CHICKASAW NATIONAL RECREATION AREA: SOCIETAL PREFERENCES AND RATIONALE FOR TRADITIONAL AND CURRENT COLLECTION AND CONSUMPTION OF SPRING WATERS

By

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CHAPTER I:

INTRODUCTION

For decades, the region around Chickasaw National Recreation Area (CNRA) has been one of the principal attractions in south-central Oklahoma for wildlife, Native Americans, and settlers (Figure 1 and 2). At present, CNRA is the one of three national park sites in Oklahoma. CNRA's mission is to provide for public outdoor recreation use and enjoyment of Lake of the Arbuckle Reservoir and adjacent lands, and to provide for more efficient administration of areas containing scenic, scientific, natural, and historic values contributing to public enjoyment of the area (NPS 1994b).

Each year an estimated 1.5 million visitors travel to CNRA to enjoy it's natural beauty and to utilize its fresh and mineralized waters (Figure 3). However, as a result of this rate of visitation, the quality, quantity, and use of the springs located throughout CNRA have become a principle focus of concern for park officials. Unfortunately, lack of funds and staffing have created a situation where park officials have only limited information concerning current visitor use of spring waters. Furthermore, a comparison of current spring data and data from the peak visitation era of the 1920's and 1930's may also be of use to park officials, because it provides insight concerning change in spring use.

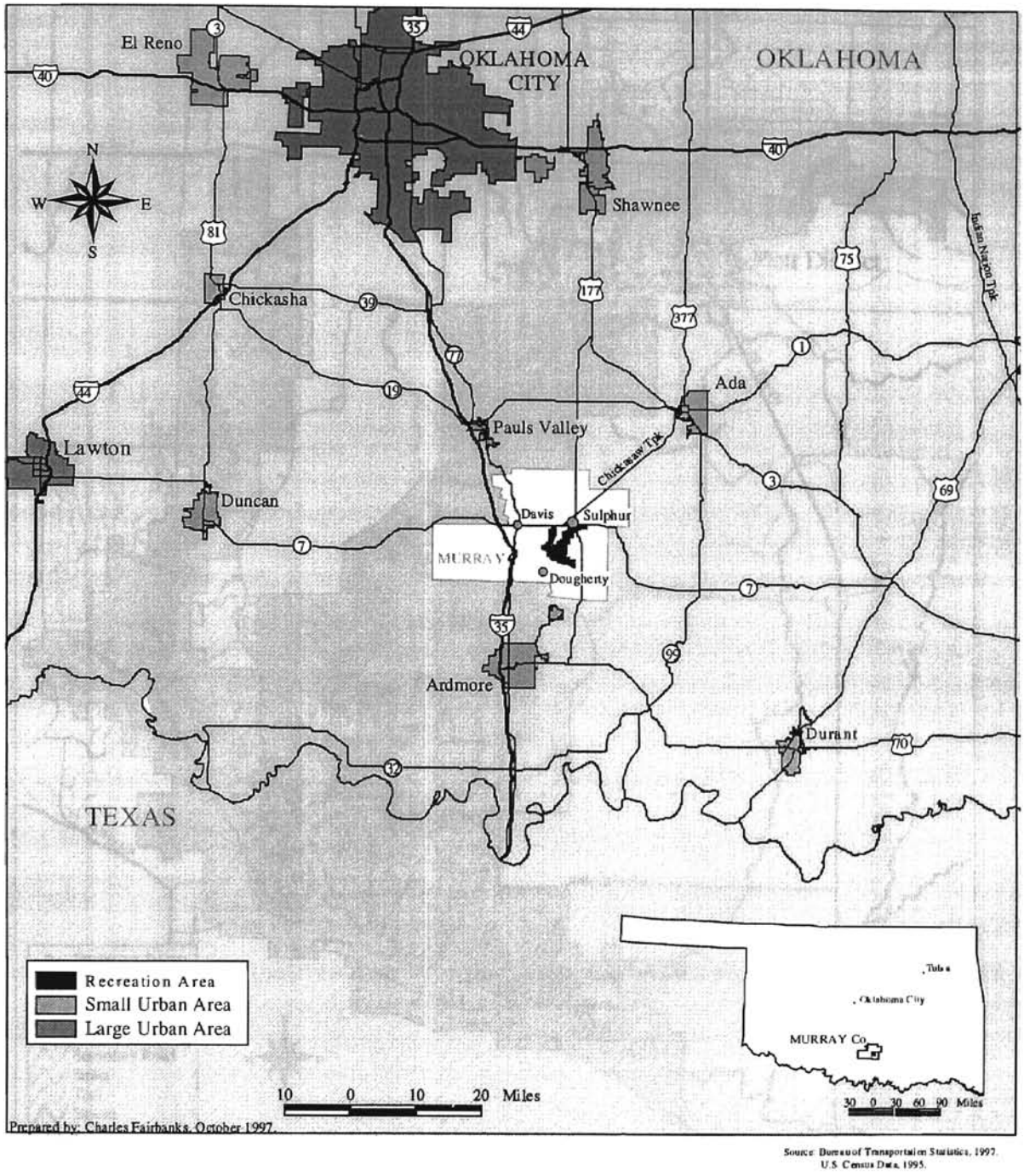

Figure 1. Regional Map

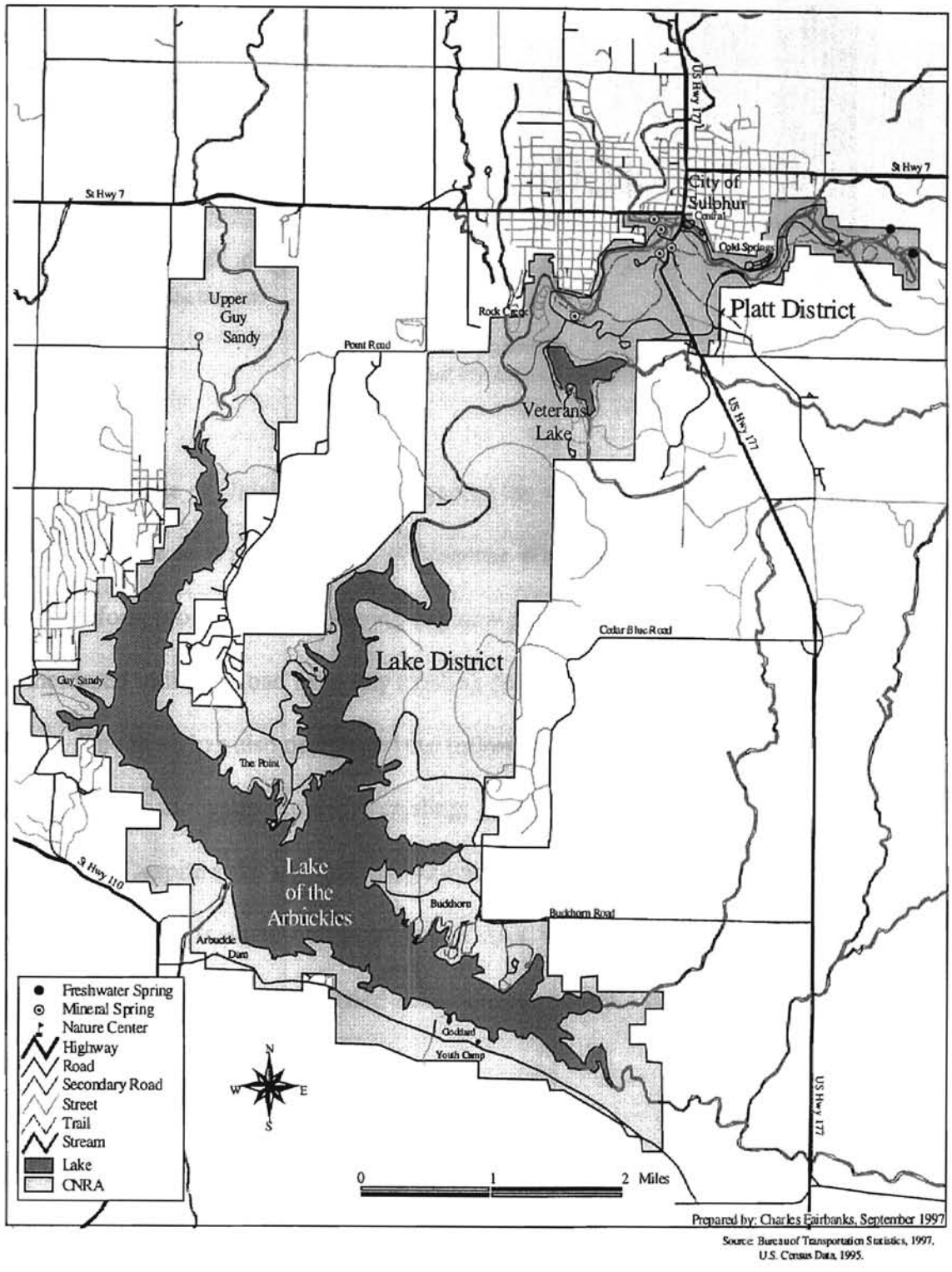

Figure 2. Chickasaw National Recreation Area

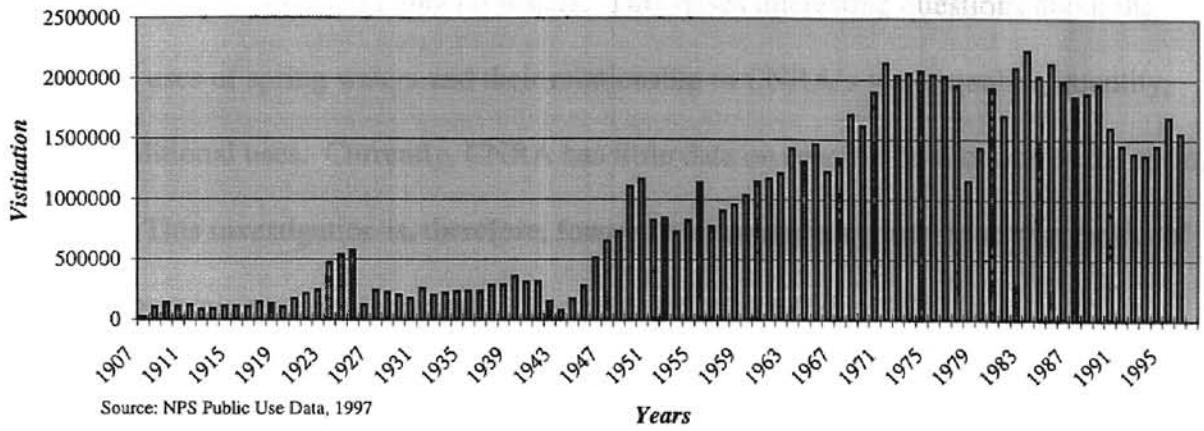

Figure 3.
Annual Visitation 1907-1997

The State of Oklahoma has designated the waters within CNRA as "Sensitive Public and Private Water Supplies" (Oklahoma Water Resources 1973). These waters are, therefore, prohibited from having any new point source discharge(s) of any pollutant or increased sediment load from any existing point source (Oklahoma Water Resources 1973). The State has also designated the following beneficial uses for CNRA springs: 1) public and private water supply; 2) cooling; 3) primary body contact recreation; and 4) aesthetics. Despite strict regulations, potential sources of pollution including the City of Sulphur's sewage treatment plant on Rock Creek, nearby ranch land and residential developments, and the use of agri-chemicals, pose possible threats to these beneficial uses (NPS 1994b).

Problem Statement

In the 1920's and 1930's, Platt National Park, now CNRA, provided visitors with healing and medicinal waters which revitalized spirits and was believed to cure common aliments. Although only 19 of the original 33 springs exist today, people continue to

collect CNRA's fresh and mineral waters. This raises interesting questions about the current uses of spring waters and their relationship to CNRA's water quality, quantity, and traditional uses. Currently, CNRA has little data on specific public uses of the spring water. This investigation is, therefore, focused on investigating this issue as a means of better managing water resources.

Research Questions and Hypotheses

Despite the existence of oral and written records, little is known of the contemporary uses of park waters at CNRA. Several sources (Sallee and Schoneweis 1997; Boeger 1987; Cunningham 1941) have discussed the historical importance of the spring waters; however, no sources have been discovered that have examine contemporary uses of spring waters at CNRA. This is a significant observation, because visitors continue to collect the water for various uses.

Although the park waters are occasionally tested and surveyed for contamination and flow rate, little is known of visitors' perception of water quality and quantity of the spring waters. It is important that park managers understand how visitors perceive the spring waters so they can better manage the resource. Equally important to park managers is the ability to make determinations of general spring use characteristics. It is also critical that managers know who the visitors are, so that they can anticipate the recreational needs and desires of users. In considering these influential factors, five research questions and hypotheses have been developed.

1. Are contemporary uses of the spring water at CNRA the same as those of the 1920' s and 1930's?

   Uses of CNRA spring water are not the same as those of the 1920's and 1930's. The majority of collectors do not use the water for its medicinal value.

2. Has the collectors' perception of the quality and quantity of the CNRA spring flows changed over the last 60 to 70 years? If so, how have these changes influenced traditional uses of the water at CNRA?

   The majority of the collectors' perceive the water quality and quantity of the spring flow to have changed.

3. Are users of the water local residents of the City of Sulphur, surrounding area residents within Murray County, or are they individuals traveling from even greater distances?

   The majority of the users are locals, who travel less than 10 miles to collect water.

4. Are the spring water collectors and users relatively new to CNRA or have they and their families been collecting and using the water for generations?

   The majority of the users are generational (individuals who have collected for more than 30 years).

5. At what quantity does collection of spring waters by individual visitors occur?

   The majority of individual visitors collect less than three gallons each visit.

Project Significance

Water recreators of all kinds come to enjoy the natural beauty of CNRA, yet historically the most important reason that people came to CNRA has been the fresh and mineral spring waters (Boeger 1987). Over the years the springs have become a cultural symbol for CNRA, the City of Sulphur, and the Arbuckle Mountains. Despite CNRA's historical legacy, little is known about the current use of the natural, artesian spring, and

well waters of this area. Equally important, few research studies have been completed on the importance of the cultural and healing uses of spring water in the United States.

This project is intended to add to our basic knowledge about spring waters and their use in the United States and provides a source for future comparison. In addition, it provides information about the reasons why people collect and drink spring waters nationwide.

Over the years, expansion of recreational opportunities within CNRA has drawn the management focus away from the springs and toward other pressing resource management issues. Therefore, managers of CNRA are eager to learn and understand more about the varying uses of CNRA's spring waters in order to better manage and protect the resource. Lastly, this project is intended to help in educating the general public about water quality and the Oklahoma Water Quality Standards.

Physiographic Setting

CNRA is located in south-central Oklahoma midway between Dallas, Texas and Oklahoma City, Oklahoma (Figure 1). The area occupies 9,888 acres, most of which is situated at the juncture of the southern Osage Plains and the ancient remnants of the Arbuckle Mountains (Barker and Jameson 1975; Sallee and Schoneweis 1997). CNRA's landforms vary from steep ridges dominated by weathering resistant outcrops of conglomerate rock to valley floors that are drained by several streams. Topography generally slopes to the southwest, with the high point located at the Bromide Hill Overlook (Sallee and Schoneweis 1997). Surface elevations in CNRA vary from almost 1200 feet above mean sea level (msl) southeast of Veterans Lake to 800 feet above msl at

the Lake of the Arbuckles. The gentlest slopes within CNRA occur in northern portions of the area along streambeds. One such location is found along Travertine Creek, where the National Park Service (NPS) has established numerous recreation sites.

The main drainage area within CNRA is called the Rock Creek Watershed (Figure 4). This watershed contains several streams including Travertine, Rock, Guy Sandy, Wilson, and Buckhorn Creeks. Stream flow is supplied year-round by the area's numerous natural springs that eventually feed either Lake of the Arbuckles or Veterans Lake.

Springs within CNRA are among the region's most important assets. Archaeological evidence suggests that human use of the springs dates back 7,000 years (Boeger 1987). Wild and domesticated animals also frequently relied on CNRA's springs as water sources. Today, visitors are attracted to CNRA by water-based recreational activities such as swimming, boating, and hiking.

The Early Years: Platt National Park

Long before federal management, the abundance of springs, streams, and lakes drew resident tribes such as the Wichitas and their allies the Caddos as well as nonresident tribes including the Comanche, to the area that is now CNRA (Boeger 1987). The area's allure to Native American groups was largely tied to fresh and mineralized springs located within the rolling hills. Native American groups valued spring water for its medicinal uses and viewed the springs themselves as sacred places (Boeger 1987; National Parks and Conservation Association 1993). In the 1830's, the Indian Nations

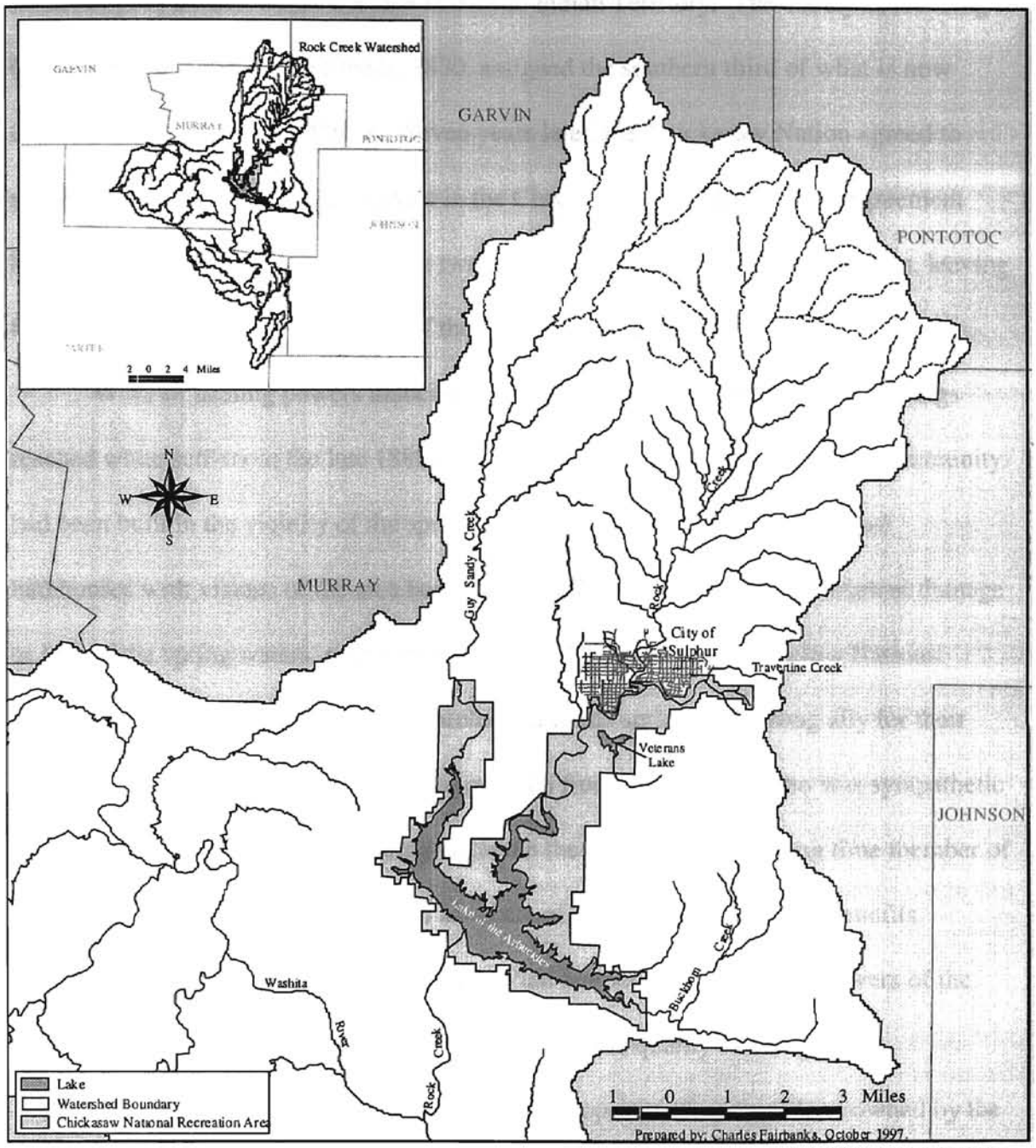

Figure 4.
Rock Creek Watershed
of the Washita River Watershed

commonly referred to as "The Five Civilized Tribes" were relocated west of the Mississippi to an area which became known as Indian Territory. The Treaty of Dancing Rabbit Creek, signed in September, 1830, assigned the southern third of what is now Oklahoma to the Choctaw Nation. Seven years later, the Chickasaw Nation agreed to move west after purchasing an interest in the Choctaw Nation. In 1855, an agreement between the U.S. Government and the two nations divided the area into two parts, leaving the present day CNRA in the hands of the Chickasaw Nation.

Word of healing powers associated with the area's bromide and sulfur springs reached white settlers in the late 1880s. By the turn-of-the-century a bustling community had been built in the vicinity of the springs. Developers constructed hotels and bathhouses with visions of the area becoming a health resort. Fearing permanent damage or loss of the spring waters, representatives of the Chickasaw and Choctaw Nations petitioned the federal government for protection of the springs. A strong ally for their cause was Orville H. Platt, an U.S. Congressman from Connecticut who was sympathetic to the importance of protecting spring waters in the area. Platt was a long time member of the Committee on Indians Affairs and advocate of the spring's medicinal benefits. Through his contacts with local inhabitants, Platt learned of the curative powers of the area's spring water and the danger of losing the pristine quality of the springs (Cunningham 1941; Gibson 1996). With Platt's support, 640 acres of land owned by the Nations was set aside by Congress on July 1, 1902 as the Sulphur Springs Reservation under the supervision of the U.S. Department of the Interior.

Included within the enabling legislation was a mandate that enough land be set aside to embrace all of the natural springs and enough of Sulphur (now Travertine), Rock,

and Buckhorn Creeks as deemed necessary by the Secretary of the Interior for the proper utilization and control of these waters (32 Stat. 655) (reference to governmental documents). A payment of $20.00 per acre was made to the Choctaw and Chickasaw Nations. Improvements to the land, which were lawfully established, were appraised and a payment made based upon the market value at the time of ratification (32 Stat. 655). To provide further protection for the springs, the Congressional Appropriations Act of April 21, 1904 added another 218 acres (33 Stat. 220). The Choctaw and Chickasaw Nations received $60.00 per acre for this land and improvements were to be paid according to the agreement of 1902. Due to the land acquisitions, the town of Sulphur Springs was moved to its present location and became known as the City of Sulphur (Laatsch 1966; Boeger 1987). Believing that a private organization would have better managed the reservation, many residents of the area regarded the legislation as a mistake. Many felt that the town would benefit from the construction of health spas within the reservation. In addition, ranchers, who grazed their cattle by the springs, didn't appreciate the government's interference because they would no longer be allowed to graze their cattle freely in the area (Boeger 1970).

As was originally desired by the Chickasaw and Choctaw Nations, Congress designated the area as a national park to provide additional protection for the area. A joint resolution of Congress on June 29, 1906, directed that Sulphur Springs Reservation be named Platt National Park (34 Stat. 837) to honor Congressman Platt from the State of Connecticut.

Platt National Park was unique within the NPS for two reasons: it was the country's smallest national park and the only one established through a conveyance of

property from two Native American Nations (Boeger 1987). The creation of the NPS as a separate entity within the Department of the Interior in 1916 brought Platt under NPS control. The mission of the NPS was the conservation of scenery and natural and historic objects, and to facilitate public enjoyment in such a way so as to protect areas and leave them unimpaired for the enjoyment of future generations (39 Stat. 535: 16 U.S.C. 1.). Platt's popularity grew as a result of visitor interests in the springs as recreation destinations. In 1927, Platt attracted more than a quarter of a million visitors. With an acreage of 912 acres, the park was ranked second in terms of visitation among the national parks (Boeger 1970). Today CNRA receives about a million and a half visitors (Figure 3); however, most visitors today seek lake-based opportunities rather than visiting the area to gather water.

The Civilian Conservation Corps

During the 1930's Platt National Park was the focus of several Civilian Conservation Corps (CCC) projects. The CCC planted trees and constructed roads, bridges, and trails (Boeger 1987; NPS 1996; Sallee and Schoneweis 1997). Given the importance of water to the area, construction was focused on various improvements adjacent to springs and streams (see Figure 5 and 6) such as pavilions, outflow channels, bank stabilization and dams that made access to waters easier (Boeger 1987). The dams built along Travertine Creek improved the swimming areas, creating many of the popular "swimming holes." An example of CCC productivity can be illustrated by "sapling crews" who, in their first year, planted 200 cedar trees and 2000 shrubs at the park's entrance and elsewhere such as Hillside Spring, around pavilions, and at employee

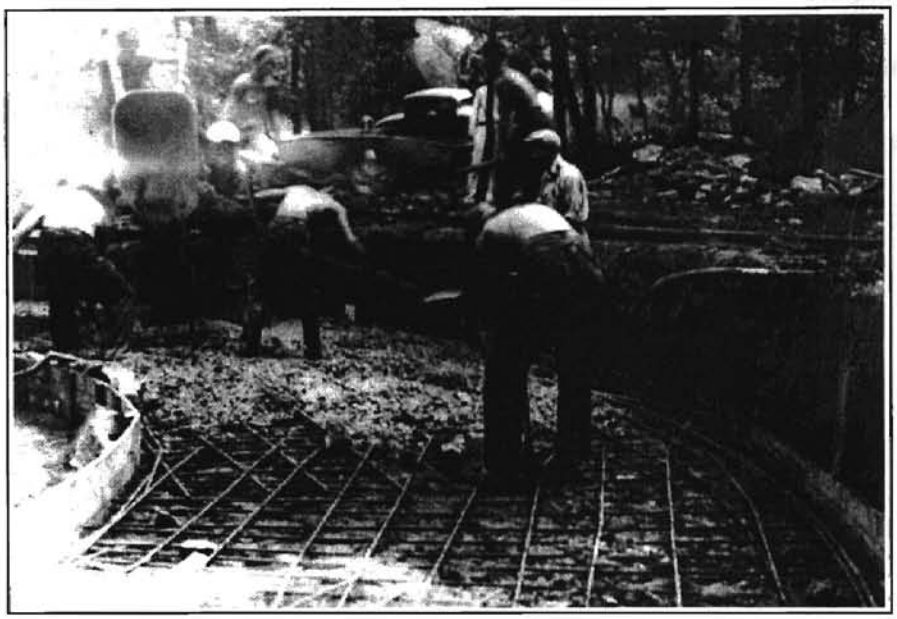

Figure 5. Complements of CNRA Archives
CCC workers constructing the Buffalo Spring's pool, 1930's.

Figure 6. Complements of CNRA Archives
CCC Tree Surgeon, 1930's

residences (Laatsch 1966; Boeger 1987; Sallee and Schoneweis 1997). Although the CCC constructed most of the man-made structures in the park, during the great depression the Public Works Administration, Works Project Administration and Civil Works Administration of Roosevelt's New Deal were involved in periodic developments within and adjacent to the park's boundaries (Boeger 1970; Sallee and Schoneweis 1997).

Lake of the Arbuckles and the Expansion of Park Boundaries

Visitation to Platt National Park declined after the 1930's. Despite the decrease in use, the mineral springs continued to be the park's principal attraction until the completion of a nearby reservoir, which became known as the Lake of the Arbuckles. On August 24, 1962, the Arbuckle Federal Reclamation Project (76 Stat. 395) was authorized to facilitate flood control and to serve as a municipal water supply under the authority of the Bureau of Reclamation (BOR). Recreation was to be a secondary purpose of the project following municipal and industrial uses (Boeger 1987; Sallee and Schoneweis 1997).

Redesignation as CNRA

Completion of the reservoir created a situation where Platt National Park and the Arbuckle Recreation Area complemented each other, with the lake providing types of water recreation the park could not (Boeger 1987). Recognizing the synergistic relationship between the park and the Arbuckle area, Park Service officials made a proposal that the NPS purchase land between Lake of the Arbuckles and the park in 1970. Also considered was a change in the area's designation from a national park to a

national recreation area (Figure 7). Although many local residents expressed dissatisfaction with the concept of reclassification, the majority of visitors to the region were interested in recreational pursuits. Therefore, visitor desires for water sports and recreation played an important role in Platt's redesignation as a national recreation area. During a public meeting to discuss the issue, a member of the Chickasaw Nation suggested that the reclassified area be named Chickasaw National Recreation Area as a memorial to the those who initiated the conveyance of the original tract of land forming the area (Boeger 1987). On March 17, 1976, CNRA was established by Public Law 94-235 (90 Stat. 235) (Figure 7). The act was passed,

> ...to provide for public outdoor recreation use and enjoyment of Arbuckle Reservoir and land adjacent thereto, and to provide for more efficient administration of other adjacent areas containing scenic, scientific, natural, and historic values contributing to public enjoyment of the area, and to designate the area in such manner as will constitute a fitting memorialization of the Chickasaw Indian Nation... (NPS 1994b, p. 1).

Legislation mandated that the area could not exceed ten thousand acres and would include the former Platt National Park (Platt District), the Lake of the Arbuckles (Arbuckle District), and land adjacent to the new districts. Additionally, the Act provided that these new lands be administered in accordance with the provisions of the Act of August 24, 1916 (39 Stat. 535: 16 U.S.C. 1, 2-4), which established the NPS. It should be noted that this latter provision is not typically present in the legislation of other national recreation areas.

The principal mission of the new CNRA was to provide sustainable opportunities for diverse outdoor experiences ranging from recreation to nature study and to preserve

natural and cultural resources. CNRA presently includes two lakes (Veterans and Arbuckle), six publicly used springs (Black Sulphur, Pavilion, Hillside, Bromide, Antelope, and Buffalo), one well (Vendome), and four creeks (Travertine, Guy Sandy, Buckhorn, and Rock). On November 14, 1983, the NPS obtained a quit claim deed to Veterans Lake through a donation by the City of Sulphur, bringing the total size of the recreation area to 9,888 acres (Figure 7).

Resources protected within CNRA include mineralized and freshwater springs, and clear streams and lakes nestled among shady woods and rolling hills (National Parks and Conservation Association 1993; NPS 1978; Sallee and Schoneweis 1997). Minerals and dissolved gasses mixed in various proportions gave each of the original thirty-three springs a unique identity (Baker and Jameson 1975; Boeger 1987). Not all of these springs were named by Native Americans; white settlers gave names to many of the springs. For example, residents who lived in the area prior to federal management developed Pavilion, Bromide, Sulphur and Hillside Spring for public use (Figures 8 and 9). Vendome Well, historically important to this region, was drilled in 1922 and acquired by the park in 1983 (Boeger 1987; Sallee and Schoneweis 1997). At one time the area adjacent to Vendome Well included a privately owned dance hall, bathhouse, and swimming pool called the "Vendome Plunge" (Laatsch 1966).

The mineralized water at CNRA is highly prized for its perceived medicinal value, making these springs one of the region's most important natural features. Despite having received federal protection, degradation to free flowing springs has taken place. Bromide and Medicine Springs, two mineral springs historically important for their reputed

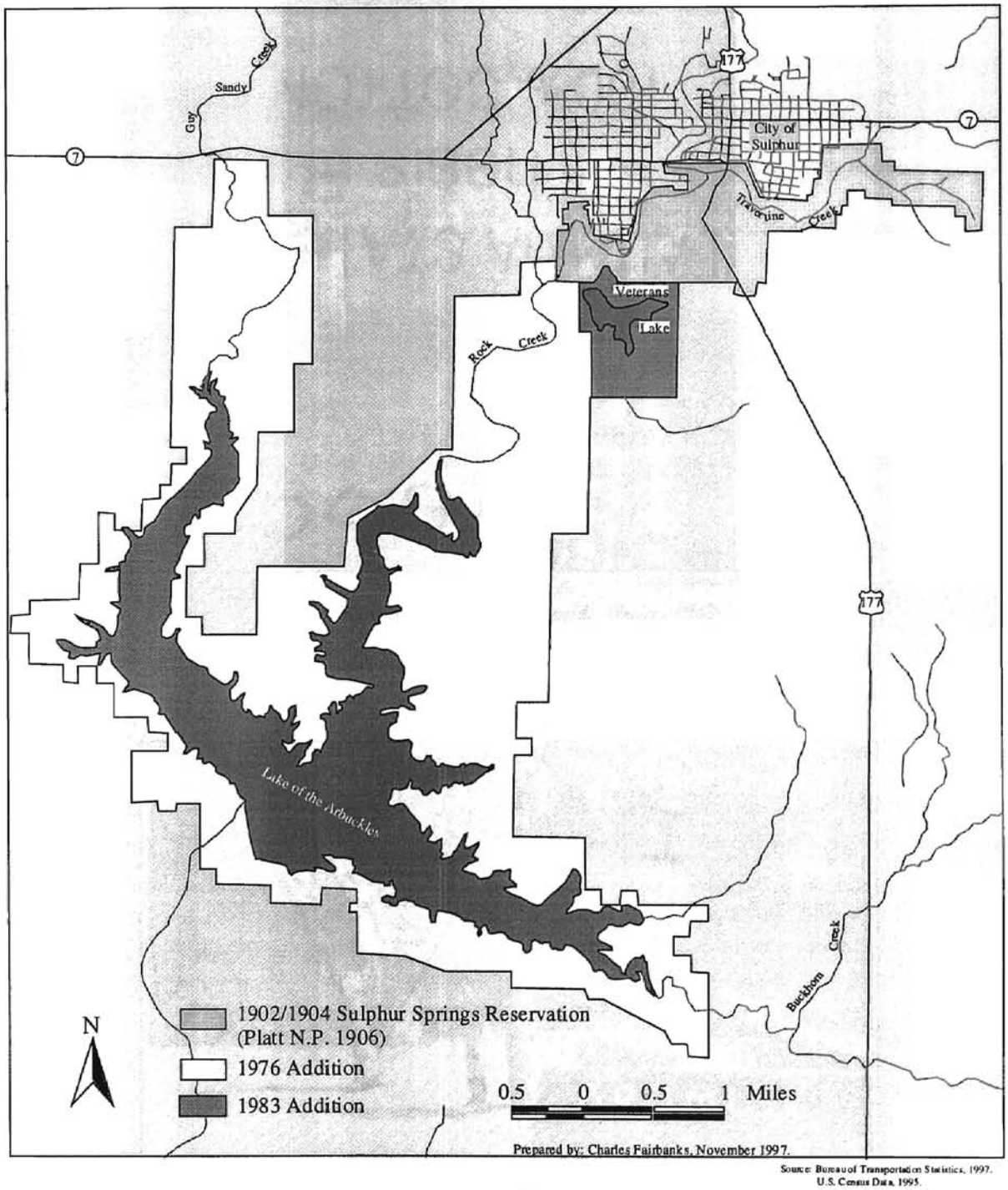

Figure 7.
Boundary Changes

Complements of CNRA Archives

Figure 8.
Visitors Collecting Bromide Water, 1967.

Complements of CNRA Archives

Figure 9.
Visitors Collecting Bromide Water.
1960's.

mineral value, ceased flowing in the 1970's (National Parks and Conservation Associations 1993; Boeger 1987; Sallee and Schoneweis 1997).

Unlike other NPS units, mineralized water at CNRA is used primarily for drinking. In addition, facilities at CNRA do not include bathhouses, which have been included at other NPS units with natural springs such as Hot Springs National Park in Arkansas (Barker and Jameson 1975). However, outside of CNRA's boundaries, afterbath houses can still be found, and during the 1920's and 1930's many more existed.

CHAPTER II:

LITERATURE REVIEW

In order to comprehend the significance of CNRA's spring waters at the national, regional, and local levels, it is important to discuss general spring water use worldwide as well as within CNRA's boundaries. Equally important, the water quantity and quality of the springs plays a pivotal role in the natural and cultural health of this region. Historically, visitation to this region has largely been dependant upon spring flows currently found within CNRA's boundaries. Therefore, it is vital that CNRA protect this natural resource in order ensure future attraction to this region. This chapter will investigate the literature that has been devoted to the traditional use of spring water worldwide and within CNRA's boundaries, as well as the water quantity and quality of the CNRA springs.

Traditional Uses of Water Worldwide

The literature on traditional uses of water and how they have changed at CNRA is not extensive, and reports on traditional uses of spring water in the 1920's and 1930's is mostly presented in anecdotal form. However, sources dealing with the historical healing and medicinal values of water at many other locations around the world give insight into the traditional uses and the reasons for change at CNRA.

Lanz (1995) discusses the curative properties of water -- its origin and use. He notes that as far back as the New Stone Age, people have been drawn to certain springs, which were regarded as sacred. Washing themselves in them was believed to cure wounds. He also notes that the folk or ancient knowledge of the healing springs was based on careful observations and passed down through the generations. Finally, he explains that this is in contrast to modern scientific approaches that attempt to discover the healing properties of the water by chemical analysis. Several authors discuss how the mineral composition and different proportions of minerals (such as chlorides, sodium, potassium, magnesium, iron, sulfur, carbon dioxide, hydrogen sulfide, iodine, bromide, and calcium) in some spring water give it healing powers (Lanz 1995; Cain 1995; Keefer 1995; Leaf 1990).

Lanz (1995) also suggests that the development of medicine is related to the healing powers of water by discussing Hippocrates' holistic approach to medicine and the prescription of sweating and bathing cures as a normal part of treatment. Despite the common belief that many people hold in regard to the healing powers of water, science tries to prove, or perhaps to disprove, the curative powers that water offers. Even health insurance companies refuse to recognize curative bathing, suggesting that it has no scientific basis. By simply listing the components in the water, most scientists can find no physical evidence of the curative powers of water. However, they do not deny that the characteristics of water's internal structures may have some relationship to its curative powers (Lanz 1995; Leaf 1990).

Throughout the world, spas and natural springs draw people for their curative, medicinal, and therapeutic properties. Frome (1995) notes that during the 1930's and

1940's no other spas located in the United States were more important than ones at Hot Springs National Park, which provided medicinal cures within their thermal, bathing waters. He states that millions came to seek relief from the aches and pains of arthritis, gout, and assorted other diseases. Cain (1995) discusses Mount Clemens as another spring that drew people. The baths of this small city, located several miles northeast of Detroit, Michigan, bring back childhood memories of rotten-egg smells, whose curative powers were discovered by Dorr Kellogg. Upon Kellogg's accidental discovery of the water, a new industry that utilized the medicinal powers of the water was created. Keefer (1995) tells how a spa and motel were established in the Wiregrass region of southeastern Alabama, in a town called Cottonwood. Accounts such as these provide anecdotal insights into the curative and rejuvenating powers of water, and they tell of individuals whose aches, pains, and ailments (such as post-surgical wounds, and scarring from chicken pox) have been healed by these spring waters (Stokker 1991; Leaf 1990; Keefer 1995; Lanz 1995; Cain 1995).

Many springs that were seen as having healing powers were also viewed as possessing sacred and religious values (Stokker 1991; Leaf 1990). Stokker (1991) tells of the St. Olav springs located in Norway. In pre-Christian times, Norwegians probably came to these springs for the water itself and later attributed the water's curative properties to Thor, Odin and other deities. With the coming of Christianity, the springs attained new significance because individuals associated the water's healing with the power of saints. To this day, handmade crosses are still found adjacent to many of these springs, for upon drinking from the spring, the custom was to leave a cross in gesture of thanks to St. Olav (Stokker 1991). These springs were also used to combat lice, sores,

and skin rashes, and since doctors were often not available to people during this time, the healing power of the springs, along with many home remedies and traditional practices, were often the only medical care people received. These cures proved effective, probably because of the strong faith people had in them; therefore, when modern practices cast doubt upon the curative powers of these waters, people found them less effective and sought the aid of professionals (Stokker 1991). However, recently there has been a renewed interest in natural healing. In addition, with evidence that the power of the mind has healing power, people now have re-acquired a belief in the curative influence of spring waters (Stokker 1991).

While reviewing the healing powers of Israel's inland seas, Leaf (1990) reinforces the importance in faith and medicinal powers of water. The Dead Sea provides a chronology of curative remedies, which involve soaking in the waters and "black mud" to alleviate symptoms associated with skin and joint diseases, nervous system, arthritis, and tense muscles.

Today, new springs continue to be discovered, such as the one found in the town of Tlacote, Mexico. Millions of people travel to this town to gather water that they believe will lessen symptoms of diabetes, heart disease, cancer, or AIDS (Stockbauer 1997).

Traditional Uses of Water at Chickasaw National Recreation Area

It has not been precisely determined when CNRA spring water was first used for its curative purposes; however, it is believed that Native Americans used the waters in tribal ceremonies and for cures of their daily aliments before the turn of the century

(Tripp 1935; NPS n.d.; NPS 1949). Historians believe that the first white settler who viewed present-day Platt District was Thomas Nuttal. Nuttal was a well-known biologist who is remembered for a trip southwest from Fort Smith, Arkansas in 1819 (Tripp 1935). Natives Americans are believed to have introduced him to the sulphur, iron, and bromide springs (Tripp 1935).

Littleheart (1908) provides a historical view of the area that now contains CNRA. She notes that the area's allure drew many prominent individuals and that the effect of the medicine springs on their lives was significant. In addition, she mentions the significance Platt's development had on this area. She tells of the "paleface" people's settlement, which occurred in great numbers, and how they came to know the marvelous medical properties of the springs. She goes on to explain how the "red man" had journeyed long distances over dusty trails to the medicine springs, and how current times [1900's] had changed the mode of transportation from horse to railcars. According to Littleheart:

> ...Indian and the paleface were coming alike to this Indian resort in palace cars and sleepers. For the Frisco had built to the springs, from its main line nine miles to the east, and was meeting all its main line trains with an elegantly-equipped, silver-plated train called "The Health Special." The main line of the Santa Fe, nine miles to the west, had maintained for years a stage line to Sulphur. The railroad promoter, foreseeing a more rapid development of the great Indian country than had ever before been witnessed –an instantaneous development- when the Indian had allotted his lands and Congress had removed the restriction forbidding its sale, had built railroads into every section of the Indian Territory... (Littleheart 1908, p.14).

She describes how settlers sent word to afflicted friends and family, which in turn spread news throughout the country about the healing properties of the medicine springs

at Sulphur. Thousands began to visit the park each year for its reputed medicinal value (National Parks and Conservation Association 1993). Spring water was even being shipped to places as far away as New York, Chicago, Kansas, and Arkansas, allowing people to have access to the healing Bromide and Sulphur water without having to travel to Oklahoma (Cunningham 1941; Laatsch 1966; Boeger 1970; Barker and Jameson 1975). Examples of authorization for the shipment of Bromide water can be found in Appendix A.

During the 1920's and 1930's, the Sulphur Chamber of Commerce, Frisco Lines, and Santa Fe Lines promoted the development of tourism to the medicine springs, and increased tourism brought improvements to the economy of Sulphur. Throughout their publications, the pages displayed advertisements geared toward expanding Sulphur's economy by trying to lure people to move to Sulphur. Also of significance, the Chamber of Commerce (1921) provided a written statement from the governor of Oklahoma that offered support for the springs (see Appendix A). He stated,

> ...the mineral waters from the springs have cured thousands of sufferers and in the millions of gallons that flow each day there is renewed vitality and zest for living for the visitors (Chamber of Commerce 1921, p.4).

In another Chamber of Commerce publication (Oklahoma Aid News 1923), it was claimed that Ponce de Leon was right in assuming that there was a "Fountain of Perpetual Youth." This article stated that had he lived long enough, he may have found the fountain of youth, for they believed that it was located at the City of Sulphur. The article further described benefits that the springs offered and provided water analysis data for the

springs. In addition, it provided, in great detail, information about the city and the goods and services it offered.

In another attempt to promote visitation to the area, the Chamber of Commerce (1924), stated:

> ...This booklet is dedicated to the unfortunates, who are ill in body and broken in spirit and who have no hope for health in this world, to those who have been dismissed by the medical profession elsewhere as incurable, and to those having less serious ailments- we recommend the health-giving waters of Platt National Park (Chamber of Commerce 1924, p. 1).

They further offered physician recommendations for the spring water, data analysis of the springs, and testimonials from those that had been cured of their aliments by the spring waters. For example, one individual testified that his father was suffering from rheumatism and was so impoverished that his body weight dropped to 100 pounds, restricting him to a wheel chair. After drinking Bromide water for six months, he was walking, selling real estate, and enjoying life (Chamber of Commerce 1924).

Additional examples are provided by the Chamber of Commerce (1933) and Frisco Lines (n.d.), which stated that the waters from the Bromide and Black Sulphur Springs were considered by many to be the most effective from a medicinal standpoint. They further stated that all thinking persons believed that if the stomach, bowels, liver, and kidneys are functioning well, illness was practically impossible. It was believed that if a person's intestinal tract was free from poisonous waste, nature could repair any contracted ailment. As natural laxatives, the water flushed the system. With an antiseptic value (chlorine), it permitted no absorption of food impurities, which allowed blood to improve and red corpuscles to multiply. It was stated, "Combined with sulfur, iron, soda,

and magnesia, the medicinal value is not to be overestimated" (Chamber of Commerce 1933, p.4). Visitors to the area often collected souvenirs to take home with them. For example, LeClare's (1925) book of poems and songs were all related to the springs and their health-giving qualities.

Tripp (1935) noted that the City of Sulphur was also known as the "City of Health," not only because of the mineral springs in the park, but also because of 20 artesian mineral wells within the city limits. In 1935, the population of Sulphur was 6,000. Each year, the town experienced an influx of tourists from all parts of the United States, who came via the Santa Fe and Frisco railroads or by car for health, rest, and recuperation (Tripp 1935).

According to Boeger (1970), Native Americans readily shared the spring waters with the first white settlers. It was believed that the springs cured rheumatism, diseases of the stomach, ailments of the liver, nervousness, or just about any ailment that afflicted man. Testimonies as to the curative power of spring water include the following:

> A 13-year old girl, given up by the doctors, was healed of eczema at the springs. Painters knew that sulphur water was the best thing they had for sores caused by lead-based paints. A war veteran's bad stomach righted itself with Bromide water. A man who hung around the springs died at a great age. His liver refused to die. The funeral finally had to be stopped and the liver killed with a club before the funeral could go on (Boeger 1970, p.5).

He further states that the bromide water was in such demand that visitors were restricted to only one gallon per day unless authorized by a physician. The superintendent even hired a former U.S. marshal to guard the spring, and those found in violation of the new rule were forced to drink the water immediately. Aware of Bromide

Spring's laxative qualities, most visitors didn't dare to disobey the rule (Boeger 1970; Barker and Jameson 1975; Boeger 1987; Cunningham 1941). To avoid punishment, users would often visit a physician who would write a prescription for the spring water, allowing them to collect more than one gallon (Appendix A) (Boeger 1970; Boeger 1987; Sallee and Schoneweis 1997).

A precursor to Boeger's book *Oklahoma Oasis* was a graduate thesis written by Cunningham (1941) titled, *The Creation and Development of Platt National Park.* In this study, Cunningham developed a comprehensive examination of the creation and development of the park and benefits derived from its creation. This work stressed the recreational nature of the park and the curative qualities of its mineral waters. It also recorded how the Native Americans used these waters for medicinal and ceremonial purposes long before settlers arrived. The author also pointed out how wildlife (as well as people) were attracted to the springs for drinking, or to repel insects by rolling in the muddy pools.

Evidence for these uses are supported by Boeger (1987) who stated:

> Farmers know that cattle, which drink sulphur water, have fewer ticks. Early ranchers deliberately hauled water for their livestock from Sulphur wells in town. City residents who sprinkled sulphur water on their lawns had fewer chiggers. Before bug repellant, men who worked outdoors would put a pinch of sulphur in their socks and trousers cuffs to repel pesky chiggers. It is still said that if a person drinks enough sulphur water, mosquitoes will not bother him (Boeger 1987, p.24).

Barker and Jameson (1975) provide a detailed review of the environment and ecology of the park. In addition, they mention the springs' curative powers and highlight

the belief in the therapeutic value of the Bromide water that was popular during the period before World War I. Along with Hanson and Cates' (1994) publication, these works are useful in providing a geologic description of the area with insights about the origin and development of the springs.

Several extensive historical reviews of Platt National Park's cultural and natural resources and its transformation into CNRA have been completed (Boeger 1987; Sallee and Schoneweis 1997; Lacctsch 1966). These note the importance of the springs in terms of their origin and mystique. The most compelling historical evidence of the water's power is presented in accounts of the heightened use period of the 1920's and 1930's, which describe men crippled with rheumatism being cured, or situations where sores healed, skin aliments disappeared, and asthma was cured. It is my opinion that their accuracy is questionable and that many of the accounts were exaggerated over the years. Despite this fact, it should be noted that sulfur found in some mineralized springs is an ingredient in many modern medicinal preparations (Boeger 1987). The general trend today may be leading away from using these waters for medicinal cures. Disbelievers can be found staring at visitors who continue to fill containers with sulfur water (Boeger 1987).

Spring Water Quantity at Chickasaw National Recreation Area

Because the park was set aside partially to protect water quantity, the quantity of spring water outflow is a constant and continuing concern to park officials and visitors. Therefore, studies over the years have attempted to address these concerns. As the region around the current CNRA boundary became more populated in the late 1800's and early

1900's, reliable sources of water were required. To address this need, several artesian wells were drilled, the first of these in about 1889 (Hanson and Cates 1988). Some estimates suggest that over the last 50 years approximately 40 wells were drilled in the region. A number of wells also remove water from the aquifers serving CNRA; most notable are nine City of Sulphur wells, Vendome Well, and one State Veteran's well. Despite these stresses, it is believed that the largest threat to spring flow is drought, which is defined as the lack of precipitation that recharges underground aquifers. Boeger (1987) reviews interviews with long-time collectors who describe the park during excessively dry periods of the past that caused several of the springs to cease flowing. More information is available through Hanson and Cates (1994) who provide a scientific portrait of these periods through a review the hydrogeology of CNRA. As demonstrated in their report, monthly precipitation totaling less than 0.1 inches has occurred on numerous occasions and zero monthly precipitation has occurred on six occasions. Significant dry periods, when annual precipitation was below normal for three or more consecutive years, took place during the periods of 1920-22, 1950-56, 1961-66, and 1975-80. Other periods of dryness with intermittent normal precipitation were years 1930-39 and 1955 (Hanson and Cates 1994). The period from June to October (1955) was the driest 6 months in the preceding 25 years. While the exact cause of these no-flow periods is not fully understood, the authors suggest that no-flow conditions at Antelope and Buffalo Springs commonly occur during extended periods of below-normal rainfall, particularly when precipitation is below normal for three or more consecutive years.

In 1985, a USGS stream gauging station (#07329849) was installed at Antelope Springs (Hanson and Cates 1994). Using this device, discharge between 1985 and 1989 was shown to have ranged from 0.1 to 11 cfs (Figure 10). The peak discharge of nearly 11 cfs occurred during this time period in the spring of 1988, while the minimum discharge of less than 1 cfs occurred in early 1989.

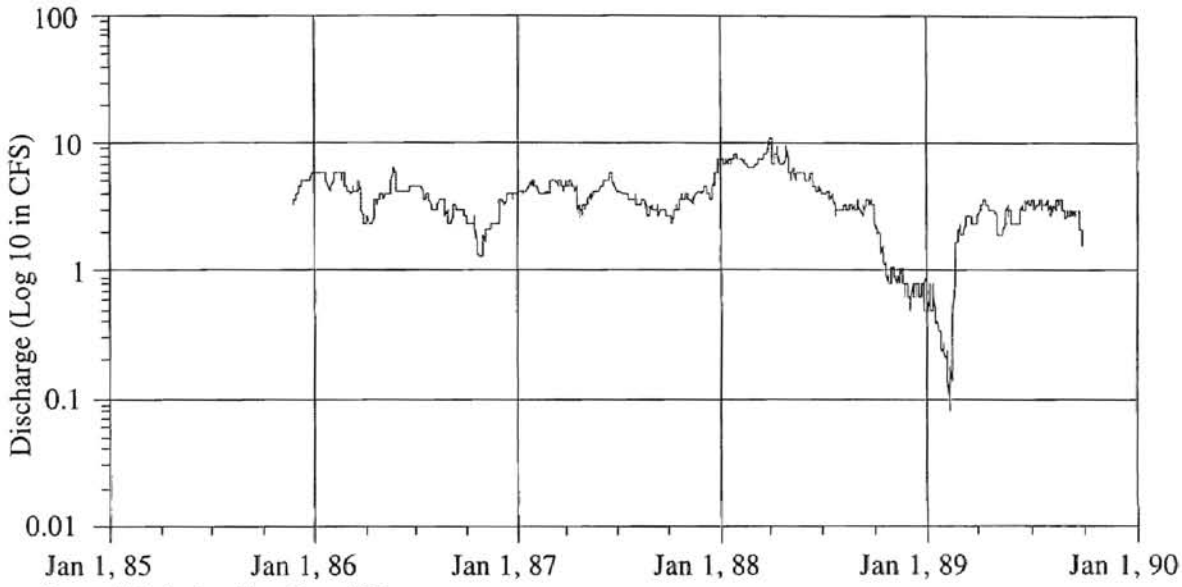

Figure 10.
Flow Data at Antelope Spring
(USGS Station 007329849)

Recent data suggest that discharges from the mineralized springs in CNRA are much less than that coming from the freshwater springs. During a water inventory in 1988, it was determined that flow from three of the mineral springs (Pavilion, Hillside, and Black Sulphur) in CNRA yielded 158 gallons per minute. However, this inventory showed that mineralized spring water accounted for only 4.6% of the total spring water being discharged within CNRA. As of 1992, no gagging stations have been installed on any of the mineralized springs in CNRA. According to Harp et al. (1976) flow was less

than one gpm at both Bromide and Medicine Springs. It is believed that these two springs had times of no flow, particularly during one period in 1974 (Hanson and Cates 1992).

A study conducted by Schornick et al. (1976), also provides an example of the springs' dependence on precipitation. Table 1 shows the periods when Antelope and Buffalo Springs were not flowing during the period from 1920 to 1970. If no other information were available for comparison, a look at Hanson and Cates' data would provide an avenue for the assumption that drought periods have an impact on spring flow.

Table 1
Antelope and Buffalo Periods of No Flow

Start	End
March 1926	August 1926
September 1937	June 1939
January 1951	May 1951
October 1951	June 1953
October 1993	June 1956
February 1958	December 1958
October 1962	November 1963
July 1966	October 1964

Source: Schornick 1976.

Data collected from studies conducted by Dunn (1953) and Taylor (1988 and 1991) and presented in Tables 2 and 3 are not related and are not meant to be an illustration of correlated data. However interpretation of the data does suggest a long-term decrease in spring flow. Dunn's study (1953) was necessary due to the need for an investigation into the potential sources of water that could supply surrounding cities. Table 2 provides a summary of Dunn's data and displays flow levels from 1906 to 1939 for three spring groups.

Table 2
Flow Data 1906 to 1939
Discharge in gpm

Location	1906	1911	1939
Hillside Spring Group	80	90	10
Pavilion Spring Group	62	140	12
Beach Spring Group	70	86	16

Source: Dunn 1953.

These data do show a significant decrease in the level of spring flow from 1906 to 1939, yet one should be careful not to assume that the spring flow has followed a decreasing trend based on Dunn (1953) and Taylor's (1991) findings. Instead, the data demonstrate a wide fluctuation in spring flow, which has recently raised concern among CNRA managers. Dunn's study determined that discharge from Antelope and Buffalo Springs was nearly negligible at the time of the study, and that the mineralized springs in CNRA were flowing at rates similar to those observed by Gould and Schoff in 1939. Dunn was one of the first to express concern over the trend of declining flow rates of springs within CNRA and identified two possible causes. First, he noticed that the region had experienced several years of below average precipitation and that flow rates during the early 1950's appeared to fluctuate according to climatic conditions. Second, he noted that withdrawals from several artesian wells within the region might explain the decline in flow from the springs.

Taylor (1988) performed a spring survey in an attempt to locate all of the springs that were documented by Gould in 1906. Using coordinates provided by Gould, Taylor was able to locate 21 of the original 33 springs, two more than the Gould and Schoff study had found in 1939. Taylor's (1991) summary, shown in Table 3, supplies data illustrating individual well flows in and around park boundaries for the years 1939 and 1988.

Table 3
Percent Flow Decrease from 1939 and 1988
Discharge in gpm

Well Name	1939	1988	% decrease
Wynodotte (Caylor)	1000	40	96.0
Cunningham	2500	136	94.6
Frye	1000	2	99.8
Ketchem	25	1	95.6
Lacey #1 (Little)	1010	327	67.6
Belleview (Molacek)	3000	247	91.8
Townsley	200	22	89.0
Vendome	2500	624	75.0
Total	11235	1768	87.5

Source: Taylor 1991; Gould & Schoff 1939; Hanson and Cates 1988

Though not tied directly to visitor use (except for Vendome), the data show sizable decreases and fluctuations in groundwater flow from the aquifers. In addition Taylor compiled data on Antelope and Buffalo Springs (Table 4), which also illustrates the decrease and fluctuation in the flow rate of the springs.

Table 4
Flow Rates for Antelope and Buffalo Springs

Year	Discharge in gpm
1906	3,500
1953	240
1968	3,826
1988	3,273

Sources: Taylor 1991; Gould 1905; Schornick 1976;
Hanson and Cates 1988;Hanson and Cates 1994

Spring Water Quality at Chickasaw National Recreation Area

As previously demonstrated, water quantity is extremely important to the continued health of CNRA. A subject that also deserves attention is the water quality of springs in CNRA. During the late 1960's the water quality in CNRA was threatened by land uses in the surrounding area. The largest potential contributor to decreasing levels

of water quality in CNRA was identified as the City of Sulphur's aging sewage system (Streebin and Harp 1977). Due to the relatively large watershed area, a wide range of possible threats exist today. Examples of possible sources of pollution that threaten CNRA's water quality include solid waste disposal, waste water discharges from poultry facilities, sewage leaks, discharges from fish hatchery operations, accidental spills on state highways that run through and adjacent to CNRA, and urban activities. Other threats include the pumping of groundwater for agriculture and municipal purposes, farming, cattle ranching, oil and gas operations (including saltwater injection wells), sand and asphalt mining, threats from potentially hazardous material, and municipal wastewater disposal (Sallee and Schoneweis 1997; Boeger 1970; Boeger 1987).

The most recent degradation to CNRA's water quality occurred in the summer and autumn of 1994. On at least four different occasions, the city sewer lines backed up and flowed into a storm drain that, in turn, emptied into CNRA's Travertine Creek. This stream was closed to human contact until the flow was stopped and coliform counts were determined to have returned to acceptable levels (Sallee and Schoneweis 1997; Hanson and Cates 1994). Except for episodic events, previous water quality measurements (taken by CNRA employees) have shown that water quality remains at acceptable levels. Nutrient loading has not been a problem in CNRA's major lakes, yet algal blooms do occur in some of CNRA's smaller ponds. In an effort to monitor biological hazards, CNRA staff regularly sample and analyze streams and lakes for total load and fecal coliform bacteria.

Several studies have investigated the water quality characteristics of streams, lakes, and groundwater in and adjacent to CNRA (Gould 1906; Gould and Schoff 1939;

Hart 1972; Schornick et al. 1976; Streebin and Harp 1977; Hanson and Cates 1994). Despite the availability of such studies, only a few have focused solely on groundwater (Cumiford 1968).

Schornick et al. (1976) focused on problems with creek and spring flow through both a spring water quality analysis and an examination of chemical and physical data related to the springs (Table 5). Parameters for this study were found to vary greatly depending on sampling location within CNRA. In some cases, the water was found to exceed National Drinking Water Quality Standards or Oklahoma Water Quality Standards for being free of noxious odors and tastes (Appendix B). Although having high mineral concentrations (Tables 5, 6, and 7), the springs were found not to pose a health risk to the individual using the water. However, due to the high mineral content (see Tables 5, 6, and 7), CNRA officials advised the public that the mineral waters should not be consumed extensively unless advised by a physician (Tripp 1935; NPS 1949; NPS 1963; and NPS n.d.; Sallee and Schoneweis 1997).

Table 5
WATER ANALYSIS OF SPRINGS AT PLATT NATIONAL PARK 1976(mg/l)

Location	Na	Ca	Mg	Cl	HCO3	SO4	CaCO3	TDS
Bromide Spring	1340	50	30	2020	610	48	249	3960
Medicine Spring	1490	68	36	2370	610	14	318	4520
Antelope Spring	44	50	30	8	290	0	240	293
Buffalo Spring	40	52	32	7	300	0	262	295
Black Sulphur	254	51	28	350	316	0	244	816
Pavilion Spring	110	60	38	140	305	0	307	588

Source: Schornick et al. 1976

Table 6
WATER ANALYSIS OF SPRINGS AT CNRA 1993 (mg/l)

Location	Na	K	Ca	Mg	Fe	HCO3	Br	SO4	Cl
Vendome Well	323.00	8.95	86.1	39.3	.0050	394	.485	18.7	572.00
Black Sulphur	121.00	5.15	64.5	29.4	.0050	385	.181	16.9	152.00
Pavilion Spring	78.60	3.86	68.4	31.0	.0053	371	.098	14.5	92.60
Hillside Spring	73.60	3.73	69.0	31.4	.0053	363	.050	13.6	74.20
Antelope Spring	3.02	1.31	77.1	36.3	.0053	418	.022	16.1	3.13
Sulphur/ Bromide	305.00	9.40	110.0	44.7	2.1700	316	.385	53.0	603.00

Source: U.S. Environmental Protection Agency 1993

Table 7
TOTAL DISSOLVED SOLIDS (mg/l)

Location	TDS
Buffalo and Antelope Springs	239
Bromide Spring	3,960
Medicine Spring	4,520
Pavilion Springs Group	588
Beach Springs Group	816
Vendome Well	1,200

Source: Hanson and Cates 1994; Hart 1972

Despite the significance of the high mineral counts, fecal coliform counts are suggested to be of significant concern to park managers. The Oklahoma Water Quality Standards set limits on the levels of the fecal coliform in drinking and recreational waters. The standards specify that in water used for recreational purposes fecal coliform rates shall not exceed a monthly geometric mean of 200 organisms per 100 ml based on a minimum of not less than five samples (Schornick et al. 1976; Oklahoma Water Resources Board 1973). Schornick's et al. (1976) study found counts in excess of 2000/100 ml (where the legal limit is 200/100ml). Sources of these contaminants were found to be directly related to the City of Sulphur's sewage system.

Streebin and Harp (1977) examined the information necessary to evaluate the quality of the water in the Rock Creek watershed and reported the physical and chemical properties of the watershed. Included in their report was a description of the potentially harmful non-point source pollution associated with land uses (especially pasture and cropland), and how they affect park water resources. Although their study did not directly address groundwater, their findings suggest that the water quality of the Rock Creek watershed (surface or underground) is directly related to the adjacent land use (Streebin and Harp 1977).

Cumiford (1968) presents a more direct evaluation of groundwater and its contaminants. In this report, the naturally occurring (avian and mammalian) high levels of fecal coliform were analyzed to determine the point or non-point sources of the pollutant(s). Unfortunately, the results were not conclusive in determining the main source of contamination. Park Service personnel were especially interested in this study because people were traveling great distances to CNRA to consume and collect the alleged therapeutic waters. It was this continuing public use of water from the springs that created concern on the part of park officials regarding the public health aspects of these waters. In an effort to address problems suggested in Cumiford's study, the NPS installed chlorinating units in both Medicine and Bromide Springs (no longer operating), and an ultra-violet light was installed in the waterlines of Black Sulphur Spring to disinfect the water before it is consumed by the public. Unfortunately, no attempt has been made to treat the water from Hillside Spring (Cumiford 1968).

In summary, research has been conducted on traditional uses of spring water worldwide, on historical uses of spring waters within CNRA itself, and on water quantity and quality in CNRA. However, the record of information on the current uses of spring water at CNRA is incomplete. No data exist which determines: 1) the general origin of visitation, 2) defined medicinal and non-medicinal spring water use, 3) perceived water quality and quantity, or 4) future visitor spring water use. These topics are addressed in the next chapter.

CHAPTER III:

REVIEW OF STUDY AREA, SURVEYS, AND RESULTS

In order to determine the nature of visitor spring use and their origin, a visitation survey was conducted. This chapter summarizes the results of the survey, provides statistical analysis of the data, and presents research findings. Observations and conclusions are also offered.

Study Area

One of the principal objectives of the federal government when it established Platt National Park was to make it a health as well as a pleasure resort with its mineral waters free to all (Tripp 1935). At the time Platt was established, Pavilion, Bromide, and Medicine Springs were among the best-known mineral springs within the area (National Park Service 1949; National Park Service n.d.). Due to the importance of these springs to the region, there have been several attempts to determine the number of springs located in and around CNRA. As mentioned earlier, the first assessment was performed in 1906 by state geologist Charles Gould who documented 33 springs (Boeger 1987). Of these, Gould noted that six were fresh water and 27 were mineralized. A second assessment was performed in 1939 by Gould and Schoff in which only 19 of Platt's (CNRA's) original 33 springs were located (Gould and Schoff 1939). During this survey, the

investigators noted that Antelope and Buffalo Springs were dry, and it was estimated that discharge was only 20% of what it was in 1906 (Hanson and Cates 1992).

Fresh Spring Water

Antelope and Buffalo Springs

In the eastern end of the Platt District of CNRA (see Figures 1 and 11) along Travertine Creek are two natural springs with combined flows of over 5 millions gallons per day during normal years (Barker and Jameson 1975). During periods of drought the flow from these springs weakens or even stops completely (Figure 8). Flowing from the underlying bedrock, both springs maintain a year-round temperature of 65 to 66 degrees. It is said that these springs were named for the herds of antelope and buffalo from the surrounding prairies, which formerly came to the springs to drink (Boeger 1987; NPS n.d.). The names survive from Native American legends describing these animals. Settlers recalled that animals had trampled Buffalo Spring into a soupy-mixture that covered half an acre. The runoff from the two springs forms Travertine Creek, which was named by the Board of Geographical Names in 1908. Early settlers called this stream "Sulphur Creek" (Boeger 1987). At one time, Native Americans watered their horses at these springs and settlers grazed their cattle by the creek. The spring was also important to many early residents of the Town of Sulphur Springs, who collected drinking water in barrels (Boeger 1987).

Until the 1930's, Buffalo Springs boiled through a bed of sand. Today it bubbles up quietly from the earth within a pool built by the CCC (Boeger 1987). An extensive development of the adjacent area was later undertaken by the NPS that included a natural

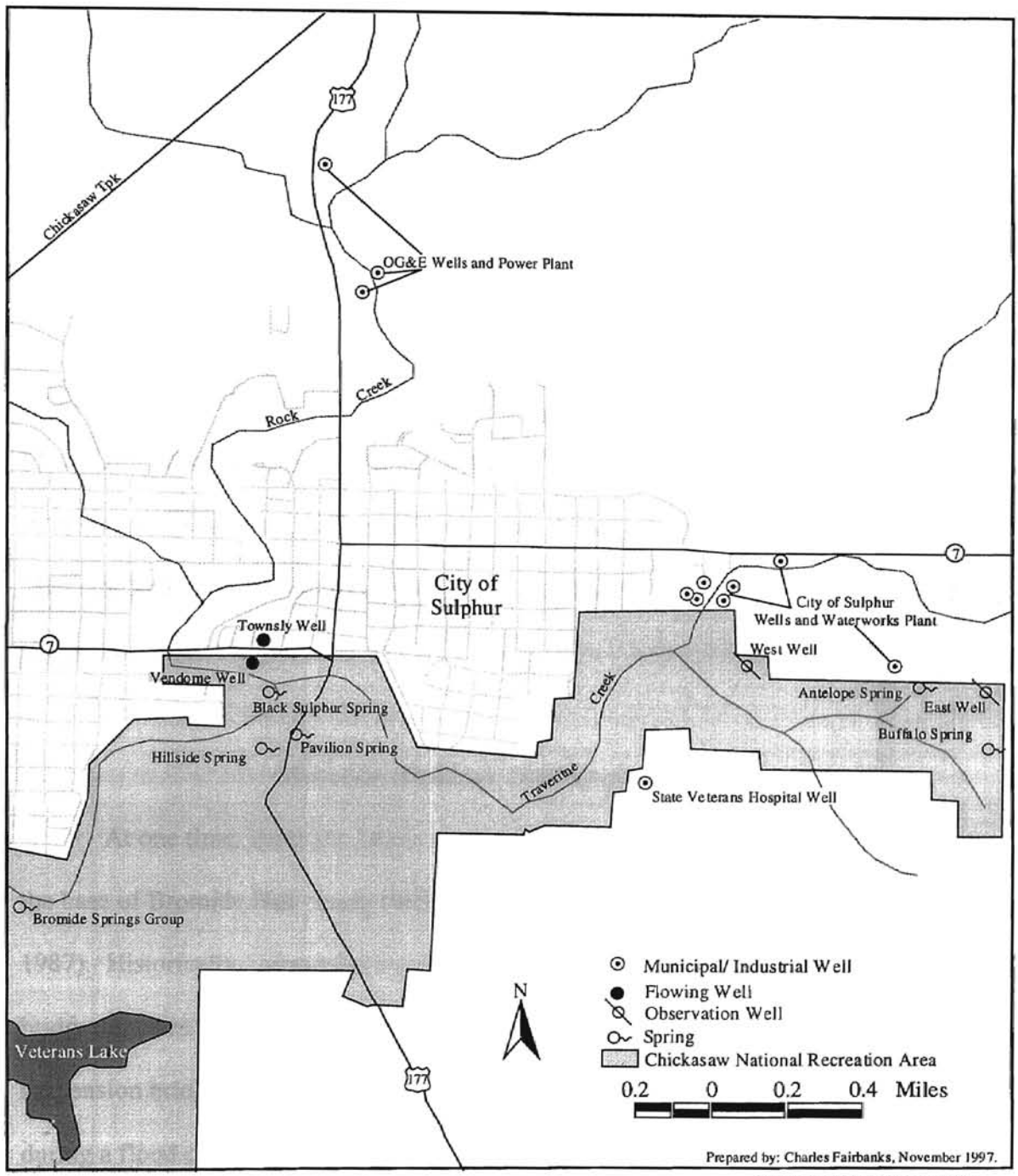

Figure 11.
Well and Spring Locations at
Chickasaw National Recreation Area

stone basin for the spring, a barbecue pit, parking space, and picnic grounds (of which only the stone basin exists today). Buffalo Springs marks the eastern end of the Platt District and the terminus of the trail and road system (NPS n.d).

A short distance away, Antelope Springs flows from a grotto at the base of a group of conglomerate rocks situated within a hillside. Flowing at a rate of 2000 gallons per minute, Antelope is probably the most popular spring in CNRA (Boeger 1987; Sallee and Schoneweis 1997; and NPS n.d).

Mineralized Spring Water

Located in the central portion of CNRA's Platt District are several sulfur springs. Identifiable by an odor that is reminiscent of rotten eggs, these springs include Hillside, Pavilion, and Black Sulphur. Two of the other major mineralized springs in CNRA are Medicine and Bromide Springs. Within the western part of CNRA, these two bromide springs are located in the same pavilion at the base of Bromide Hill (Figures 1 and 11).

Bromide, Medicine, and Sulphur Springs

At one time, Bromide, Medicine, and Sulphur Springs trickled from a fissure at the base of Bromide Hill. Early cattlemen knew them as "The Salt Springs"(Boeger 1987). Historically, informal crossings developed to access these spring waters, and two bridges once existed. The first bridge was the historic "Swinging Bridge." In 1908, a suspension bridge, designed by H.V. Hinckley, was completed but was washed away during a flood of Rock Creek in 1916. Called "Rainbow Bridge," the second bridge was made completely of steel and arched across Rock Creek allowing access to the newly

built Bromide Pavilion, which rested against the almost vertical wall of Bromide Hill, historically known as "Robber's Roost." In 1942, Rainbow Bridge was scrapped to aid in the war effort. No bridge can be found today at these historic sites. As shown in Figure 12, the pavilion that stands today was built by the CCC in the 1930's (Boeger 1987; Sallee and Schoneweis 1997). Spring water has been replaced by pumped city water.

Vendome Well

Vendome Well is located on the northern portion of the Platt District adjacent to State Highway 7 (see Figures 1 and 11). The well is of significant cultural importance to CNRA and to the City of Sulphur because it has been discharging a mineralized mixture of water from the Simpson and Arbuckle Aquifers since its construction in 1922. Its flowing presence, along with its distinctive sulfur smell, is noticeable at the north entrance of CNRA (see Figure 13). From the 1920's to the 1950's, Vendome served as a public drinking fountain and a source of water for a nearby swimming pool that was called "Vendome Plunge." Chemical analyses of Vendome indicate that the water is relatively hard and has a total dissolved solid count of about 1,200 milligrams per liter (mg/l) (Table 7). Over the years, Vendome's initial discharge rate (Table 3) of approximately 2,500 gpm has declined to about 500 gpm, possibly be due to its deteriorating well casing or to a lowering of the groundwater level (Harp et al. 1976). Outflow for the years 1985 to 1989 is shown in Figure 14.

Water discharge from Vendome is thought to be a factor in the depletion of the Arbuckle Aquifer. Park officials believe that this aquifer supplies both Antelope and Buffalo Springs within CNRA as well as city and privately owned artesian wells in the

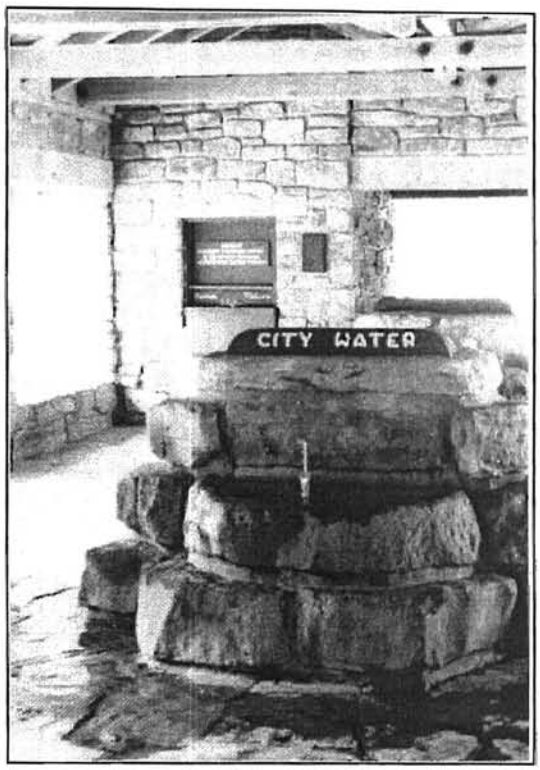

Figure 12
Bromide Pavilion

Figure 13
Vendome Well

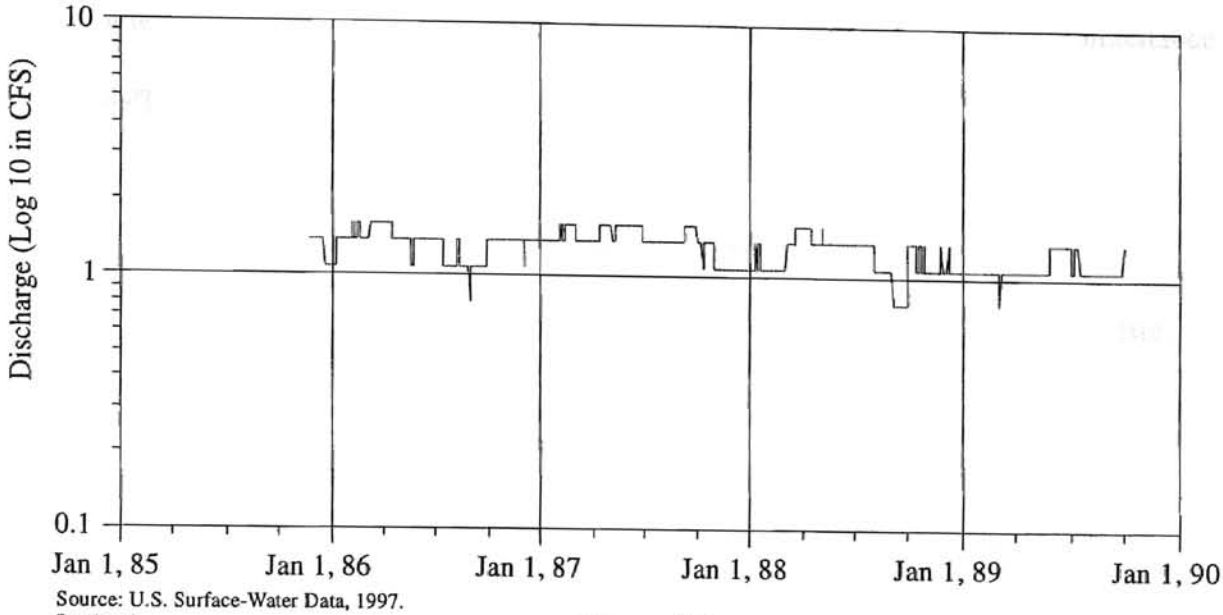

Figure 14.
Flow Data at Vendome Well
(USGS Station 007329851)

area. The amount of groundwater (artesian flow) produced by Vendome is reported to be about the same as that produced by the City of Sulphur well field for municipal supply. Present data also suggest that continued flow of the well may be adversely affecting the discharge of mineralized water from springs in CNRA because each use "competes" with others for the available water. By allowing the well to flow freely, Vendome may be contributing to the reduction or elimination of discharge from nearby mineralized springs.

CNRA officials are attempting to address this issue. For example, a new well has been constructed to replace the existing corroded well. The current plan is to plug and abandon the existing well and install underground plumbing from the new well to the fountain where the existing well is located. If the plan is carried out, groundwater from the new well will flow through plumbing to the existing fountain. Valves will be employed to regulate discharge from the new well, and a schedule for water releases from

the new well will be formulated to meet CNRA purposes, which include the maintenance of interpretive and historic values of the site.

Pavilion Springs

The best known of the Pavilion Springs in the early days of the park was "Big Tom" (Figure 15), which flowed at forty gallons per minute (NPS n.d; Sallee and Schoneweis 1997). Pavilion Springs (Figure 8) was named because of the seven separate flowing vents that came together in this portion of the park (Sallee and Schoneweis 1997), and from the simple fact that for several years these springs were the only ones in the area sheltered by a pavilion (Boeger 1987). Early visitors to the springs found only an animal wallow which they called "The Buffalo Suck" because of the sucking noise the buffalo made while drinking the water (Boeger 1987; Sulphur Weekly Times 1909; and Sallee and Schoneweis 1997). One townsman placed a section of a hollow cottonwood log over Big Tom, allowing for easy collection of the flow, and other residents brought stone and dirt, which helped in constructing the basin. Residents later constructed concrete vents over four of the seven springs and covered them with a pavilion (Boeger 1987; and Sallee and Schoneweis 1997). Using the surrounding rock, the CCC built a permanent pavilion in the 1930s that can been seen today (see Figure 16).

Black Sulphur Spring

A group of four sulphur springs bubbled up through the sandy beach along Rock Creek just before Travertine Creek joins the stream. Originally known as Beach Springs, because of their creek bank location, this group was first developed with lengths of red

Figure 15 Complements of CNRA Archives
Big Tom Spring

Figure 16
Pavilion Springs

clay tile in 1926. Later, one of these acquired the name of Black Sulphur (Boeger 1987). The waters of Black Sulphur Spring are heavily impregnated with sulphur. This spring is located directly across from Rock Creek and Flower Park and was dispensed from a small pavilion (Figure 8 and 17). The pavilion still stands today; however, water has been diverted to a faucet allowing for improved sanitary conditions (see Figure 18). Another site known as Black Sulphur Spring was located on the old Cliffside Trail and cannot be found today (Boeger 1987).

Hillside Spring

Prior to CCC development, Hillside Spring issued from a grotto in a rock wall just below the park office. Today, the water flows through a cistern at the base of the rock wall (Figures 8 and 19). Heavy in sulphur content, this water flows at a rate of about eighty gallons per minute (Boeger 1987; NPS n.d.). Hillside was known for thirty years as the "Beauty Spring" because the water was believed to brighten eyes and beautify complexions (Boeger 1987). Due to avian and mammalian fecal coliform counts, this water is not presently fit for human consumption.

Figure 17.
Black Sulphur Spring

Figure 18.
Black Sulphur Faucet

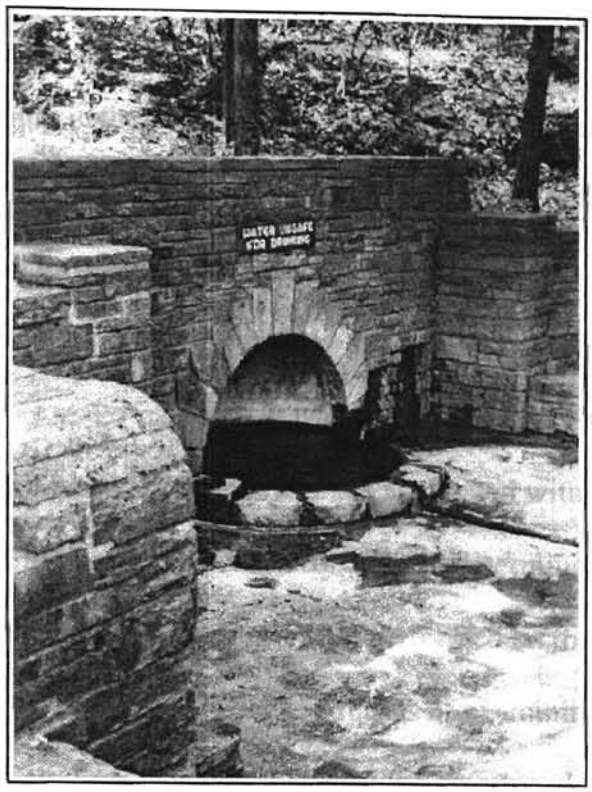

Figure 19.
Hillside Spring

Problem Statement

As noted earlier throughout the 1920s and 1930s, Platt National Park provided visitors with healing and medicinal waters which revitalized spirits and cured common aliments. Although only 19 of the original 33 springs exist today, people continue to collect CNRA's fresh and mineral waters. This fact raises interesting questions about the current uses of spring waters and their relationship to CNRA's water quality, quantity, and traditional uses. Currently, CNRA has little data on specific public uses of the spring water. Therefore, this investigation is focused on gathering information that will enable CNRA staff to better manage water resources.

Methodology

CNRA is currently in the process of developing a Water Resource Management Plan. Unfortunately, however, CNRA has little data on current public uses of the spring water. Interest has therefore focused on determining why visitors come to CNRA to gather water from the fresh and mineral artesian springs.

Due to the lack of visitor use data, it was determined that a visitor survey would assist in eliciting societal preferences and rationale associated with continued collection and consumption of spring waters at CNRA. In order to determine the general trend in spring water use, spatial analysis techniques were performed on the data. It was also necessary to develop a map of spring users as a means of examining their distribution. The survey, which consisted of questions that elicit information about the use of CNRA's spring waters, was conducted during the summer and fall of 1997 (see Appendix C). Data collection began in July and was completed in November when the survey goal (50 to 70 interviews) was met. The seven sites shown in Table 8 were chosen where individuals (presently or historically) collect water. As demonstrated earlier, these sites are important not only to NPS preservation efforts but also to residents of the region as a whole. Participants were selected only if they were directly observed drinking or collecting water from a spring. Each person observed was asked whether he/she would be willing to participate in the survey (see Appendix D).

Table 8
Data Collection Sites

1. Vendome Well	5. Bromide Springs
2. Black Sulphur Springs	6. Antelope Springs
3. Pavilion Springs	7. Buffalo Springs
4. Hillside Springs	

Research Questions and Hypotheses

As previously discussed, five research questions and hypotheses were developed regarding visitor spring use and perception.

1. Are contemporary uses of the spring water at CNRA the same as those of the 1920' s and 1930's?
   Hypothesis: Uses of CNRA spring water are not the same as those of the 1920's and 1930's. The majority (50%) of collectors do not use the water for its medicinal value.
   Test Statistic: The difference of proportions test was used to determine whether the majority of collectors were non-medicinal users.

2. Has the collectors' perception of the quality and quantity of the CNRA spring flows changed over the last 60 to 70 years? If so, how have these changes influenced traditional uses of the water at CNRA?
   Hypothesis: The majority (50%) of the collectors' perceive the water quality and quantity of the spring flow to have changed.
   Test Statistic: The difference of proportions test was used to determine if the majority of the collectors stated yes that they perceived a change in water quantity and quality.

3. Are users of the water local residents of the City of Sulphur, surrounding area residents within Murray County, or are they individuals traveling from even greater distances?
   Hypothesis: The majority (50%) of the users are locals, who travel less than 10 miles to collect water.
   Test Statistic: The difference of proportions test was used to determine if the majority of individuals traveled less than 10 miles to collect water.

4. Are the spring water collectors and users relatively new to CNRA or have they and their families been collecting and using the water for generations?
   Hypothesis: The majority (50%) of the users are generational (individuals who have collected for more than 30 years or often).
   Test Statistic: The difference of proportions test was used to determine whether the majority of users were generational.

5. Collection of spring waters by individual visitors occurs at what quantity?
Hypothesis: The majority (50%) of individual visitors collect less than three gallons each visit.
Test Statistic: The difference of proportions test was used to determine if the majority of individuals collect less than three gallons of water each visit.

Statistical Methods

The one sample difference of proportions test was chosen to analyze the data because the hypotheses raised during the study focused on the difference between a sample proportion (surveyed data) and a predetermined proportion (50%). The primary objective of this test statistic is to "compare a random sample proportion to a population proportion for difference" (McGrew and Monroe 1993, p.148). Also, the requirements and assumptions of this test statistic state that the data must be randomly selected and that the variables are measured at the nominal level and are binary. This test is sometimes called the Z test for proportions. As with the difference of means Z tests, the normal (Z) distribution is used (McGrew and Monroe 1993).

By using the one sample difference of proportion test on data collected to address the hypotheses, a determination was made concerning perceived changes in the water's quality and quantity since the 1920's and 1930's. A comparison of spring water quality, quantity and empirical data, which was collected while conducting the survey, was then analyzed. Also, a difference of proportions test was used to determine the collectors' defined uses in terms of type and amount.

NPS personnel were interested in determining where the visitors came from to collect CNRA's water; therefore background information was gathered. This information included zip code, year of birth, highest level of education attained, city or town of

residence, average population of city of town of residence, occupation, and gender. From this information, a map was generated that represents the spatial distribution of spring water users in Oklahoma and the United States.

Survey Results and Analysis of Data

For purposes of statistical analysis, survey results are presented in three sections. First, descriptive statistics were performed on all the data. This was divided into two subsections, background information and site-specific information. Secondly, difference of proportions tests were completed on those questions in the survey that related to the hypotheses and questions presented earlier to determine whether or not a significant change in spring use and perceived water quality and quantity occurred.

Data were collected at the nominal and ordinal levels. The data were then organized for statistical analysis. Several questions on the survey (Appendix C), originally divided into nominal categories, were then aggregated for statistical analysis. Dummy tables were created to calculate summary statistics for all the categories. For example, the question related to gender had three nominal levels. Level 1 was categorized "Female", level 2 was categorized "Male", and level 3 was categorized "Children".

Descriptive Statistics

To gain a better understanding of spring use and visitor perception of spring water quantity and quality, the data were summarized using descriptive statistics. Statistics

were generated as percentages. Such information is useful in determining general trends in spring use and visitor perception.

Background Information

In order to formulate a profile of the average user, background information on each of the users was collected. The first question on the survey asked the participants their zip code. This was useful in determining where the individuals lived (Figure 20). As might be expected, the largest number of participants came from Sulphur (35%). However, it was interesting that individuals traveling as far away as New Mexico, Arizona, and Washington collected water. It should be noted that it is not valid to assume that these individuals came specifically to collect the water, but they were aware of its availability or had past experience in collection. Figure 20 shows the spatial distribution of the participants as well as the relative users from each town or city.

Grouped into categories by year, Table 9 represents the year of birth of each participant. It is interesting to note that when combined, individuals born during the age categories of 1921-1940 and 1941-1960 account for 73% of the total respondents. This trend may be the result of generational use. For example, by comparing data on the "Year of First Collection" and "Use Definition," one could infer that those born in the 1920's and 1930's ("the heydays" of medicinal use) and stated as being generational users, grew up drinking the spring water and passed on the tradition to their children those born in the 1950's and 1960's. Such visitors are considered generational users.

Figure 20.
Surveyed Visitor Origin and Number

Table 9
Year of Birth of Spring Users

YEAR OF BIRTH	NO.	PERCENT
1900-1920	2	4%
1921-1940	21	42%
1941-1960	16	32%
1961-1970	6	12%
Child	6	12%

With a mean of 50 years, age may be a determinant of use. In contrast, gender and education did not seem to influence overall use. Almost 40% of surveyed participants were female and almost 51% were male. It should be noted that children were not defined by gender but were simply categorized in a separate group (9%). Based on the percentages, it does not appear that the education level of participants plays a role in use. Of those interviewed, 37% of the participants claimed to have a 9^{th} to 12^{th} level of education and a combined total of 33% claimed to have higher than a 12^{th} grade level of education (see Appendix C). It should also be noted that all respondents were given the option to refuse answering questions that they felt were too personal (represented as N/A).

Occupation does appear to have a relationship to water use (Table 10). From Table 10, it is easy to determine that those participants who are retired (33%) or blue collar (37%) outweigh all other occupation groupings. It should be noted that during the time of the survey, it was observed that the majority of "morning walkers" at Flower Park appeared to be of retirement age.

Table 10
Occupation

OCCUPATION	NO.	PERCENT
House wife	3	6%
Retired	17	33%
Student	8	16%
White collar	4	8%
Blue collar	19	37%

Site-Specific Information

Site-specific information provides detailed records about each individual spring and its use and the overall use types for all the springs. Therefore, the current location or site of the survey and the amount of water collected at each site were recorded for each participant (Tables 11 and 12). As demonstrated in Table 11, Pavilion Springs and Vendome Well accounted for the majority of collected data (87%). This happened for two reasons. Early during the data collection it was determined that Pavilion Springs and Vendome Well were receiving the largest proportion of visitation, therefore a greater proportion of data collection time was devoted to these two sites. Based on the observed visitation of these two sites, the chance of tourist visitation occurring (site-seeing or curiosity) appeared to be high, therefore it was not surprising that the data in Table 12 demonstrated "sips" to be the highest percentage of collection (47%).

Beyond the interview site, participants were asked if there were any other sites at CNRA or outside of CNRA boundaries where they collected spring water. Although some participants responded that they did collect at other sites, a large percentage (75%) of respondents did not collect at other CNRA springs. Most respondents (86%) did not collect at sites outside of CNRA's boundaries. Of those that responded that they did

collect at other sites within CNRA (26%), all said that they collected the water for the same reasons as at the site where the interview took place.

Table 11
Spring Collection Location

SITE	NO.	PERCENT
Pavilion Springs	11	22%
Vendome Well	33	65%
Black Sulphur	3	6%
Antelope Spring	4	8%
Buffalo Spring	0	0%
Bromide Spring	0	0%
Other	0	0%

Table 12
Amount of Spring Water Collected

AMOUNT	NO.	PERCENT
Sip	24	47%
Cup	3	6%
Gallon	4	8%
2 to 4 gallons	15	29%
5 to 20 gallons	5	10%

In order to determine if there was a relationship between current age and the age when the respondent first collected water, participants were asked when they first collected at the current site (Table 13). A comparison of Tables 9 and 13 does not reveal a clear relationship between age and the first time respondents collected water. It is interesting that almost half (51%) of the collectors began collecting water during the 1980's and 1990's. This trend seems to be linked to national interest in the environment and natural healing that has occurred in recent years (Stokker 1991).

Table 13
Year of First Collection or Drink

YEAR	NO.	PERCENT
1900-1920	0	0.00%
1921-1940	12	24%
1941-1960	10	20%
1961-1980	3	6%
1981-1997	26	51%

When asked how often they collect water at the current site (Table 14), participants formed a dichotomy between daily users (41%) and other (yearly or longer) users (35%). As shown in Table 14, the participants were asked to define their use as generational (collection for more than 30 years or often), occasional (collection for less than 10 years or sometimes), or individual (collection a few times a year or first time). Although a high percentage of users said that they collected on a yearly basis or longer, 63% of the participants responded that they were generational users (Table 14). This would lead one to believe that those collecting on a yearly basis have been doing so for a significant period of time (30 years of longer).

Table 14
Frequency of Collection and Use Definition

FREQUENCY	NO.	PERCENT
Daily	21	41%
Several times per week	6	12%
Weekly	4	8%
Monthly	2	4%
Other (yearly or longer)	18	35%
USE DEFINITION		
Generational	32	63%
Occasional	3	6%
Individual	16	31%

The participants were also asked their original reason(s) for spring water collection. The responses varied from "like it" to "curing physical ailments." As mentioned earlier, tourist visitation may account for a large percentage of spring water collection, and Appendix C demonstrates this possibility with "Curiosity" (14%) ranking second to "like it." As shown in Table 15, participants used the spring water for a variety of purposes, however drinking the water (75%) proved to be the most important use type. The participants were then asked if their current reason for collection was the same as their original purpose for collection: 82% responded "yes" to this question, while only 4% said that they were not collecting for the same reason, and 14% had no response to the question.

Table 15
Use Type

USE TYPE	NO.	PERCENT
Drinking water	49	75%
Ice cubes	2	3%
Cooking	1	2%
Bathing (wading)	8	12%
Dogs and humans (reduces ticks, fleas, chiggers, and mosquitoes)	3	5%
Hang-overs (helps to recover from them)	2	3%

In order to gain an understanding of individuals' perceptions of water quality and quantity, participants were asked a series of questions related to these topics. The first question asked how they rated water quality. More than 90% of the participants felt that the water quality was good or excellent, and a large portion of individuals (67%) felt the water quality had not changed since the time of their original collection. Of those who did perceive a change in water quality (14%), all suggested that only the taste had changed, and many noted that the sulfur taste was not as strong as it had been in the past

(in reference to Vendome and Pavilion Springs). Participants were also asked if their perceptions of water quantity had changed since their first collection. Among those who felt quantity had changed (43%), the principle reasons cited were a loss of pressure (especially at Vendome Well) and lack of water at historic sites (Bromide, Sulphur, and Medicine Springs).

As a means of gauging perceptions of future use of the springs, respondents were asked to identify the greatest threat to their continued consumption (Table 16). Almost 50% felt that there were no threats great enough to influence their continued use, while 10% felt that decreased water quality from pollution or contamination could threaten their continued use. Unfortunately, participants felt the potential lack of spring maintenance by CNRA officials (8%) was almost as threatening as the potential of quantity loss.

Table 16
Potential Threats Affecting Continued Use

THREAT	NO.	PERCENT
Quality/Pollution/Contamination	10	19%
Sodium level	2	4%
Taste	0	0%
Quantity (springs drying up)	5	10%
Lack of maintenance	4	8%
None	25	49%
N/A	5	10%

Difference of Proportions Test

In order to test the hypotheses and questions raised earlier, responses to several questions on the survey were grouped into categories so that difference of proportion tests could be run. For example, the question related to the participant's original reason for collection was divided into two categories: medicinal and non-medicinal.

For each Z test, it was hypothesized that 51% or the majority of the sampled proportion (p) would respond in a designated manner. Although greater than 50% (right-tailed) responses were expected, it was determined that a two-tailed test would be more appropriate for the data. The null hypotheses for the Z tests were (H_o: $p = \rho$) and the alternate hypotheses were (H_A: $p \neq \rho$) For each of the Z test (except the medicinal use test), the overall sample size (n) was 51 and the standard error of the proportion (σ_p) was .07. The sample size (n) for the medicinal use Z test was 86 and the standard error of the proportion (σ_p) was .054.

The first hypothesis stated that the majority of collectors did not use the water for its medicinal value. As shown in Table 17, 74% of the participants said that they did not use the spring water for medicinal purposes, which produced a Z-score of 4.34. The associated p-value was .000, meaning that H_o should be rejected. Therefore, the majority of the participants do not collect the spring water for medicinal purposes.

Table 17
Difference of Proportion Tests

Difference Test	Response	Number	Percentage	P-Value	Z-score
Original Reason	Non-medicinal	64	74%	0.000**	4.34*
Quality Change	Yes	7	14%	0.000**	-5.33*
Quantity Change	Yes	22	43%	0.2628	-1.12*
Distance from CNRA	10 miles or less	20	39%	0.093	-1.68*
Use Type	Generational	32	63%	0.093	1.68*
Collection Amount	Less than 3 gallons	37	73%	0.008**	2.65*

* Z critical 2.58
**Significant at the .01 level

The second hypothesis stated that the majority of collectors' perceived that the water quality and quantity of spring flow has changed. In Table 17, 14% of the participants responded that the water quality had changed, which produced a Z-score of

-5.33 and an associated significance level and *p*-value of 0.000. This suggests that there is statistically no change of committing a Type I error of incorrectly rejecting the null hypothesis, therefore H_o should be rejected. By analyzing the data and the Z-score it can be seen that the majority of participants said that no change occurred in the water quality, which with the assumption of a normal curve distribution resulted in a left-tailed Z-score. Therefore contrary to the hypothesis, a significant proportion of the participants responded that they did not observe any change in water quality.

As shown in Table 17, 43% of the participants perceived a change in water quantity. In this case, the Z-score produced was –1.12 and the associated significance level and *p*-value was 0.26, which represents a 26% chance of committing a Type I error. Therefore, H_o should be retained. Since the participants were divided in their perceptions of water quantity change, an interesting question was raised. Were the participants that perceived a change in the water quantity long-term (more than 30 years) or recent collectors? Table 18 shows that there is no definite answer to this question. Of those participants who perceived a change in the water quantity, 55% were long-time collectors. Among the individuals who did not observe a change in the water quantity, 48% were recent collectors. In both cases, there was not a significant majority to suggest that long-time collectors were more likely to perceive a change.

Table 18
Percentage of the Years of Original Collection Derived from the Total Water Quantity Change Percentage

Water Quantity	NO.	Total Water Quantity Change Percentage	1900-1920	1921-1940	1941-1960	1961-1980	1981-1997
Yes	22	43%	0%	**23%**	**32%**	**0%**	47%
No	23	45%	0%	26%	13%	13%	**48%**
N/A	6	12%	0%	17%	0%	0%	83%

In the third hypothesis, it was suggested that the majority of visitors traveled less than 10 miles to collect water. Table 17 shows that 39% of the participants travel less than 10 miles to collect water. Based on a .01 level of significance and the calculated Z-score (Z= -1.68) it appears that local users are not in the majority.

The fourth hypothesis stated the majority of users are generational (individuals who have collected for more than 30 years or most of their lives). Table 17 shows that 32 (63%) of the participants responded that they believe themselves to be generational collectors, and the calculated Z-score was 1.68 with a .093 associated *p*-value. With a .01 level of significance, H_o should be retained. Therefore, there does not appear to be a significantly higher number of generational users. The data suggest that vacationers and infrequent visitors participate in water collection almost as frequently as local or generational users.

Hypothesis five suggests that individual visitors collect less than three gallons of spring water per visit. As shown in Table 17, the data suggest that 73% of the participants collect less than three gallons each visit. A Z-score of 2.65 and associated *p*-value of .008 were calculated for a test of the sample data. Given the *p*-value, there appears to be a majority of users who collect less than three gallons of spring water. This conclusion seems logical for a high percentage (49%) of collectors are recent collectors and a high percentage (47%) only take a sip of water during their visit (Table 12).

In summary by using a two-tailed test, it was significantly determined that visitors used the water for non-medicinal purposes; that they did not observe any change in water quality; and that they collect less than three gallons of water each visit. It was not significantly determined whether the visitors did or did not observe a change in water

quantity; that they traveled less than 10 miles to collect water; or that they were generational users.

CHAPTER IV:

CONCLUSIONS

As noted earlier throughout the 1920s and 1930s, Platt National Park provided visitors with healing and medicinal waters which revitalized spirits and cured common aliments. Although few of the original springs exist today, people continue to collect CNRA's fresh and mineral waters. Currently, CNRA has little data on specific public uses of the spring water. Therefore, this investigation focused on gathering information that will enable CNRA staff to better manage water resources.

Due to the lack of visitor use data, it was determined that a visitor survey would assist in eliciting societal preferences and rationale associated with continued collection and consumption of spring waters at CNRA. In order to determine the general trend in spring water use, spatial analysis techniques were performed on the data. It was also necessary to develop a map of spring users as a means of examining their distribution. Participants were selected only if they were directly observed drinking or collecting water from a spring. Each person observed was asked whether he/she would be willing to participate in the survey (see Appendix D).

It was determined that a change in visitor interests over the last six decades has caused traditional uses of spring water at CNRA to change. However, inconsistent with spring flow data that demonstrated fluctuations in flow because of land use change (Dunn 1953; Taylor 1988), many participants did not observe a decline in spring flows, and none stated that they were aware of any contamination to the springs or streams in this

area. This is an important observation, because it suggests that there is no perceived immediate threat to use as a result of declines in spring flow or a lack of appropriate management at CNRA. Currently, no attempt has been made to restore water to the pavilion that houses Bromide, Sulphur, or Medicine Springs. It should be noted that since the time the survey was administered, Vendome Well has undergone drilling to create a new well shaft. Construction of a new casing by the NPS is anticipated to restore historic flow levels back to the well.

Many of the participants interviewed accept concepts offered by Lanz (1995), Cain (1995), Keefer (1995), and Leaf (1990) who suggest that the minerals in some groundwater has provided curative powers. As with Stokker's (1991) work, it was discovered that the faith that many individuals have in the curative properties of CNRA's waters might provide more evidence of its power than can be determined through chemical testing.

Although some visitors collect and drink the spring water to help in curing physical aliments such as cancer, arthritis, swollen joints, and bladder problems (Appendix C), the majority of visitors collecting water no longer use it for its perceived medicinal purposes. In fact, it was discovered that many participants collect the water because they simply like its taste or feel that the minerals in the water are good for them. However, they do not necessarily feel that the water will cure disease. Although the majority of participants do not collect the water for medicinal purposes, some fascinating medicinal uses were observed. On one occasion, a man was soaking his arm in the cold water of Vendome Well. Later, he walked over to Flower Park and scooped up sulfur-smelling, black mud and rubbed it on his arm and shoulder and allowed it to dry. When

asked what he was doing, he said he had been suffering from swelling and pain in his shoulder and could not find any relief through conventional methods. His chiropractor had told him to come and soak in the cold sulfur water of Vendome Well (Appendix D).

Reaffirming the visitor's words, Boeger (1987) states that mud bathers like the strong sulphurous water of Vendome Well. The sulphur water left a slimy scum that clung to rocks and creek banks and gave the water an inky hue. Mud bathers ("mud puppies") believed that the blackish, sticky mud was effective in healing arthritic knees and other aching joints. As noted by Former (1995), the mud from some sulfur-water pools is also helpful in treating certain skin diseases.

Though spring water use was not found to be generational, the springs were found to be a part of daily life for many visitors. Traveling on Highway 177 or 7, many visitors pass by the springs on a daily basis. Visitors sip from their fountains, collect spring water on a weekly or monthly basis, or simply make a yearly visit to gather spring water with friends and family while staying at nearby campgrounds. Even though the name of the park has changed, familiar springs have dried up, and traditional uses have been forgotten, there remains a mystique and importance of the springs to the region and our national heritage.

Limitations of the Research

The most obvious limitation of this study is that visitors were not surveyed during all seasons of visitation. Also, the sample size required that the spring data be grouped into overall categories, which may give incomplete data on individual spring water collection and use. If CNRA is to gain a complete picture of visitor spring use, then a

detailed examination should be completed for individual springs. Further studies of spring water use nationwide may prove beneficial, since they might provide avenues for comparison with CNRA uses.

Call for Further Research

CNRA's springs are not only important to their visitors, but to wildlife and our historical heritage. More scientific study of the water and its chemical make-up should be carried out to determine the true nature of its medicinal value to humans. Long-term surveys need to be initiated to evaluate not only the spring water use, but also all recreational activity at CNRA. Such research should address reasons why some past visitors no longer travel to CNRA for recreation. Also, long-term studies that analyze the springs' quality and quantity need to be carried out, given the fact that groundwater sources and the complex geology of the region are not clearly understood.

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Appendix A

TAKE THIS TO **LON GORDON**, PRESCRIPTION DRUGGIST
KONAWA, OKLAHOMA

℞ For Mrs. N. O. Slaughter

Bromide Water 5 gals—
one 5 days
Sig # use water freely for
nervousness and Gastritis—

W. P. Luddleston M. D.

DOWDY'S PHARMACY
PRESCRIPTION DRUGGISTS
ROFF, - OKLAHOMA

℞ For

Superintendent. (Platt)
National Park. You
will please ship
Sam'l. P. Steward one
5 gal. Bromide Water
which Work to be
used for Stomach
trouble

Reg. No. Dr. J. L. Jeffries
No. Date Jan 29 1916

Complements of CNRA Archives

Prescriptions for Bromide Water, 1916

October 9, 1915.

Agent Wells-Fargo Express Co.,

City.

Sir:

This will be your authority to procure from the Bromide Springs 5 gallons of Bromide water every 5 days for the next 60 days for shipment to each of the following persons:-

P. O. Young,----------Memphis, Texas.

Mrs. C. B. Taylor,----------Oklahoma City, Okla.

Mrs. H. B. Snodgrass,-1214 N.Geary St.-- " "

Respectfully,

Superintendent.

per Clerk.

Sir:

This will be your authority to procure from the Bromide Springs 5 gallons of Bromide water every 5 days for the next 60 days, for shipment to the following persons:-

Sam B. Steward,----------Roff, Okla.

H. C. Main,----------Arapaho, Okla.

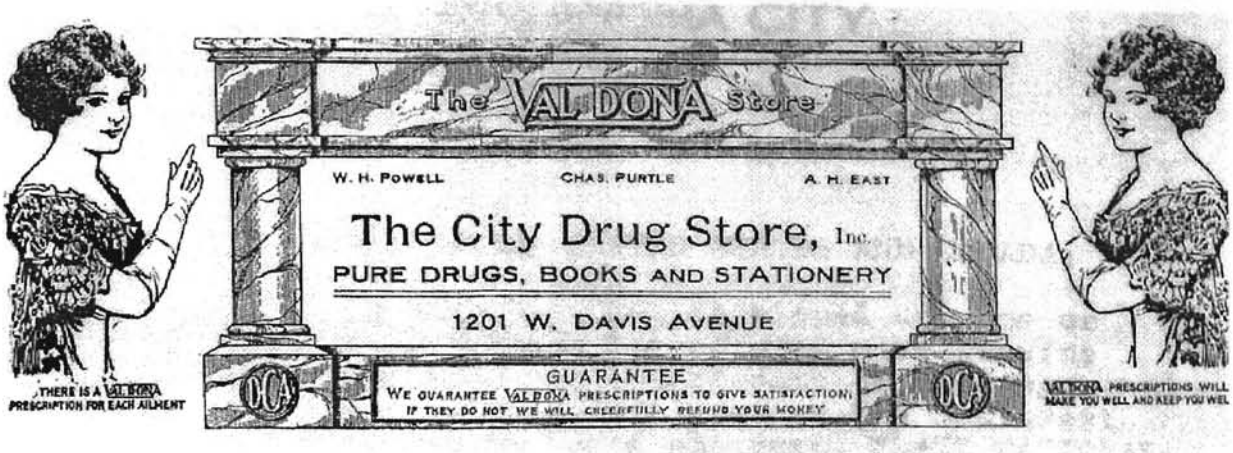
Respectfully,

Supervisor.

per Clerk.

Complements of CNRA Archives

Authorization for Bromide Water, 1915



SULPHUR, OKLA. 9/14/15.

Col. R. A. Sneedy

City.

Dear Sir: This is to advise that Mrs. Anna Strand is suffering from Rheumatism and I have prescribed Bromide water for her to drink.

Respectfully,

W. H. Powell, M. D.

Complements of CNRA Archives

Prescription for Bromide Water, 1915

GOVERNORS OFFICE
OKLAHOMA CITY

November 3, 1921.

TO THE PEOPLE OF THE UNITED STATES AND CANADA:

No duty that has developed upon me as Governor of this State has offered more genuine pleasure than does the opportunity of bidding you welcome to this beauty spot of the Southwest, where health awaits those who come, PLATT NATIONAL PARK

The mineral waters from these springs have cured thousands of sufferers and in the millions of gallons that daily continue to bubble from artesian wells and springs there is renewed vitality and zest for living for the visitor.

Ancient outing place of the Red Man, beautified under the United States supervision and dedicated forever FREE to the pleasures of all of of the people PLATT NATIONAL PARK offers rest, quiet, contentment and health.

Oklahoma is very proud of the National Park and believes that in the course of a very few years it will be one of the great watering places of the world. As the Executive of this Commonwealth I extend to you a hearty invitation to enjoy at an early date the benefits of these health giving waters.

GREAT SEAL OF THE STATE OF OKLAHOMA 1907

J. B. A. Robertson
Governor.

Attest:

Jos. S. Morris
Secretary of State.

Chamber of Commerce 1921, p.4
Complements of CNRA Archives

Cover Letter from the Governor of the State of Oklahoma, 1921

Appendix B

National Water Summary 1986- Ground Water Quality; DRINKING-WATER REGULATIONS

The U.S. Environmental Protection Agency's National Primary Drinking-Water Regulations and National Secondary Drinking-Water Regulations are summarized in the following tables. The primary regulations specify maximum contaminant levels (MCL), recommended maximum contaminant levels (RCML), and health advisories. The MCL's, which are the maximum permissible level of a contaminant in water at the tap, are health related and are legally enforceable. If these concentrations are exceeded or if required monitoring is not performed, the public must be notified. The RMCL's are the maximum levels of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur; they are nonenforecable health goals. The secondary drinking-water regulations specify the secondary maximum contaminant levels (SMCL). The SMCL's are for contaminants in drinking water that primarily affect the aesthetic qualities related to public acceptance of drinking water; they are intended to be guidelines for the States and are not federally enforceable. Health advisories are guidance contaminant levels that would not result in adverse health effects over specified short-time periods for most people.

Primary Drinking-Water Regulations		Secondary Drinking-Water Regulations	
Constituent or property	**Level (MCL) mg/L**	**Constituent or property**	**Level (SMCL) mg/L**
Inorganic:		Chloride	250
Arsenic	0.05	Color	15 color units
Barium	1.0	Copper	1
Cadmium	0.010	Corrosivity	Noncorrosive
Chromium	0.05	Dissolved solids	500
Lead	0.05	Fluoride	2.0
Mercury	0.002	Foaming agents	.5
Nitrate (as N)	10.0	Iron	.3
Selenium	0.01	Manganese	.05
Silver	0.05	Odor	3 (threshold odor #)
Fluoride1	4.0	pH	6.5-8.5 units
Organic:		Sulfate	250
Endrin	0.0002	Zinc	5
Lindane	0.004		
Methoxychlor	0.1		
Toxaphene	0.005		
2,4-D	0.1		
2,4,5-Tp Silvex	0.01		
Total trihalomenthanes	0.10	**Health Advisory**	
Microbiological:		Constituent	Level (mg/L)
Coliform bacteria	1 per 100 mL (mean)	Sodium	20
Turbidity:			
Turbidity	1-5 tu		
Radionuclides:			
Radium 226 and 118 (combined)	5 pCi/L		
Gross alpha particle activity	15 pCi/L		
Gross beta particle activity	4 mrem/yr		

Recommended Maximum Contaminant Level (RCML)	
Benzene	0.0
Carbon Tetrachloride	0.0
p-Dichlorobenzene	0.75
1,2-Dichloroethane	0.0
1,1-Dichloroethylene	0.007
1,1,1-Trichoroethane	0.20
Trichloroethylene	0.0
Vinyl chloride	0.0

Appendix C

Chickasaw National Recreation Area
Questionnaire on Traditional Uses of Park Water

SITE SPECIFIC INFORMATION

---

1. When was the first time that you collected water at this site? _____ (year or age)

Q1	NO.	PERCENT
1900-1910	0	0.00%
1911-1920	0	0.00%
1921-1930	6	11.76%
1931-1940	6	11.76%
1941-1950	6	11.76%
1951-1960	4	7.84%
1961-1970	2	3.92%
1971-1980	1	1.96%
1981-1990	1	1.96%
1990-1997	25	49.02%

2. How often do you collect water here? _____ (daily, several times per week, weekly, monthly, other)

USE	NO.	PERCENT
Daily	21	41.18%
Several times per week	6	11.76%
Weekly	4	7.84%
Monthly	2	3.92%
Other	18	35.29%

3. What was the reason for your original collection? _____

ORIGINAL REASON	NO.	PERCENT
Like it	30	34.88%
Grew up with it	9	10.47%
It's free	2	2.33%
Don't like chlorinated water (city water)	3	3.49%
It's good for you (healthy/minerals)	8	9.30%
Natural (God's water)	7	8.14%
Curiosity (Just wanted to try it)	12	13.95%
Cleaning (skin)	2	2.33%
Cancer (it may help cure)	1	1.16%
It's cold	4	4.65%
Good for teeth (calcium)	1	1.16%
Mud puppy	1	1.16%
Soaking (reduces swelling)	1	1.16%
Arthritis (helps to cure)	1	1.16%
It doesn't blot or cramp the stomach like city water	2	2.33%
Kidneys (good for them)	1	1.16%
Bladder problems (helps to cure)	1	1.16%

USE TYPE	NO.	PERCENT
Drinking water	49	75.38%
Ice cubes	2	3.08%
Cooking	1	1.54%
Bathing (wading)	8	12.31%
Dogs and humans (reduces ticks, fleas, chiggers, and misquotes)	3	4.62%
Hang-overs (helps to recover from them)	2	3.08%

4. Is your reason for collecting water today the same as it was when you first collected? _____ (yes or no)

Q4	NO.	PERCENT
yes	42	82.35%
no	2	3.92%
N/A	7	13.73%

5. If not, how is it different? _____

6. Would you describe your water use as generational (you have been collecting for more than 30 years or often), occasional (you collected for less than 10 years or sometimes), or individual (only a few times a year or first time)?

WATER USE	NO.	PERCENT
Generational	32	62.75%
Occasional	3	5.88%
Individual	16	31.37%

7. How would you rate the water quality at this site (excellent, good, fair, bad)? _____

QUALITY	NO.	PERCENT
excellent	17	34.00%
good	30	60.00%
fair	1	2.00%
bad/poor	2	4.00%

8. Are you familiar with Oklahoma's Water Quality Standards? _____ (yes or no)

Q8	NO.	PERCENT
yes	5	9.80%
no	28	54.90%
N/A	18	35.29%

9. Has the water quality changed since the time that you began collecting? _____ (yes or no)

Q9	NO.	PERCENT
yes	7	13.73%
no	34	66.67%
N/A	10	19.61%

10. If so, how? _____

Q10	NO.	PERCENT
taste	7	13.73%
N/A	44	86.27%

11. What do you see as the greatest threat to the water and your continued use of it? _____

(examples: quality, quantity) (smell, taste, color, turbidity)

THREAT	NO.	PERCENT
Quality/Pollution/Contamination	10	19.61%
Sodium level	2	3.92%
Taste	0	0.00%
Quantity (springs drying up)	5	9.80%
Lack of maintenance	4	7.84%
None	25	49.02%
N/A	5	9.80%

12. Has the quantity of water changed at this site? _____ (yes or no)

Q12	NO.	PERCENT
yes	22	43.14%
no	23	45.10%
N/A	6	11.76%

13. If so, how? _____

Q13	NO.	PERCENT
pressure	15	28.85%
places	8	15.38%
N/A	29	55.77%

14. Do you know of documented proof of this change? _____

15. What other sites at CNRA do you collect at? _____

SITE	NO.	PERCENT
Pavilion Springs	6	11.54%
Vendome Well	4	7.69%
Black Sulphur	0	0.00%
Antelope Spring	1	1.92%
Buffalo Spring	0	0.00%
Bromide Spring	2	3.85%
Other	0	0.00%
None	38	74.51%

16. Are the reasons for collection at the other site the same as this site? _____ (yes or no)

Q16	NO.	PERCENT
yes	13	25.49%
no	0	0.00%
N/A	38	74.51%

17. If not, what are your reasons for collection? _____

18. Do you have a name and number of anyone who no longer collects water at the Park? _____

19. Are there any other places (other than CNRA) where you collect water? _____ (yes or no)

Q19	NO.	PERCENT
yes	7	13.73%
no	44	86.28%

20. If so, where? _____

BACKGROUND INFORMATION

What is your zip code? _____

AREA TITLE	ZIP CODES	NO.	PERCENT
Lavaca, AR	72941	2	3.92%
Davis, OK	73030	2	3.92%
Marlow, OK	73055	2	3.92%
Norman, OK	73071	1	1.96%
Sulphur, OK	73086	18	35.29%
OKC, OK	73127, 73129	3	5.88%
Ada, OK	74820	8	15.69%
Stratford, OK	74872	1	1.96%
Sherman, TX	75090, 75092	6	11.76%
Wichita Falls, TX	76301	1	1.96%
Phoenix, AZ	85015	1	1.96%
Albuquerque, NM	87101	2	3.92%
Pasco, WA	99301	4	7.84%

Year of birth? _____

YEAR OF BIRTH	NO.	PERCENT
child	6	11.76%
1900-1910	1	1.96%
1911-1920	1	1.96%
1921-1930	15	29.41%
1931-1940	6	11.76%
1941-1950	4	7.84%
1951-1960	12	23.53%
1961-1970	6	11.76%

What is the highest level of education that you have completed?

__ 8th grade or less
__ 9th to 12th grade/GRE
__ Some college
__ Bachelors degree
__ Some graduate study
__ Masters or Doctorate degree

EDUCATION LEVEL	NO.	PERCENT
8^{th} grade or less	9	17.65%
9^{th} to 12^{th}/GED	19	37.25%
some college	7	13.73%
Bachelors degree	6	11.76%
Some graduate study	2	3.92%
Masters or Doctorate degree	2	3.92%
N/A	6	11.76%

City or Town of residence? _____

AREA TITLE	ZIP CODES	NO.	PERCENT
Lavaca, AR	72941	2	3.92%
Davis, OK	73030	2	3.92%
Marlow, OK	73055	2	3.92%
Norman, OK	73071	1	1.96%
Sulphur, OK	73086	18	35.29%
OKC, OK	73127, 73129	3	5.88%
Ada, OK	74820	8	15.69%
Stratford, OK	74872	1	1.96%
Sherman, TX	75090, 75092	6	11.76%
Wichita Falls, TX	76301	1	1.96%
Phoenix, AZ	85015	1	1.96%
Albuquerque, NM	87101	2	3.92%
Pasco, WA	99301	4	7.84%

What best describes the place where you live?
__ Farm or rural
__ Town (population under 5000)
__ Town or city (population of 5000 or more)

LOCATION	NO.	PERCENT
Farm or rural	4	7.84%
Town (population under 5000)	7	13.73%
Town (population of 5000 or more)	40	78.43%

What is your current occupation? _____

OCCUPATION	NO.	PERCENT
Student	8	15.69%
Banker	1	1.96%
Carpenter	1	1.96%
Construction	2	3.92%
Drilling	2	3.92%
Engineer	1	1.96%
Farmer	1	1.96%
Hotel manager	1	1.96%
House wife	3	5.88%
Janitorial	1	1.96%
Lawyer	1	1.96%
Maintenance	2	3.92%
Park staff	2	3.92%
Police	1	1.96%
Retired	17	33.33%
Security guard	1	15.69%
Self employed	1	15.69%
SWB telephone	1	15.69%
Teacher	3	15.69%
Trucking Co.	1	15.69%

Current location? _____

SITE	NO.	PERCENT
Pavilion Springs	11	21.57%
Vendome Well	33	64.71%
Black Sulphur	3	5.88%
Antelope Spring	4	7.84%
Buffalo Spring	0	0.00%
Bromide Spring	0	0.00%
Other	0	0.00%

Gender? _____

GENDER	NO.	PERCENT
Female	19	37.25%
Male	26	50.98%
Child	6	11.76%

Gallons? _____

GALLONS	NO.	PERCENT
Sip	24	47.06%
Cup	3	5.88%
Liter	2	3.92%
Gallon	2	3.92%
2gallon	6	11.76%
3gallon	8	15.69%
4gallon	1	1.96%
5gallon	4	7.84%
20+gallons	1	1.96%

Appendix D

Observations

During the course of the field studies, many general observations and interesting anecdotal information about the springs were collected. They are listed in categories of "site-specific" and "general" below.

Site-Specific

1. Former superintendent, John Welch, was seen drinking from Pavilion Springs while out jogging. Also, he picked up trash by the road.
2. Buffalo Springs: people soak their feet in the pool.
3. There is a one-mile hike to collect water from Buffalo and Antelope Springs: maybe why less people collect at Buffalo and Antelope Springs. My opinion: Since Buffalo and Antelope Spring used to have a road running directly to them and there used to be a higher collection rate, but today only a trail accesses the area- therefore less collect in this area.
4. Judy Reeder, a Park Ranger, said that most visitors never did collect water at Antelope and Buffalo Springs for medicinal purposes. Today, people are suspicious of the water because of parasitic infections like giardia. Judy said that one man used to collect at Antelope Springs because his wife had cancer and she couldn't drink chlorinated water and that he used a golf cart to haul the water.
5. One woman watched the drilling of Vendome Well's new shaft. She said that her grandfather drilled the original shaft. She heard about the re-drilling in the newspaper and she said that she hoped that they didn't ruin the well.
6. Don Wollenhaupt, a Park Ranger, said that they witched the new spot for Vendome Well. Witching was used for the first sight at Vendome Well.
7. Many visitors said if you put the water (Vendome Well) in the refrigerator for a couple days the sulfur smell goes away making the water easier to drink.
8. Two visitors said that the water (Pavilion Spring) is great medicine for hangovers, and that it works better than tomato juice. Many visitors said that they liked the vitamins and minerals in the water, especially Cilium.
9. One visitor said that she keeps 6 gallons of water (Vendome Well) in her refrigerator, and when she drinks two gallons she comes and refills them.
10. One individual feels that the government has let the springs deteriorate, and that they haven't managed them properly. He recalled how his grandfather used the mud at Vendome Well to reduce the swelling in his knees. He said that it saddens him to see

so many springs not flowing because he couldn't share them with his grandchildren, who were with him.

11. Another outspoken individual believes that the park is being mismanaged. He said that there used to be thousand of people that came to collect the spring water, but now they come to water ski etc. He said that the town (City of Sulphur) had potential- but not today. He believes that it is the park's fault.
12. One gentleman was observed soaking his shoulder in the mud. He said that his chiropractor told him to come here to soak in the cold water of Vendome Well, for it would reduce the swelling.
13. A daughter collected water at Vendome Well for her mother, said that her mother had cancer and could only eat ice chips of Vendome Well water. She went on to say that they believed that it (Vendome Well water) will help to reduce the cancer.

General

1. Rain and cold weather: people don't collect as often.
2. Many retired folks walk every morning.
3. Vacationers seem less willing to drink the water than the locals are.
4. People are coming to swim in the creeks and not to partake in healing water. Children play in Bromide Pavilion.
5. Children drink directly from all of the springs.
6. One woman said that she used to buy bottled water because she didn't like chlorinated water, but now, she said, that the money she saves with free spring water allows her to visit relatives in Ardmore. She also said that she takes water to her relatives. She collected 20 gallons.
7. Many visitors read all of the posted signs by the springs and taste the water then leave.
8. Many visitors collect spring water on their way to work, while leaving their cars running.
9. A couple of visitors collect the spring water because the don't think that city water is safe, and they don't trust the government. They are fearful of unauthorized and toxic dumping in the area.

Appendix E

Form 10-114
Rev. Aug. 86
OMB No. 1024-0026

UNITED STATES DEPARTMENT OR THE INTERIOR
National Park Service

Special Use Permit

Name of Use: Research Project
Traditional & Current Uses of Park Waters

Date Permit Reviewed 19 __ _____
Reviewed 19 __ _____
Reviewed 19 __ _____
Expires 19 98 June 8

Long Term _____
Short Term xxx

Permit # IMR (Region) CHIC (Park) 25AO (Type) 023 (No #)
Chickasaw National Recreation Area
Name of Area

Tonia Brown (Name or Permittee) of 914 N. Dryden Circle, Stillwater, OK 74075 (Address) (405) 372-8573 (Phone)

is hereby authorized during the period from (Time 12:01 a.m. day 9 Month 6 19 97), through (Time 12:00 p.m. day 8 Month 6 19 98), to use the following described land or facilities in the above named area:

Vendome Well
Black Sulphur Springs
Pavilion Springs
Hillside Springs
Bromide Springs
Antelope Springs
Buffalo Springs

For the purpose(s) of:
Collecting data on traditional and current uses of park waters.

Authorizing legislation or other authority (RE- NPS-53 Appendix 1):

NEPA Compliance: CATEGORICALLY EXCLUDED ___ EA/FONSI ___ EIS ___ OTHER APPROVED PLANS ___

PERFORMANCE BOND: Required ___ Not Required X Amount $ _____

LIABILITY INSURANCE: Required ___ Not Required X Amount $ _____

ISSUANCE of this permit is subject to the conditions on the reverse hereof and appended pages and when appropriate to the payment to the U.S. Dept. of the Interior, National Park Service of the sum of $ Ø .

The undersigned hereby accepts this permit subject to the terms, covenants, obligations, and reservations, expressed or implied herein.

PERMITTEE Tonia Brown (Signature) 7/6/97 (Date)

Authorizing Official John E. Wilson (Signature) Superintendent 7/10/97 (Date)

Appendix F

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 06-22-97 **IRB#:** AS-97-072

Proposal Title: CHICKASAW NATIONAL RECREATION AREA: TRADITIONAL AND CURRENT USES OF PARK WATERS

Principal Investigator(s): Thomas Wikle, Tonia Brown

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature

Chair of Institutional Review Board

Date: June 25, 1997

cc: Tonia Brown

VITA

Tonia L. Brown

Candidate for the Degree

of Master of Science

Thesis: CHICKASAW NATIONAL RECREATION AREA: SOCIETAL PREFERENCES AND RATIONALE FOR TRADITIONAL AND CURRENT COLLECTION AND CONSUMPTION OF SPRING WATERS

Major Field: Geography

Biographical:

Personal Data: Born in Liberia, Africa, On August 31, 1972, the daughter of Melissa Bowman and Douglas Brown.

Education: Graduated from Edward C. Reed High School, Sparks, Nevada in June 1991; received Bachelor of Science degree in Geography from Oklahoma State University, Stillwater, Oklahoma in May 1996. Completed the requirements for Master of Science degree with a major in Geography at Oklahoma State University in May, 1998.

Experience: Instructor of Physical Geography Laboratory in the Department of Geography at Oklahoma State University; Research Assistant in the Department of Geography at Oklahoma State University and Chickasaw National Recreation Area; Contract Cartography for Heartland Wireless Cable of Stillwater; Cartographic Internship with the USDA in the Department of Water Resources within the Natural Resource Conservation Services.

Professional Memberships and Awards: Member of the Association of American Geographers; Geography Department Outstanding First Year Graduate Student 1997; National Collegiate Natural Sciences Award Winner; Geography Department Outstanding Senior 1996; Highest Merit Student/Athlete; Dean's Honor Roll.