	Price Base 1976	Index	1976 Value	2014 Value	Index from 1976	Updated Benefits
Crop and Pasture	$135,960	REC	70.34	173.00	2.46	$334,391.24
Other Agricultural	$3,470	PPF	55.75	225.00	4.04	$14,004.48
Scour	$7,024	LV	342.00	1300.00	3.80	$26,699.42
Deposition	$5,230	LV	342.00	1300.00	3.80	$19,880.12
Road and Bridge	$7,683	ENR	2401.00	9936.44	4.14	$31,795.78
Indirect	$16,350	CPI	56.90	236.15	4.15	$67,856.81
More Intensive Land Use	$13,148	LV	342.00	1300.00	3.80	$49,977.78
Secondary	$21,109	CPI	56.90	236.15	4.15	$87,607.91
Total	$210,154					$632,213.54

Lyons Creeks WJD 41

Item	Price Base 1966	Index	1966 Value	2014 Value	Index from 1966	Updated Benefits
Crop and Pasture	$96,300	REC	40.00	173.00	4.33	$416,497.50
Other Agricultural	$5,900	PPF	28.45	225.00	7.91	$46,660.81
Road and Bridge	$17,000	ENR	1019.00	9936.44	9.75	$165,769.85
Railroad	$500	ENR	1019.00	9936.44	9.75	$4,875.58
Urban	$2,400	CPI	32.40	236.15	7.29	$17,492.59
Subtotal	$122,100					$651,296.34
Erosion, Flood Plain Scour	$4,300	LV	135.00	1300.00	9.63	$41,407.41
Indirect	$13,600	CPI	32.40	236.15	7.29	$99,124.69
Total	$140,000					$791,828.44

Price Base - Projected Long term Prices (Used 1966) - Most general plans are completed using a price base the year prior to the publication year of the general plan.

21 FRS and 1 MPS

Damage Reduction	$120,000	CPI	32.40	236.15	7.29	$874,629.63
More Intensive Use	$28,000	LV	135.00	1300.00	9.63	$269,629.63
Changed Land use	$12,100	LV	135.00	1300.00	9.63	$116,518.52
Benefits outside watershed	$2,400	CPI	32.40	236.15	7.29	$17,492.59
Secondary	$18,300	CPI	32.40	236.15	7.29	$133,381.02
Water Supply Benefits	$18,100	CPI	32.40	236.15	7.29	$131,923.30
Recreation Benefits	$51,300	CPI	32.40	236.15	7.29	$373,904.17
Total	$250,200					$1,917,478.86

In addition, it is estimated that land treatment measures will provide damage reduction benefits of 20,000 annually

Maramton WJD 102

Item	Price Base 2009	Index	2009 Value	2014 Value	Index from 2009	Updated Benefits
Crop and Pasture	$602,200	REC	137.00	173.00	1.26	$760,442.34
Other Agricultural	$138,287	PPF	183.00	225.00	1.23	$170,025.00
Road and Bridge	$166,943	ENR	8660.08	9936.44	1.15	$191,547.78

Flood Plain Land Damage (Scour)	$21,893	LV	1010.00	1300.00	1.29	$28,179.11
Urban and Indirect (In District)	$231,865	CPI	214.54	236.15	1.10	$255,223.67
Sedimentation Damage	$31,608	ENR	8660.08	9936.44	1.15	$36,266.52
Below District to State Line	$1,303,695	CPI	214.54	236.15	1.10	$1,435,012.47
State Line to Mouth of Dry wood Creek	$355,417	CPI	214.54	236.15	1.10	$391,217.14
Total	$2,851,900					$3,267,914.02

Middle Creek WJD 62

Item	Price Base 1981	Index	1981 Value	2014 Value	Index from 1981	Updated Benefits
Crop and Pasture	$227,400	REC	95.17	173.00	1.82	$413,367.66
Other Agricultural	$72,600	PPF	85.06	225.00	2.65	$192,040.91
Road and Bridge	$14,600	ENR	3535.00	9936.44	2.81	$41,038.76
Subtotal	$316,200					$646,447.33
Damage Reduction Benefits to Cottonwood River Properties						
Crop and Pasture	$65,100	REC	95.16	173.00	1.82	$118,351.20
Other Agricultural	$3,100	PPF	85.06	225.00	2.65	$8,200.09
Road and Bridge	$10,800	ENR	3535.00	9936.44	2.81	$30,357.44
Railroad	$4,100	ENR	3535.00	9936.44	2.81	$11,524.58
Subtotal	$83,100					$168,433.32
Grand Total	$399,300					$814,880.65
11 FRD						
Damage Reduction	446000					
More Intensive Land Use	126300	LV	619.00	1300.00	2.10	$265,250.40
Outside Watershed Boundaries	$117,200	CPI	90.90	236.15	2.60	$304,475.03
Total	$689,500					

Average annual costs includes interest and accrued benefits during installation as follows:
flood prevention, 163,900; more intensive land use, 35300,
Includes table interest during construction of 107500

Middle Walnut WJD 60

Item	Price Base 1969	Index	1969 Value	2014 Value	Index from 1969	Updated Benefits
Crop and Pasture		REC		173.00		
Other Agricultural		PPF		225.00		
Road and Bridge		ENR		9936.44		
Flood Plain Land Damage (Scour)		LV		1300.00		
Urban and Indirect (In District)		CPI		236.15		
Sedimentation Damage		ENR		9936.44		
Total	$200,000					

**No itemized listing. Total listed as $200,000. Estimates will reduce damages by 60%, pg 19 of general plan

Mill Creek WD 98

Item	Price Base 2008	Index	2008 Value	2014 Value	Index from 2008	Updated Benefits
Crop and Pasture	$263,762	REC	133.00	173.00	1.30	$343,088.92
Other Agricultural	$59,910	PPF	177.00	225.00	1.27	$76,156.78
Roads	$78,438	ENR	8549.06	9936.44	1.16	$91,167.27
Bridges	$5,859	ENR	8549.06	9936.44	1.16	$6,809.82
Flood Plain Land Damage (Scour)	$6,852	LV	1020.00	1300.00	1.27	$8,732.94
Urban	$18,602	CPI	215.30	236.15	1.10	$20,403.45
Indirect	$49,476	CPI	215.30	236.15	1.10	$54,267.34
Sedimentation Damage	$10,893	LV	1020.00	1300.00	1.27	$13,883.24
Below District to State Line	$211,493	CPI	215.30	236.15	1.10	$231,974.32
State Line to Drywood Creek	$58,814	CPI	215.30	236.15	1.10	$64,509.64
Total	$764,099					$910,993.72

Mill Creek WJD 85

Item	Price Base 1974	Index	1974 Value	2014 Value	Index from 1974	Updated Benefits
Crop and Pasture	$315,611	REC	72.41	173.00	2.39	$754,049.21
Other Agricultural	$33,121	PPF	47.70	225.00	4.72	$156,231.13
Road and Bridge	$16,898	ENR	2020.00	9936.44	4.92	$83,121.76
Railroad	$16,451	ENR	2020.00	9936.44	4.92	$80,922.96
Flood Plain Land Damage (Scour)	$30,562	LV	253.00	1300.00	5.14	$157,037.94
Urban	$1,690	CPI	49.30	236.15	4.79	$8,095.20
Indirect	$43,163	CPI	49.30	236.15	4.79	$206,753.40
Misc, Incidental and Secondary Benefits	$25,347	CPI	49.30	236.15	4.79	$121,413.67
Total	$482,800					$1,567,625.28

Mission Creek WD 51

Item	Price Base 1964	Index	1964 Value	2014 Value	Index from 1964	Updated Benefits
Crop and Pasture	$33,130	REC	36.55	173.00	4.73	$156,812.31
Other Agricultural	$6,580	PPF	27.30	225.00	8.24	$54,230.77
Road and Bridge	$3,530	ENR	901.00	9936.44	11.03	$38,929.67
Subtotal	$43,240					
Erosion, Floodplain Scour	$1,550	LV	115.00	1300.00	11.30	$17,521.74
Erosion, Gullies	$2,560	LV	115.00	1300.00	11.30	$28,939.13
Erosion, Subtotal	$4,110					
Indirect	$4,820	CPI	30.60	236.15	7.72	$37,197.48
Total	$52,170					$333,631.10
FRS 12, Grade Stabilization Structures 4						
Damage Reduction	$46,060					$328,521.00
Changed Land Use	$680	LV	115.00	1300.00	11.30	$7,686.96
Secondary	$3,980	CPI	30.60	236.15	7.72	$30,714.93
Total	$50,720					$366,922.89

In addition, it is estimated that land treatment measures will provide flood damage reduction benefits fof 5110 annually.

Mt Hope WJD 54

Item	Price Base 1968	Index	1968 Value	2014 Value	Index from 1968	Updated Benefits
Crop and Pasture	$28,300	REC	38.62	173.00	4.48	$126,771.10
Other Agricultural	$1,700	PPF	28.74	225.00	7.83	$13,308.98
Road and Bridge	$1,800	ENR	1155.00	9936.44	8.60	$15,485.36
Railroad	$300	ENR	1155.00	9936.44	8.60	$2,580.89
Urban	$700	CPI	34.80	236.15	6.79	$4,750.14
Subtotal	$32,800					
Indirect	$3,400	CPI	34.80	236.15	6.79	$23,072.13
Total	$36,200					$185,968.60
In addition, it is estimated that land treatment measures will provide flood damage reductin benefits from 1800 annually						
4 FRS and 6.53 miles of channel improvement						
Damage Reduction	$34,400					$184,168.60
More Intensive Land Use	$14,600	LV	156.00	1300.00	8.33	$121,666.67
Secondary	$15,300	CPI	34.80	236.15	6.79	$103,824.57
Total	$64,300					$409,659.84

Muddy Creek WJD 27

Item	Price Base 1962	Index	1962 Value	2014 Value	Index from 1962	Updated Benefits
Crop and Pasture	$8,300	REC	36.55	173.00	4.73	$39,285.91
Other Agricultural	$1,400	PPF	27.01	225.00	8.33	$11,662.35
Road and Bridge	$2,100	ENR	872.00	9936.44	11.40	$23,929.50
Railroad	$700	ENR	872.00	9936.44	11.40	$7,976.50

Oil Field	$200	CPI	30.20	236.15	7.82	$1,563.91
Subtotal	$12,700					
Erosion Flood Plain Scour	$1,100	LV	107.00	1300.00	12.15	$13,364.49
Indirect	$1,400	CPI	30.20	236.15	7.82	$10,947.35
Total	$15,200					$108,730.00
In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of 300 annually						
Damage Reduction	$14,900					$105,730.00
More Intensive Land Use	$700	LV	107.00	1300.00	12.15	$8,504.67
Changed Land Use	$300	LV	107.00	1300.00	12.15	$3,644.86
Secondary	$2,200	CPI	30.20	236.15	7.82	$17,202.98
Benefits Outside Watershed	$7,600	CPI	30.20	236.15	7.82	$59,428.48
Total	$25,700					$194,510.99

Nemaha Brown WJD 7

Item	Price Base 1978	Index	1978 Value	2014 Value	Index from 1978	Updated Benefits
Crop and Pasture	$1,230,000	REC	79.31	173.00	2.18	$2,683,016.01
Other Agricultural	$490,000	PPF	62.07	225.00	3.62	$1,776,220.40
Road and Bridge	$38,000	ENR	2776.00	9936.44	3.58	$136,017.55
Secondary	$80,000	CPI	65.20	236.15	3.62	$289,754.60
Siltation Reduction into Lower Delaware Valley and Perry Reservoir	$65,650	ENR	2776.00	9936.44	3.58	$234,988.22
More Intensive Use of Land	$15,000	LV	418.00	1300.00	3.11	$46,650.72
Recreational, Environment Enhancement	$27,000	CPI	65.20	236.15	3.62	$97,792.18
Water Supply	$250,000	CPI	65.20	236.15	3.62	$905,483.13
Erosion Flood Plain Scour	$50,000	LV	418.00	1300.00	3.11	$155,502.39
Indirect	$35,000	CPI	65.20	236.15	3.62	$126,767.64
Kickapoo - Municipal and Industrial Water	$450,000	CPI	65.20	236.15	3.62	$1,629,869.63
Kickapoo - Supplemental Irrigation	$125,000	PPF	79.31	225.00	2.84	$354,621.11
Kickapoo - Recreational, Environmental Enhancement	$80,000	CPI	65.20	236.15	3.62	$289,754.60
Total	$2,935,650					$8,726,438.17

Otter Creek WJD 83

Item	Price Base 1975	Index	1975 Value	2014 Value	Index from 1975	Updated Benefits
Crop and Pasture	$33,300	REC	69.66	173.00	2.48	$82,700.26
Other Agricultural	$3,200	PPF	52.30	225.00	4.30	$13,766.73
Road and Bridge	$12,200	ENR	2212.00	9936.44	4.49	$54,803.15
Flood Plain Scour	$56,000	ENR	2212.00	9936.44	4.49	$251,555.44
Indirect	$6,100	CPI	53.80	236.15	4.39	$26,775.37
Incidental stockwater	$3,400	CPI	53.80	236.15	4.39	$14,923.98
More Intensive Use	$3,000	LV	296.00	1300.00	4.39	$13,175.68
Secondary Benefits	$8,500	CPI	53.80	236.15	4.39	$37,309.94
Off Project	$22,100	CPI	53.80	236.15	4.39	$97,005.86
Total Benefits	$97,400					
	$147,800					
3 Completed Dams						
Flood Reduction	$15,856					
Water Quality and Sediment Reduction in Federal Reservoir	$67,444	CPI	53.80	236.15		
Recreation	$4,674	CPI	53.80	236.15		
Stock Water	$12,000	CPI	53.80	236.15		
Total Benefits	$28,474					

Price Base 2003

Flood damage reduction figures were evaluated, utilizing the original 1975 general plan economic data; figures were updated to 2003 values by comparison of construction cost indexes and relative farm commodity prices

Annual costs were compute by amortizing all expended construction costs for a period of 100 years at 5% interest. Five percent was considered average return, for this period, that a public entity could expect from investments

24 proposed dams					
Flood Damage Reduction	$152,068				
Water Quality and Sediment Reduction in Federal Reservoir	$55,776	CPI	53.80	236.15	
Recreation	$29,356	CPI	53.80	236.15	
Stock Water	$14,400	CPI	53.80	236.15	
Total Benefits	$251,600				

Price Base 2003

Flood damage reduction figures were evaluated, utilizing the original 1975 general plan economic data; figures were updated to 2003 values by comparison of construction cost indexes and relative farm commodity prices

Annual costs were compute by amortizing all expended construction costs for a period of 100 years at 6% interest.

Inclusion of dry hydrants in structure design, for the purpose of fire protection, in rurla areas, have been included for specific sites, where the proposed structures are close to public roads.

Pawnee WJD 81

Item	Price Base 1988	Index	1988 Value	2014 Value	Index from 1988	Updated Benefits
Flood damage Reduction	$1,268,300					
Groundwater Recharge	$314,700	CPI	118.30	236.15	2.00	$628,202.92
Recreation	$792,000	CPI	118.30	236.15	2.00	$1,580,987.32
Incidental stockwater	$12,200	CPI	118.30	236.15	2.00	$24,353.59
Secondary Benefits	$126,800	CPI	118.30	236.15	2.00	$253,117.67
Total Benefits	$2,514,000					$2,486,661.50

Annual costs were computed by amortizing all estimated costs (construction; land; adminstration; legal; engineering and maintenance) for a period of 50 years at 8-7/8 percent interest.

Peyton Creek WD 71

Item	Price Base 1980	Index	1980 Value	2014 Value	Index from 1980	Updated Benefits
PL 566						
Crop and Pasture	$36,400	REC	92.41	173.00	1.87	$68,144.14
Other Agricultural	$4,900	PPF	79.31	225.00	2.84	$13,901.15
Road, Bridge and Railroad	$6,500	ENR	3237.00	9936.44	3.07	$19,952.69
Floodplain Land Damage	$2,200	LV	587.00	1300.00	2.21	$4,872.23
Other Direct	$5,800	CPI	82.40	236.15	2.87	$16,622.21
Off Project	$7,700	CPI	82.40	236.15	2.87	$22,067.42
More Intensive Use	$24,600	LV	587.00	1300.00	2.21	$54,480.41
Trib Benefits	$8,000	CPI	82.40	236.15	2.87	$22,927.18
Total	$96,100					$222,967.43
	Price Base					
State	2000					
Crop and Pasture	$26,900	REC	96.00	173.00	1.80	$48,476.04
Other Agricultural	$3,600	PPF	120.00	225.00	1.88	$6,750.00
Road, Bridge and Railroad	$4,800	ENR	6221.00	9936.44	1.60	$7,666.76
Floodplain Land Damage	$1,600	LV	625.00	1300.00	2.08	$3,328.00
Other Direct	$4,300	CPI	172.20	236.15	1.37	$5,896.89
Off Project	$5,700	CPI	172.20	236.15	1.37	$7,816.81
More Intensive Use	$18,200	LV	625.00	1300.00	2.08	$37,856.00
Trib Benefits	$5,900	CPI	172.20	236.15	1.37	$8,091.09
Sediment Storage	$8,000	LV	625.00	1300.00	2.08	$16,640.00
Water Based Recreation	$6,600	CPI	172.20	236.15	1.37	$9,051.05
Incidental Livestock Water	$7,200	CPI	172.20	236.15	1.37	$9,873.87
Rural Fire Protection	$4,000	CPI	172.20	236.15	1.37	$5,485.48
Total	$96,800					$166,931.99
	$192,900					$389,899.41

Pony Creek WJD 78

Item	Price Base 1974	Index	1974 Value	2014 Value	Index from 1974	Updated Benefits
Crop and Pasture	$264,300	REC	72.41	173.00	2.39	$631,458.36
Other Agricultural	$1,800	PPF	47.70	225.00	4.72	$8,490.57
Flood Plain Scour	$6,400	LV	253.00	1300.00	5.14	$32,885.38
Road and Bridge	$11,100	ENR	2020.00	9936.44	4.92	$54,601.23
Indirect	$8,300	CPI	49.30	236.15	4.79	$39,757.51
Secondary	$29,600	CPI	49.30	236.15	4.79	$141,785.80
Municipal and Industrial Water Supply	$79,100	CPI	49.30	236.15	4.79	$378,893.81
More Intensive Use of Land Resources	$4,600	LV	253.00	1300.00	5.14	$23,636.36
Recreation, Environmental Enhancement	$10,000	CPI	49.30	236.15	4.79	$47,900.61
Total	$415,200					$1,359,409.63

Pottawatomie Creek WJD 90

Item	Price Base 1982	Index	1982 Value	2014 Value	Index from 1982	Updated Benefits
Crop and Pasture	$194,315	REC	91.72	173.00	1.89	$366,512.16
Indirect	$15,800	PPF	87.93	225.00	2.56	$40,429.89
Recreation (Incidental)	$27,990	CPI	96.50	236.15	2.45	$68,495.74
Roads and Bridges	$15,800	ENR	3825.00	9936.44	2.60	$41,044.64
Stockwater (Incidental)	$13,840	CPI	96.50	236.15	2.45	$33,868.56
Sediment Control	$57,942	ENR	3825.00	9936.44	2.60	$150,519.53
Secondary	$32,570	CPI	96.50	236.15	2.45	$79,703.68
Total	$358,267					$780,574.20

Monetary Benefits from Works of Improvements

Rock Creek WJD 28

Item	Price Base 1963	Index	1963 Value	2014 Value	Index from 1963	Updated Benefits
Crop	$53,200	REC	36.55	173.00	4.73	$251,808.48
Other Agricultural	$12,400	PPF	27.30	225.00	8.24	$102,197.80
Road and Bridge	$9,300	ENR	901.00	9936.44	11.03	$102,562.59
Railroad	$600	ENR	901.00	9936.44	11.03	$6,616.94
Subtotal	$75,500					
Erosion, Flood Plain Scour	$9,200	LV	112.00	1300.00	11.61	$106,785.71
Indirect	$8,000	CPI	30.60	236.15	7.72	$61,738.56
Total Damage Reduction, On Project	$92,700					
More Intensive Land Use	$10,900	LV	112.00	1300.00	11.61	$126,517.86
Changed Land Use	$14,600	LV	112.00	1300.00	11.61	$169,464.29
Secondary	$16,500	CPI	30.60	236.15	7.72	$127,335.78
Off Project	$26,500	CPI	30.60	236.15	7.72	$204,508.99
Grand Total	$161,200					$1,259,537.00

Rock Creek WD 45

Item	Price Base 1972	Index	1972 Value	2014 Value	Index from 1972	Updated Benefits
Crop	$36,500	REC	47.59	173.00	3.64	$132,685.44
Other Agricultural	$1,100	PPF	35.06	225.00	6.42	$7,059.33
Road and Bridge	$4,100	ENR	1753.00	9936.44	5.67	$23,239.82
Erosion, Flood Plain Scour	$7,200	LV	174.00	1300.00	7.47	$53,793.10
Urban	$1,100	CPI	41.80	236.15	5.65	$6,214.47
Indirect	$5,200	CPI	41.80	236.15	5.65	$29,377.51
Municipal and Industrial Water Supply	$2,300	CPI	41.80	236.15	5.65	$12,993.90
Sediment Storage	$14,400	LV	174.00	1300.00	7.47	$107,586.21
Recreation	$8,800	CPI	41.80	236.15	5.65	$49,715.79
Incidental Stock Water	$13,400	CPI	41.80	236.15	5.65	$75,703.59
Incidental Recreation	$31,000	CPI	41.80	236.15	5.65	$175,135.17

Secondary	$12,800	CPI	41.80	236.15	5.65	$72,313.88
Off Project	$14,300	CPI	41.80	236.15	5.65	$80,788.16
Total	$152,200					$826,606.36

Rock Creek WJD 84

Item	Price Base 1974	Index	1974 Value	2014 Value	Index from 1974	Updated Benefits
Crop and Pasture	$154,100	REC	72.41	173.00	2.39	$368,171.52
Other Agricultural	$8,500	PPF	47.70	225.00	4.72	$40,094.34
Road , Railroad and Bridge	$20,000	ENR	2020.00	9936.44	4.92	$98,380.59
Floodplain Land Damage	$9,900	LV	253.00	1300.00	5.14	$50,869.57
Urban	$3,700	CPI	49.30	236.15	4.79	$17,723.23
Indirect	$20,800	CPI	49.30	236.15	4.79	$99,633.27
More Intensive Land Use	$19,600	LV	253.00	1300.00	5.14	$100,711.46
Sediment Storage	$200	ENR	2020.00	9936.44	4.92	$983.81
Secondary	$192,900	CPI	49.30	236.15	4.79	$924,002.74
Off Project - Mainstem Neosho River	$2,100	CPI	49.30	236.15	4.79	$10,059.13
Total	$431,800					$1,710,629.65

Price Base Adjusted Normalized, Plan prepared in June 1979, general plan used 1974 price base for annual costs

Roys Creek WD No. 75

Item	Price Base 1978	Index	1978 Value	2014 Value	Index from 1978	Updated Benefits
Crop and Pasture	$246,000	REC	79.31	173.00	2.18	$536,603.20
Other Agricultural	$98,000	PPF	62.07	225.00	3.62	$355,244.08
Flood Plain Scour	$10,000	LV	418.00	1300.00	3.11	$31,100.48
Road and Bridge	$7,600	ENR	2776.00	9936.44	3.58	$27,203.51
Indirect	$7,000	CPI	65.20	236.15	3.62	$25,353.53
Secondary	$16,000	CPI	65.20	236.15	3.62	$57,950.92
Siltation Reduction into lower Nemaha River	$13,150	ENR	2776.00	9936.44	3.58	$47,069.23
More Intensive Land Use	$3,000	LV	418.00	1300.00	3.11	$9,330.14
Total Damage Reduction, On Project	$400,750					$1,089,855.09

Salt Creek WJD No. 46

Item	Price Base 1967	Index	1967 Value	2014 Value	Index from 1967	Updated Benefits
Crop and Pasture	$182,500	REC	37.93	173.00	4.56	$832,388.61
Other Agricultural	$8,600	PPF	28.74	225.00	7.83	$67,327.77
Road and Bridge	$18,800	ENR	1074.00	9936.44	9.25	$173,933.96
Railroad	$5,100	ENR	1074.00	9936.44	9.25	$47,184.21
Erosion Flood Plain Scour	$11,000	LV	144.00	1300.00	9.03	$99,305.56
Indirect	$23,600	CPI	33.40	236.15	7.07	$166,860.48
More Intensive Land Use	$33,300	LV	144.00	1300.00	9.03	$300,625.00
Changed Land Use	$9,300	LV	144.00	1300.00	9.03	$83,958.33
Secondary	$28,000	CPI	33.40	236.15	7.07	$197,970.06
Off Project	$11,200	CPI	33.40	236.15	7.07	$79,188.02
Total	$331,400					$2,048,742.00

Salt Creek WJD No. 104

Item	Price Base 1989	Index	1989 Value	2014 Value	Index from 1989	Updated Benefits
Crop and Pasture	$258,855	REC	101.38	173.00	1.71	$441,723.37
Other Agricultural	$50,934	PPF	95.95	225.00	2.34	$119,438.77
Road, Railroad, and Bridge	$28,278	ENR	4615.00	9936.44	2.15	$60,884.65
Floodplain Land Damage	$32,273	LV	429.00	1300.00	3.03	$97,796.97
Other Direct	$46,242	CPI	124.00	236.15	1.90	$88,064.91
Off Project	$91,792	CPI	124.00	236.15	1.90	$174,811.94
Total	$508,374					$982,720.60

Sand Creek WJD No 68

Item	Price Base 1983	Index	1983 Value	2014 Value	Index from 1983	Updated Benefits
Crop and Pasture	$49,500	REC	93.10	173.00	1.86	$91,981.74
Other Agricultural	$19,100	PPF	87.36	225.00	2.58	$49,192.99
Road and Bridge	$34,400	ENR	4066.00	9936.44	2.44	$84,066.29
Railroad	$1,800	ENR	4066.00	9936.44	2.44	$4,398.82
Urban	$4,800	CPI	99.60	236.15	2.37	$11,380.72
Floodplain Scour	$11,900	LV	601.00	1300.00	2.16	$25,740.43
Indirect	$14,200	CPI	99.60	236.15	2.37	$33,667.97
Total	$135,700					$300,428.97

Silver Creek WJD No. 25

Item	Price Base 1957	Index	1957 Value	2014 Value	Index from 1957	Updated Benefits
Crop and Pasture	$7,655	REC	35.17	173.00	4.92	$37,654.68
Other Agricultural	$2,495	PPF	25.86	225.00	8.70	$21,708.24
Road and Bridge	$922	ENR	724.00	9936.44	13.72	$12,653.86
Floodplain Scour	$4,892	LV	87.00	1300.00	14.94	$73,098.85
Indirect	$1,108	CPI	28.10	236.15	8.40	$9,311.54
Changed Land Use	$256	LV	87.00	1300.00	14.94	$3,825.29
More Intensive Land Use	$3,054	LV	87.00	1300.00	14.94	$45,634.48
Total	$20,382					$203,886.94

Snipe Creek WD No. 69

Item	Price Base	Index	XXXX Value	2014 Value	Index from XXXX	Updated Benefits

**No Monetary Benefits or Flood Damage Reduction Benefits in Work Plan

South Fork WJD No. 76

Item	Price Base 1972	Index	1972 Value	2014 Value	Index from 1972	Updated Benefits
Crop and Pasture	$140,400	REC	47.59	173.00	3.64	$510,384.53
Other Agricultural	$11,100	PPF	35.06	225.00	6.42	$71,235.03
Road and Bridge	$9,700	ENR	1753.00	9936.44	5.67	$54,982.01
Railroad	$2,400	ENR	1753.00	9936.44	5.67	$13,603.80
Floodplain Land Damage	$19,600	LV	174.00	1300.00	7.47	$146,436.78
Indirect	$19,100	CPI	41.80	236.15	5.65	$107,905.86
Sediment Storage	$39,600	ENR	1753.00	9936.44	5.67	$224,462.65
Incidental Stock Water	$5,300	CPI	41.80	236.15	5.65	$29,942.46
Incidental Recreation	$33,900	CPI	41.80	236.15	5.65	$191,518.78
Secondary	$41,300	CPI	41.80	236.15	5.65	$233,325.24
Off Project - Mainstem Cottonwood River	$85,900	CPI	41.80	236.15	5.65	$485,293.90
Total	$408,300					$2,069,091.04

Spillman Creek, Revised No. 43

Item	Price Base 1965	Index	1965 Value	2014 Value	Index from 1965	Updated Benefits
Crop	$54,300	REC	37.24	173.00	4.64	$252,253
Other Agricultural	$4,600	PPF	27.59	225.00	8.15	$37,514
Road and Bridge	$12,500	ENR	971	9936.44	10.23	$127,915
Railroad	$2,300	ENR	971	9936.44	10.23	$23,536
Urban	$100	CPI	31.5	236.15	7.49	$750
Floodplain Scour	$3,600	LV	123	1300.00	10.56	$38,049
Indirect	$8,400	CPI	31.5	236.15	7.49	$62,973
More Intensive Land Use	$22,000	LV	123	1300.00	10.56	$232,520
Changed Land Use	$8,200	LV	123	1300.00	10.56	$86,667

Secondary	$14,900	CPI	31.5	236.15	7.49	$111,703
Off Project	$16,100	CPI	31.5	236.15	7.49	$120,699
Grand Total	$147,000					$1,094,578

Spring Creek WJD No. 16

Item	Price Base 1958	Index	1958 Value	2014 Value	Index from 1958	Updated Benefits
Crop and Pasture	$2,689	REC	37.93	173.00	4.56	$12,264.62
Other Agricultural	$2,869	PPF	26.44	225.00	8.51	$24,414.71
Road and Bridge	$5,697	ENR	759.00	9936.44	13.09	$74,582.21
Sediment Damage Overbank Deposition	$4,135	ENR	759.00	9936.44	13.09	$54,133.31
Indirect Damage	$1,125	CPI	28.90	236.15	8.17	$9,192.69
Changed Land Use	$2,405	LV	93.00	1300.00	13.98	$33,618.28
Total	$18,920					$208,205.82

Switzler Creek WD No. 63

Item	Price Base 1954	Index	1954 Value	2014 Value	Index from 1954	Updated Benefits
Crop and Pasture	$3,925	REC	37.24	173.00	4.65	$18,233.75
Other Agricultural	$1,286	PPF	25.57	225.00	8.80	$11,316.00
Road and Bridge	$3,327	ENR	628.00	9936.44	15.82	$52,640.98
Non-Agricultural	$4,970	CPI	26.90	236.15	8.78	$43,630.69
Floodplain Scour	$1,143	LV	79.00	1300.00	16.46	$18,808.86
More Intensive Land Use	$5,207	LV	79.00	1300.00	16.46	$85,684.81
Conservation benefits	$123,610	CPI	26.90	236.15	8.78	$1,085,148.75
Total	$143,468					$1,315,463.84

Tauy Creek WJD No. 82

Item	Price Base 1977	Index	1977 Value	2014 Value	Index from 1977	Updated Benefits
Crop and Pasture	$251,993	REC	68.97	173.00	2.51	$632,083.36
Other Agricultural	$6,332	PPF	57.47	225.00	3.92	$24,790.33
Flood Plain Scour	$8,118	LV	398.00	1300.00	3.27	$26,516.08
Silt and Debris deposition	$6,493	ENR	2576.00	9936.44	3.86	$25,045.54
Road and Bridge - Direct	$14,400	ENR	2576.00	9936.44	3.86	$55,545.32
Road and Bridge - Indirect	$2,161	ENR	2576.00	9936.44	3.86	$8,335.65
Indirect (other than roads)	$27,294	CPI	60.60	236.15	3.90	$106,361.02
More Intensive Land Use	$12,664	LV	398.00	1300.00	3.27	$41,364.82
Municipal and Industrial Water Supply	$153,256	CPI	60.60	236.15	3.90	$597,217.89
Recreational and Environmental Enhancement	$9,660	CPI	60.60	236.15	3.90	$37,643.71
Total	$492,371					$1,554,903.73

Thompsonville WD No. 6

Item	Price Base 1957	Index	1957 Value	2014 Value	Index from 1957	Updated Benefits
Crop and Pasture	$3,590	REC	35.17	173.00	4.92	$17,659.08
Other Agricultural	$152	PPF	25.86	225.00	8.70	$1,322.51
Road and Bridge	$65	ENR	724.00	9936.44	13.72	$892.08
Land Damage - Sediment	$2,115	ENR	724.00	9936.44	13.72	$29,027.03
Land Damage - Swamping	$771	ENR	724.00	9936.44	13.72	$10,581.49
Indirect	$669	CPI	28.10	236.15	8.40	$5,622.22
Total	$7,362					$65,104.41

Timber Creek WJD No 38

Item	Price Base 1964	Index	1964 Value	2014 Value	Index from 1964	Updated Benefits
Crop and Pasture	$88,200	REC	35.86	173.00	4.82	$425,504.74
Other Agricultural	$17,500	PPF	27.01	225.00	8.33	$145,779.34

Road and Bridge	$25,200	ENR	936.00	9936.44	10.62	$267,519.54
Railroad	$1,700	ENR	936.00	9936.44	10.62	$18,046.95
Erosion Flood Plain Scour	$6,200	LV	115.00	1300.00	11.30	$70,086.96
Indirect	$14,600	CPI	31.00	236.15	7.62	$111,219.03
More Intensive Land Use	$12,000	LV	115.00	1300.00	11.30	$135,652.17
Changed Land Use	$10,400	LV	115.00	1300.00	11.30	$117,565.22
Secondary	$21,800	CPI	31.00	236.15	7.62	$166,066.77
Off Project	$38,800	CPI	31.00	236.15	7.62	$295,568.39
Total	$236,400					$1,753,009.11

Tri Creek WJD No. 100

Item	Price Base 1979	Index	1979 Value	2014 Value	Index from 1979	Updated Benefits
Crop and Pasture	$260,822	REC	91.03	173.00	1.90	$495,685.00
Other Agricultural	$12,078	PPF	71.84	225.00	3.13	$37,827.81
Floodplain Land Damage	$17,225	LV	501.00	1300.00	2.59	$44,695.61
Road and Bridge	$30,999	ENR	3003.00	9936.44	3.31	$102,570.66
Indirect	$33,677	CPI	72.60	236.15	3.25	$109,543.02
Total	$354,801					$790,322.11

Turkey Creek WJD No. 32

Item	Price Base 1964	Index	1964 Value	2014 Value	Index from 1964	Updated Benefits
Crop and Pasture	$79,600	REC	35.86	173.00	4.82	$384,015.62
Other Agricultural	$11,600	PPF	27.01	225.00	8.33	$96,630.88
Road and Bridge	$14,900	ENR	936.00	9936.44	10.62	$158,176.24
Erosion Flood Plain Scour	$1,800	LV	115.00	1300.00	11.30	$20,347.83
Indirect	$11,400	CPI	31.00	236.15	7.62	$86,842.26
More Intensive Land Use	$13,600	LV	115.00	1300.00	11.30	$153,739.13
Total	$132,900					$899,751.94

Turkey Creek WD No 103

Item	Price Base 1984	Index	1984 Value	2014 Value	Index from 1984	Updated Benefits
Crop and Pasture	$36,600	REC	97.93	173.00	1.77	$64,656.39
Other Agricultural	$6,120	PPF	89.08	225.00	2.53	$15,458.02
Scouring and Sedimentation	$2,650	ENR	4146.00	9936.44	2.40	$6,351.08
Road and Bridge	$7,070	ENR	4146.00	9936.44	2.40	$16,944.19
Urban and Indirect	$9,250	CPI	103.90	236.15	2.27	$21,023.94
Total	$61,690					$124,433.62

Turkey Creek WJD No. 109

Item	Price Base 2002	Index	2002 Value	2014 Value	Index from 2002	Updated Benefits
Crop and Pasture	$513,500	REC	98.00	173.00	1.77	$906,484.69
Erosion and Sediment	$77,000	ENR	6538.00	9936.44	1.52	$117,024.45
Other Agriculture	$87,300	PPF	124.00	225.00	1.81	$158,407.26
Road, Bridges, Utilities	$102,700	ENR	6538.00	9936.44	1.52	$156,083.27
Total	$780,500					$1,337,999.67

Twin Caney WJD No. 34

Item	Price Base 1961	Index	1961 Value	2014 Value	Index from 1961	Updated Benefits
Crop	$229,600	REC	36.55	173.00	4.73	$1,086,752.39
Other Agricultural	$22,700	PPF	26.72	225.00	8.42	$191,148.95
Road and Bridge	$26,800	ENR	847.00	9936.44	11.73	$314,399.75
Railroad	$11,100	ENR	847.00	9936.44	11.73	$130,217.81
Sediment Overbank Deposition	$1,000	ENR	847.00	9936.44	11.73	$11,731.33

Erosion Floodplain Scour	$55,500	LV	102.00	1300.00	12.75	$707,352.94
Indirect	$30,900	CPI	29.90	236.15	7.90	$244,047.99
More Intensive Land Use	$31,400	LV	102.00	1300.00	12.75	$400,196.08
Changed Land Use Agr.	$14,700	LV	102.00	1300.00	12.75	$187,352.94
Municipal Water Supply	$1,600	CPI	29.90	236.15	7.90	$12,636.79
Recreational Water Supply	$5,400	CPI	29.90	236.15	7.90	$42,649.16
Total	$430,700					$3,328,486.15

Upper Black Vermillion WJD No. 37

Item	Price Base 1966	Index	1966 Value	2014 Value	Index from 1966	Updated Benefits
Crop and Pasture	$232,600	REC	40.00	173.00	4.33	$1,005,995.00
Other Agricultural	$16,900	PPF	28.45	225.00	7.91	$133,655.54
Road and Bridge	$23,300	ENR	1019.00	9936.44	9.75	$227,202.21
Railroad	$25,500	ENR	1019.00	9936.44	9.75	$248,654.78
Urban and Indirect	$9,700	CPI	32.40	236.15	7.29	$70,699.23
Flood Plain Scour	$34,600	LV	135.00	1300.00	9.63	$333,185.19
Flood Plain Sediment	$13,500	ENR	1019.00	9936.44	9.75	$131,640.77
Flood Plain Swamping	$15,200	ENR	1019.00	9936.44	9.75	$148,217.75
Gullies	$148,200	LV	135.00	1300.00	9.63	$1,427,111.11
Indirect	$40,300	CPI	32.40	236.15	7.29	$293,729.78
More Intensive Land Use	$18,800	LV	135.00	1300.00	9.63	$181,037.04
Changed Land Use Agr.	$39,500	LV	135.00	1300.00	9.63	$380,370.37
Secondary	$77,300	CPI	32.40	236.15	7.29	$563,407.25
Off Project	$81,600	CPI	32.40	236.15	7.29	$594,748.15
Total	$777,000					$5,739,654.16

Upper Littler Arkansas River WJD No. 95

Item	Price Base 1982	Index	1982 Value	2014 Value	Index from 1982	Updated Benefits
Crop and Pasture	$1,058,150	REC	91.72	173.00	1.89	$1,995,856.41
Other Agricultural	$12,479	PPF	87.93	225.00	2.56	$31,931.93
Road and Bridge	$70,893	ENR	3825.00	9936.44	2.60	$184,163.15
Railroad	$4,817	ENR	3825.00	9936.44	2.60	$12,513.42
Urban	$8,130	CPI	96.50	236.15	2.45	$19,895.33
Floodplain Scour	$7,601	LV	628.00	1300.00	2.07	$15,734.55
Sediment Damage	$3,177	ENR	3825.00	9936.44	2.60	$8,253.09
Indirect	$10,445	CPI	96.50	236.15	2.45	$25,560.48
Oil Field	$1,122	CPI	96.50	236.15	2.45	$2,745.70
Total	$1,176,814					$2,296,654.08

Upper Marais Des Cygnes WJD No 101

Item	Price Base 1978	Index	1978 Value	2014 Value	Index from 1978	Updated Benefits
Crop and Pasture	$208,848	REC	79.31	173.00	2.18	$455,563.03
Other Agricultural	$29,847	PPF	62.07	225.00	3.62	$108,193.57
Road, Railroad, and Bridge	$12,165	ENR	2776.00	9936.44	3.58	$43,543.51
Floodplain Land Damage	$38,827	LV	418.00	1300.00	3.11	$120,753.83
Indirect	$25,362	CPI	65.20	236.15	3.62	$91,859.45
More Intensive Land Use	$10,230	LV	418.00	1300.00	3.11	$31,815.79
Secondary	$2,555	CPI	65.20	236.15	3.62	$9,254.04
Total	$327,834					$860,983.22

Upper Verdigris WJD No. 24

Item	Price Base 1957	Index	1957 Value	2014 Value	Index from 1957	Updated Benefits
Crop and Pasture	$173,608	REC	35.17	173.00	4.92	$853,971.68
Other Agricultural	$13,958	PPF	25.86	225.00	8.70	$121,444.32

Road and Bridge	$7,042	ENR	724.00	9936.44	13.72	$96,646.98
City of Madison	$8,335	CPI	28.10	236.15	8.40	$70,046.63
Railroad	$3,415	ENR	724.00	9936.44	13.72	$46,868.71
Oil Installations	$1,909	CPI	28.10	236.15	8.40	$16,043.07
Floodplain Scour	$30,819	LV	87.00	1300.00	14.94	$460,513.79
Indirect	$21,892	CPI	28.10	236.15	8.40	$183,978.50
Changed Land Use to Crop Production	$3,208	LV	87.00	1300.00	14.94	$47,935.63
Total	$264,186					$1,897,449.30

Upper Verdigris Continued

Item	Price Base 1977	Index	1977 Value	2014 Value	Index from 1977	Updated Benefits
Crop and Pasture	$10,500	REC	68.97	173.00	2.51	$26,337.54
Other Agricultural	$700	PPF	57.47	225.00	3.92	$2,740.56
Road and Bridge	$400	ENR	2576.00	9936.44	3.86	$1,542.93
Urban	$500	CPI	60.60	236.15	3.90	$1,948.43
Railroad	$200	ENR	2576.00	9936.44	3.86	$771.46
Oil Installations	$100	CPI	60.60	236.15	3.90	$389.69
Floodplain Land Damage	$3,300	LV	398.00	1300.00	3.27	$10,778.89
Indirect	$1,800	CPI	60.60	236.15	3.90	$7,014.36
Sediment Storage	$300	ENR	2576.00	9936.44	3.86	$1,157.19
Secondary	$7,100	CPI	60.60	236.15	3.90	$27,667.74
Off Project	$200	CPI	60.60	236.15	3.90	$779.37
Total	$25,100					$81,128.16
Grand Total						$1,978,577.46

Upper Walnut WJD No. 33

Item	Price Base 1996	Index	1996 Value	2014 Value	Index from 1996	Updated Benefits
Crop	$218,600	REC	112.00	173.00	1.54	$337,658.93
Other Agricultural	$21,600	PPF	115.00	225.00	1.96	$42,260.87
Road and Bridge	$22,100	ENR	5620.00	9936.44	1.77	$39,073.90
Sediment	$8,900	ENR	5620.00	9936.44	1.77	$15,735.64
Floodplain Scour	$18,200	LV	553.00	1300.00	2.35	$42,784.81
Indirect	$28,300	CPI	156.90	236.15	1.51	$42,594.30
More Intensive Land Use	$84,000	LV	553.00	1300.00	2.35	$197,468.35
Changed Land Use	$22,600	LV	553.00	1300.00	2.35	$53,128.39
Redevelopment	$137,700	CPI	156.90	236.15	1.51	$207,252.10
Off Project	$180,700	CPI	156.90	236.15	1.51	$271,971.35
El Dorado Reservoir	$30,000	CPI	156.90	236.15	1.51	$45,152.96
Stockwater	$9,700	CPI	156.90	236.15	1.51	$14,599.46
Total	$782,400					$1,309,681.07

Vermillion Creek WD 70

Item	Price Base 1992	Index	1992 Value	2014 Value	Index from 1992	Updated Benefits
Crop and Pasture	$451,198	REC	98.00	173.00	1.77	$796,502.59
Other Agricultural	$192,629	PPF	101.00	225.00	2.23	$429,124.01
Flood Plain Scour	$17,800	LV	460.00	1300.00	2.83	$50,304.35
Road and Bridge	$14,065	ENR	4985.00	9936.44	1.99	$28,035.31
Indirect	$11,815	CPI	140.30	236.15	1.68	$19,886.76
Secondary	$28,010	CPI	140.30	236.15	1.68	$47,145.84
Siltation Reduction into Tuttle Creek	$13,925	ENR	4985.00	9936.44	1.99	$27,756.25
Reservoir	$12,124	CPI	140.30	236.15	1.68	$20,406.86
More Intensive Land Use	$13,100	LV	460.00	1300.00	2.83	$37,021.74
Recreational, Environment Enhancement	$754,666	CPI	140.30	236.15	1.68	$1,270,237.89
Total						$2,726,421.60

Wakarusa WJD No. 35

Item	Price Base 1965	Index	1965 Value	2014 Value	Index from 1965	Updated Benefits
Crop and Pasture	$98,600	REC	37.24	173.00	4.65	$458,050.48
Other Agricultural	$18,600	PPF	27.59	225.00	8.16	$151,685.39
Road and Bridge	$19,300	ENR	971.00	9936.44	10.23	$197,500.82
Railroad	$700	ENR	971.00	9936.44	10.23	$7,163.24
Urban	$300	CPI	31.50	236.15	7.50	$2,249.05
Flood Plain Scour	$2,500	LV	123.00	1300.00	10.57	$26,422.76
Indirect	$14,100	CPI	31.50	236.15	7.50	$105,705.24
More Intensive Land Use	$25,900	LV	123.00	1300.00	10.57	$273,739.84
Changed Land Use	$22,900	LV	123.00	1300.00	10.57	$242,032.52
Benefits Common Flood Plain	$2,500	CPI	31.50	236.15	7.50	$18,742.06
Benefits to Clinton reservoir	$38,200	CPI	31.50	236.15	7.50	$286,378.73
Secondary	$25,100	CPI	31.50	236.15	7.50	$188,170.32
Agriculture Water	$7,600	CPI	31.50	236.15	7.50	$56,975.87
Private Recreation	$9,900	CPI	31.50	236.15	7.50	$74,218.57
Total	$286,200					$2,089,034.90

Wakarusa WJD No. 35 Continued

Item	Price Base 1997	Index	1997 Value	2014 Value	Index from 1997	Updated Benefits
Crop and Pasture	$40,519	REC	107.00	173.00	1.62	$65,512.03
Other Agricultural	$17,365	PPF	118.00	225.00	1.91	$33,111.23
Flood Plain Scour	$20,408	LV	565.00	1300.00	2.30	$46,956.46
Road and Bridge	$26,917	ENR	5826.00	9936.44	1.71	$45,907.85
Secondary	$12,495	CPI	160.50	236.15	1.47	$18,384.39
Recreational, Environment Enhancement	$10,095	CPI	160.50	236.15	1.47	$14,853.17
Total	$127,799					$224,725.13

Walnut Creek Watershed No. 1

Item	Price Base 1957	Index	1957 Value	2014 Value	Index from 1957	Updated Benefits
Crop and Pasture	$10,178	REC	35.17	173.00	4.92	$50,065.23
Other Agricultural	$2,053	PPF	25.86	225.00	8.70	$17,862.53
Non-Agricultural	$7,591	CPI	28.10	236.15	8.40	$63,794.12
Sediment Damage Overbank Deposition	$635	ENR	724.00	9936.44	13.72	$8,714.97
Sediment Damage Swamping	$3,705	ENR	724.00	9936.44	13.72	$50,848.77
Erosion Damage Floodplain Scour	$1,780	LV	87.00	1300.00	14.94	$26,597.70
Erosion Damage Gullies	$35,470	LV	87.00	1300.00	14.94	$530,011.49
Indirect Damage	$2,710	CPI	28.10	236.15	8.40	$22,774.61
Changed Land Use	$23,792	LV	87.00	1300.00	14.94	$355,512.64
Benefits from Reduced Bridge Replacement Costs	$3,625	CPI	28.10	236.15	8.40	$30,464.19
Total	$91,539					$1,156,646.25

Walnut West Creeks WD No. 72

Item	Price Base 1989	Index	1989 Value	2014 Value	Index from 1989	Updated Benefits
Crop and Pasture	$228,200	REC	101.38	173.00	1.71	$389,412.11
Other Agricultural	$14,800	PPF	95.98	225.00	2.34	$34,694.73
Land Damage Reduction	$19,300	LV	429.00	1300.00	3.03	$58,484.85
Road and Bridge	$63,400	ENR	4615.00	9936.44	2.15	$136,504.94
Railroad	$3,400	ENR	4615.00	9936.44	2.15	$7,320.45
Oil Damage	$500	CPI	124.00	236.15	1.90	$952.22
Indirect Damage	$31,500	CPI	124.00	236.15	1.90	$59,989.72
More Intensive Use	$28,800	LV	429.00	1300.00	3.03	$87,272.73
Secondary	$39,200	CPI	124.00	236.15	1.90	$74,653.87
Off Project	$50,400	CPI	124.00	236.15	1.90	$95,983.55

Total	$479,500					$945,269.17

Wet Walnut Creek WD No. 58

Item	Price Base 1986	Index	1986 Value	2014 Value	Index from 1986	Updated Benefits
Crop and Pasture	$286,200	REC	84.83	173.00	2.04	$583,668.51
Other Agricultural	$361,100	PPF	82.76	225.00	2.72	$981,724.26
Road and Bridge	$21,500	ENR	4295.00	9936.44	2.31	$49,740.04
Railroad	$5,300	ENR	4295.00	9936.44	2.31	$12,261.50
Urban	$319,000	CPI	109.60	236.15	2.15	$687,334.40
Sediment Channel Deposition	$1,500	ENR	4295.00	9936.44	2.31	$3,470.24
Recreation (MP structures)	$65,000	CPI	109.60	236.15	2.15	$140,052.46
Flood Plain Scour	$42,400	LV	415.00	1300.00	3.13	$132,819.28
Indirect	$41,300	CPI	109.60	236.15	2.15	$88,987.18
More Intensive Use	$122,800	LV	415.00	1300.00	3.13	$384,674.70
Stored Water Use	$8,600	CPI	109.60	236.15	2.15	$18,530.02
Recharge	$619,400	CPI	109.60	236.15	2.15	$1,334,592.24
Secondary	$325,200	CPI	109.60	236.15	2.15	$700,693.25
Total	$2,219,300					$5,118,548.08

White Clay-Brewery-Whiskey Creeks WJD No. 26

Item	Price Base 1959	Index	1959 Value	2014 Value	Index from 1959	Updated Benefits
Crop and Pasture	$1,408	REC	36.55	173.00	4.73	$6,664.40
Other Agricultural	$845	PPF	26.72	225.00	8.42	$7,115.46
Floodplain Scour	$312	LV	98.00	1300.00	13.27	$4,138.78
Non-Agricultural	$149,112	CPI	29.10	236.15	8.12	$1,210,061.81
Total	$151,677					$1,227,980.45

Whitewater River WJD No. 22

Item	Price Base 1968	Index	1968 Value	2014 Value	Index from 1968	Updated Benefits
Crop and Pasture	$114,100	REC	38.62	173.00	4.48	$511,116.00
Other Agricultural	$7,800	PPF	28.74	225.00	7.83	$61,064.72
Road and Bridge	$19,700	ENR	1155.00	9936.44	8.60	$169,478.67
Railroad	$100	ENR	1155.00	9936.44	8.60	$860.30
Flood Plain Scour	$7,900	LV	156.00	1300.00	8.33	$65,833.33
Indirect	$16,000	CPI	34.80	236.15	6.79	$108,574.71
Towanda Reservoir	$19,500	CPI	34.80	236.15	6.79	$132,325.43
More Intensive Use	$56,500	LV	156.00	1300.00	8.33	$470,833.33
Changed Land Use	$15,000	LV	156.00	1300.00	8.33	$125,000.00
Recreation (MP structures)	$57,200	CPI	34.80	236.15	6.79	$388,154.60
Secondary	$38,300	CPI	34.80	236.15	6.79	$259,900.72
Off Project	$24,600	CPI	34.80	236.15	6.79	$166,933.62
Total	$376,700					$2,460,075.44

Wolf River WJD No. 66

Item	Price Base 1978	Index	1978 Value	2014 Value	Index from 1978	Updated Benefits
Crop and Pasture	$200,800	REC	79.31	173.00	2.18	$438,007.82
Other Agricultural	$31,200	PPF	62.07	225.00	3.62	$113,098.12
Road and Bridge	$16,700	ENR	2776.00	9936.44	3.58	$59,776.13
Railroad	$14,400	ENR	2776.00	9936.44	3.58	$51,543.49
Urban	$3,200	CPI	65.20	236.15	3.62	$11,590.18
Scour	$14,000	LV	418.00	1300.00	3.11	$43,540.67
Gullies	$3,694,200	LV	418.00	1300.00	3.11	$11,489,138.76
Sediment Deposition	$4,100	ENR	2776.00	9936.44	3.58	$14,675.58
Incidental, Secondary	$67,200	CPI	65.20	236.15	3.62	$243,393.87

Total	$4,045,800	$12,464,764.61
Total (with $27,210 in land treatment measures)		**$115,471,293.96**

Appendix F - Interview Instrument

Section 1: Demographics

1. What is your age?
2. What is your sex?
3. What is the highest level of education you have completed?
4. What is your race?
5. What is your ethnicity?
6. What is your income?
7. How long have you lived in the watershed district?
8. What is the size of your property within the watershed district?

Section 2: Formation of the Watershed District

1. What problems led to the formation of the watershed district in your area?

Section 3: Implementation of Watershed District

1. What are some of the challenges, or problems, that have come up as the watershed district has developed?
2. Should the watershed district be involved in more activities than flood control / dam construction?
a. If so, what activities? Why?
b. If not, why not?
3. How long should flood control projects be maintained?
a. What should be the useful life of flood control projects?
4. How do regulations, at either or both the federal and/or state level, affect implementation of watershed district efforts?
5. How do you feel about your representation on the watershed district board?
a. Do you feel the board adequately represents your interests?
i. In what ways does the board represent your interests?
ii. In what ways could the board better represent your interests?

Section 4: Perspectives on Success of Watershed District

1. In your opinion, have the benefits of the watershed district outweighed the costs?
a. Why or why not?
2. What are some key challenges in the watershed district going forward into the future?
a. How might these challenges be addressed?

Appendix G - SAKW Questionnaire

Kansas Watershed District Informational Questionnaire – Please return no later than Jan. 31, 2015 Return to: Pawnee Watershed District, 19005 SW 156 Hwy, Jetmore, KS 67854

Page **1** of **3**

The Watershed District Act was passed by the Kansas legislature in 1953 giving authority for citizens to establish a local Watershed District. The purpose of the Watershed District is to construct, operate and maintain works of improvement needed to provide for water management within designated boundaries. Hundreds of works of improvement in the form of dams have been built over the last sixty years. Some dams are now reaching the end of their expected life and are in need of major maintenance and rehabilitation. Many Watershed Districts still have dams to build that are listed in their General Plans. Building and maintaining dams can be very expensive and budgets are getting tighter every year. With this in mind, this questionnaire was developed to gather as much information as possible on the needs of every Watershed District in Kansas. Financial assistance from State and Federal governments or private foundations is very competitive. To put Kansas Watershed Districts in the best position to receive available funding the NEED for this assistance must be documented.
This questionnaire will provide the necessary information to quantify the current and future need for financial, technical and general watershed assistance.
Please fill out the following questionnaire to the best of your knowledge. If you have questions or would like help filling out the survey PLEASE CALL Teresa Reimer (Pawnee Watershed District Manager) at 620-357-5014. She will be happy to work through the survey with you and will even take your response over the phone.
Your name: _____ phone:
_____
Watershed District name and number:
_____
How many members are currently on your board? _____
Have you voted to change the number of board members in recent years? Reduce / Increase / No
How many board meetings are held annually? _____ Do you have an Annual Meeting? Yes / No
Do you keep minutes of your meetings? Yes / No
Are copies of the minutes sent to KDA* / Division of Conservation? Yes / No
Are copies of the annual treasurer's report sent to KDA / Division of Conservation? Yes / No
Are the following documents on file and available in your District office?
As-Built drawings for each dam Yes / No Audit of financial records in the last 5-years Yes / No Land rights/easements for each dam Yes / No
When was the last time your General Plan was amended and why?
_____
_____
___
Is your District aware it can install other practices (not flood control dams) that address erosion, silt and land conservation issues? Yes / No

Are you aware of State cost-share assistance for construction and rehabilitation? Yes / No
Are you aware of Federal cost-share assistance for construction and rehabilitation? Yes / No
Who is performing the following District activities?
Dam inspections and maintenance _____
_____
Daily office operations: i.e. reports, phone calls, filing, bill paying. . ._____
_____
How many of the following dams have been completed in your district:
NRCS _____ KDA/DOC _____ Other _____ = Total dams _____
How many of the following dams are yet to be built in your district:
NRCS _____ KDA/DOC _____ Other _____ = Total dams _____
Have your O&M Agreements for NRCS funded dams been reviewed in the last 5 years? Yes / No
How many of your completed dams have the following Hazard Classification and Emergency Action Plan (EAP)?
High Hazard_____ EAP_____ Significant Hazard_____ EAP
_____
How would you rank the condition of your existing dams?
Excellent Good Fair Poor
How often are Operation and Maintenance (O&M) inspections completed? Every year for every dam. _____Some years for some dams._____ Never_____
How often are O&M reports completed and submitted to KDA / DOC / NRCS? Every year for every dam. _____Some years for some dams._____ Never_____
Would your Watershed District be interested in merging with adjacent District(s)? Yes / No
Is your District a member of the State Association of Kansas Watersheds (SAKW)? Yes / No
Are you well represented by SAKW? Yes / No

Please score the following: (check the appropriate column)	**No problem for our District**	**This is a challenge but our District can handle it**	**Significant challenge Our District needs assistance**
State and Federal regulations			
Funding for operation and maintenance			
Funding for rehabilitation			
Finding dependable maintenance people			
Completing O&M inspections			
Completing O&M and other required reports			
Keeping board members active and informed			
Retaining board members			
Finding new board members			
Running a productive board meeting			
Keeping minutes of board meetings			
Understanding finances for the District			
Understanding insurance needs for the District			
Land owner understanding of dam benefits			
Land owner support of District work			
Asking for assistance from NRCS*			
Receiving assistance from NRCS			
Applying for Federal cost-share funds			
Asking for assistance from DWR*			
Receiving assistance from DWR			
Asking for assistance from DOC*			
Receiving Assistance From DOC			
Applying for State cost-share funds			
Amending the District's General Plan			
Understanding the O&M Agreement with NRCS			
Reviewing the O&M Agreement with NRCS			
Updating a dam's Emergency Action Plan (EAP)*			
Writing a new Emergency Action Plan (EAP)			
Asking for assistance from SAKW*			
Receiving assistance from SAKW			

Appendix H - Coding for Interview

Interview Themes	Sources	References
Climate	1	2
Economic		
Financial Limitations	10	21
Flood Insurance	2	6
Infrastructure	2	2
Property Value	2	4
Tax base	10	14
Landowner Acquisition	3	4
Life of Structures	11	23
Maintenance	4	8
Rehabilitation	1	1
Livelihood	2	2
Crop Loss	5	5
Livestock	4	6
Major Floods	7	12
General Flooding	11	26
Policies		
Corps of Engineers	7	19
Attitudes toward mitigation	4	11
Attitudes toward permitting	2	4
Attitudes toward third party easements	4	7
Environmental Policies	2	2
Clean Water Act	1	2
Conservation	9	13
Endangered Species	5	18
Groundwater Recharge	3	11
Involved Agencies		
EPA	5	9
Fish and Wildlife	3	5
Historical Society	1	2
Understaffed	1	1
Recreation	1	3
Wildlife	2	3
Policies		
Board Health		
Board Participation Challenges	10	29
Knowledge of Watershed District Functions	2	1
Member Participation Success	6	13

Family Heritage	5	7
Perceptions		
Lack of Public Awarness	3	3
Landower Perception	11	33
Perceptions of Environmental Policies	1	1
Perceptions of Landowners	5	6
Owners aware of dam benefits	1	0
Owners support the district	2	1
Perceptions of Local Support	2	2
Negative Public Support	4	4
Positive Public Support	5	6
Public Awarnes	3	8
Stewardship	2	7
Thriving Community	1	2