58. The groundwater flow direction was noted to be generally SW from WCGS to the Neosho River. Are there any localized groundwater flow directions to Wolf Creek (below CCL)?

• Historical information on how the water withdrawal controls have been implemented in the past. If there have never been any incidents where low water levels in the reservoir or low flow in the river have resulted in water withdrawal restrictions, then state this. If there have been incidents where the rights of any user (WCGS or any other user) have been restricted, provide information on the cause of the incident, length of duration, restrictions placed on which users, and any other relevant information.

• Please provide actual historical data on water withdrawal volumes from the Neosho River.

• Groundwater levels were predicted to rise 45.8 feet within 100 feet of the site 50 years after the filling of CCL. The height of the ground water table was predicted to rise 0.4 feet, 2 miles from the site after the lake was filled. Please provide the elevation of the water table before the lake was filled and the current water table elevation.

• The groundwater flow direction was noted to be generally SW from WCGS to the Neosho River. Are there any localized groundwater flow directions to Wolf Creek (below CCL)?

• Regarding water use conflicts at Wolf Creek, although the ER Section 4.1 indicates no surface water use conflicts, our Generic Environmental Impact Statement (GEIS) for license renewal says (section 4.4.2.1, p. 4-52): "Two nuclear power plants, the Braidwood Station and Wolf Creek Generating Station, have already experienced wateruse conflicts." Furthermore, the GEIS on p. 4-53 (left column, first full para) uses WCGS as an example of potential water use conflicts. Water use conflicts at Wolf Creek are also cited in section 4.4.3, p. 4-57, left column. Although there seems to be a discrepancy, perhaps all water use conflicts have been solved. If so, Wolf Creek should provide this information.

• An assessment of the impact of population increases attributable to the proposed project on the public water supply, as per 10 CFR 51.53(c)(3)(ii)(I).

2.3 GROUNDWATER RESOURCES

WCGS is located in the Central Lowland physiographic province. The land surface is gently rolling in the Central Lowland province except where major rivers and their tributaries are deeply incised. Kansas, Missouri, and Nebraska are in part of the North American craton, an area that has been tectonically stable throughout most of geologic time. The area has undergone some deformation, as demonstrated by the Nemaha Uplift, located approximately 50 miles west of WCGS. Pennsylvanian strata are present in the area of WCGS, consisting of shale, sandstone, limestone, and some coal beds. Quarternary and tertiary deposits, consisting primarily of unconsolidated sand and gravel, exist along the Neosho River (USGS 1997).

WCGS makes no groundwater withdrawals for plant consumptive use. Only small quantities of groundwater are available within a 50-mile radius of WCGS. The groundwater is produced from three types of aquifers: the alluvial deposits in the river valleys, the weathered bedrock including the shallow soil, and the unweathered bedrock (WCNOC 2004).

The regional alluvial aquifer along the Neosho River is composed of sands, silts, and gravel. The width of the alluvium in the valley ranges from 1 to 10 miles, but is less than 20 feet thick in Coffey, Woodson, and Allen counties. Yields from wells in the alluvial aquifer are less than 100 gallons per minute (WCGS 1980). Recharge occurs from precipitation and from the Neosho River during periods of high flow (WCNOC 2004). The level in the aquifer is, therefore, closely related to the river level. The chemical quality of the water in regional alluvial aquifers generally is suitable for most uses. Typically, the water is hard and a calcium biocarbonate type. Dissolved solids concentrations are generally less than 500 milligrams per liter and high iron concentrations are common (USGS 1997).

The weathered bedrock aquifer consists of weathered shales, siltstones, sandstones, and limestones (WCNOC 2004). The weathered zone may be up to 40 feet thick (NRC 1975). Pressure tests indicate that this aquifer is sufficiently permeable to yield up to 10 gallons per minute. Recharge occurs from precipitation and locally from downward percolation through the overlying alluvium. Discharge occurs into both alluvium and streams (WCNOC 2004).

The consolidated bedrock aquifers are composed of sandstones and limestones which are limited to yields ranging from about 1 to 10 gallons per minute. Recharge occurs by precipitation and infiltration of surface water at the outcrops. Where overlain by shales and siltstones, which act as aquitards and aquicludes, vertical recharge to the limestones and sandstones is minimal (WCNOC 2004). Test holes installed at WCGS suggest the presence of an aquiclude at a depth of about 40 feet (NRC 1975).

Groundwater movement is in a southwesterly direction from the plant site towards the Neosho River. The water table contour is a muted image of the surface topography. The piezometric surface of the deeper aquifers reflects the gradient of the parent formation. In all cases, the gradient is generally from the site toward the Neosho River (NRC 1975).

4.6 GROUNDWATER USE CONFLICTS (PLANTS USING COOLING TOWERS OR COOLING PONDS AND WITHDRAWING MAKEUP WATER FROM A SMALL RIVER)

NRC

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/year...[t]he applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(3)(ii)(A)

"...Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other groundwater or upstream surface water users come on line before the time of license renewal..." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 34

NRC made groundwater use conflicts a Category 2 issue because consumptive use of withdrawals from small rivers could adversely impact aquatic life, downstream users, and aquifer recharge. This is a particular concern during low flow conditions and could create a cumulative impact due to upstream consumptive use. From 1962 through 2004, the average annual flow of the Neosho River at Burlington, Kansas (U.S. Geological Survey Station 07182510) was 5.06×10^{10} cubic feet per year (1,603 cfs) (Putnam and Schneider 2005). Therefore, the Neosho River meets the NRC definition of a small river. WCGS withdraws its condenser cooling water from a cooling pond (Coffey County Lake) that receives its makeup water from the Neosho River directly below John Redmond Reservoir Dam. Coffey County Lake provides continuous recharge to the rock and soil underneath the site. Groundwater levels were predicted to rise 45.8 feet within 100 feet of the cooling lake 50 years after filling (NRC 1975). Two miles from WCGS, the rise in groundwater was predicted to be less than 0.4 feet (NRC 1975).

As discussed in Section 2.3, a regional alluvial aquifer occurs along the Neosho River (WCGS 1980). The amount of groundwater used within a 20-mile radius of WCGS is small. No groundwater is used for the operation of WCGS (NRC 1982). There are no municipalities in the vicinity of WCGS that use groundwater (EPA 2005). The only known groundwater supply being used for industrial purposes within a 20-mile radius of the site is from one well owned by the Atchison Topeka and Santa Fe Railway located 15 miles west-northwest of WCGS (WCNOC 2004), and therefore upstream of WCGS's withdrawal point from the Neosho River.

A well inventory conducted in 1973 identified 198 wells within five miles of the plant site. These local wells are used for domestic and livestock purposes. They supply small quantities of water from the weathered bedrock and larger quantities from the alluvium. Most wells in the area intercept groundwater in the weathered bedrock zone where the permeability has been increased by weathering. Information obtained during the well inventory indicated a trend away from domestic groundwater usage and toward the use of treated surface water (WCNOC 2004).

In the final environmental statement (FES) for construction, NRC conducted an analysis of Neosho River flow rates immediately downstream of the John Redmond dam with and without the water being diverted to Coffey County Lake. The results showed that there would be a reduction of flow during some portions of the period-of-record drought. However, there would be no change in the downriver flow during the worst part of the drought because the water surface in John Redmond Reservoir would be below the conservation level. In this case, water would be released downstream only for the previous water rights and for water quality purposes, which are the same with or without the presence of WCGS (NRC 1975).

In addition, a water purchase contract between the State of Kansas, Kansas Water Resources Board, Kansas Gas and Electric (KG&E), and Kansas City Power and Light Company (KCP&L) limits the amount of water that WCGS can withdraw from John Redmond Reservoir to 9,672 million gallons of water per year. KG&E and KCP&L own WCGS. The contract states that "If the total amount of waters contracted for withdrawal from the John Redmond Reservoir in the next 12-month period is greater than the supply available from that reservoir which is deemed to be 9,672 million gallons per year due to a prolonged drought, the Board will apportion the available waters among the purchasers having contracts therefore as may best provide for the health, safety, and general welfare of the people of this state as determined by the Board" (State of Kansas 1976). Should the State of Kansas determine that an insufficient amount of water is available to maintain flows in the Neosho River, the state will apportion available waters to best benefit the people of Kansas.

WCGS does not use groundwater for operation of the plant but does withdraw water from the Neosho River, which could affect recharge of the alluvial aquifer during low flows. However, during the worst drought conditions and lowest flows in the Neosho River, WCGS would not withdraw water from the Neosho River because the water level in John Redmond Reservoir would be below the conservation stage. The State of Kansas may also limit the amount of water that WCGS can withdraw from John Redmond Reservoir if a prolonged drought is experienced. Although recharge to the alluvial aquifer could, in theory, be affected by low flows in the Neosho River, impacts caused by WCGS would be minimal because lower water levels in John Redmond Reservoir would ultimately preclude or reduce releases at the dam and thus withdrawal of makeup water for Coffey County Lake. Therefore, continued operation of WCGS would have SMALL impacts on groundwater use conflicts and no mitigation is warranted.

Table 2.3. Selected gage records of the Neosho River and tributaries

Gage	Drainage area (square miles)	Location (river miles)	Period of record	Record discharge			
				Maximum		Minimum	
				Flow (cfs)	Time	Flow (cfs)	Time
Neosho River							
at Council Grove, Ka.	250	448.0	Oct. 1938–Sept. 1965	121,000	July 11, 1951	0	[a]
at Americus, Ka.	622		June 1963–Sept. 1965	6,380	Sept. 21, 1965	0	Each year
at Strawn, Ka.	2933	356.5	June 1948–June 1963	400,000	July 11, 1951	0[b]	1954–1957
at Burlington, Ka.	3042	338.4	June 1961–Sept. 1965	26,800	Sept. 13, 1961	1.1	1963[b]
near Iola, Ka.	3818	284.4	Aug. 1895–Sept. 1965[c]	436,000	July 13, 1951	0[b]	1936 and 1956
Cottonwood River							
near Marion, Ka.	329	123.9	Oct. 1938–Sept. 1965	66,000	July 11, 1951	0	[a]
near Florence, Ka.	754	102.4	June 1961–Sept. 1965	46,000	June 10, 1965	5.5	Oct. 11, 1964
at Cottonwood Falls, Ka.	1327	66.7	Apr. 1932–Sept. 1965	196,000	July 11, 1951	0[b]	1955–1957
near Plymouth, Ka.	1740	39.2	Mar. 1963–Sept. 1965	57,000	June 5, 1965	8.7	Oct. 21, 1964
Cedar Creek							
near Cedar Point, Ka.	110	9.4	Oct. 1938–Sept. 1965	52,400	June 29, 1951	0	[d]
Four Mile Creek							
near Council Grove, Ka.	55	4.4	Mar. 1963–Sept. 1965	5,480	Sept. 21, 1965	0[b]	1963–1964

[a]Several years.
[b]Occasionally, in year(s) shown.
[c]No record from December 1903 to October 1917.
[d]Occasionally.

Source: United States Geological Survey, "Surface Water Supply of the United States," Part 7, Lower Mississippi River Basin, Annual Publication, 1965.

The soil and weathered bedrock aquifer is reported to comprise weathered shale, siltstone, sandstone and limestone, and the soils derived from them. The weathered zone may be up to 40 ft thick. The overlying alluvial aquifer is hydraulically-connected to the lower weathered bedrock aquifer. Recharge to both is from local precipitation percolating through the soil. Thus, the water table elevation is responsive to local precipitation-drought conditions. Within a five-mile radius of the site, well surveys identified 142 dug wells in the two water-table aquifers (ER, Figs. 2.2-10 and 2.2-12).

The bedrock aquifers are composed of sandstones and limestones. Recharge to the aquifers is principally from precipitation at the outcrop of the formations, east of the proposed site. Some downward movement from the overlying aquifers may result in recharge of the bedrock aquifers. However, the rise of the water level in the applicant's test holes above the upper boundary of the formation strongly suggests the presence of an aquiclude at a depth of about 40 ft. The aquiclude is composed of shale beds that limit vertical permeability.

Groundwater movement is in a southwesterly direction from the plant site towards the Neosho River. The water table contour is a muted image of the surface topography. The piezometric surface of the deeper aquifers reflects the gradient of the parent formation. In all cases the gradient is generally from the site toward the Neosho River.

Use of groundwater in the site area is discussed in Sects. 4.2.2 and 5.5.2 of this statement.

2.5.3 Water quality

2.5.3.1 Surface water

The applicant sponsored surface water studies to establish baseline water quality information. The locations of the sampling stations including John Redmond Reservoir are shown in Fig. 2.7. Chemical and biological analyses were performed to identify the baseline. Algal bioassays were performed to identify the growth-support potential of the local surface water. The analyses are based on sampling accomplished in March, June, September, and December 1973.

The concentration of selected chemical parameters identified by the applicant is compared with earlier (water year October 1965 to September 1966) analyses by others[4] in Table 2.4 and Fig. 2.7.

2.5 HYDROLOGY

The Wolf Creek nuclear generating station will be located east of the proposed cooling lake in the Wolf Creek watershed. Figure 2.5-1 shows the site location with respect to the Neosho River basin in Kansas. Primary makeup water supply to the cooling lake will be derived from the conservation pool of the John Redmond Reservoir.

The Wolf Creek dam will be constructed about 5½ stream miles north of the creek's confluence with the Neosho River to form the cooling lake with normal pool elevation of 1087 feet above mean sea level (MSL). Natural topographical, hydrological and other physical features of the watershed are shown on Figure 2.5-2. | 2

The following subsections describe the site and its regional setting for both surface and ground-water regimes. Water usage has been discussed in Section 2.2.

2.5.1 Surface Water

2.5.1.1 Surface Hydrosphere

2.5.1.1.1 Wolf Creek Watershed

Wolf Creek originates about three-quarters of a mile southwest of Halls Summit and flows southward to the Neosho River. It is 26.6 stream miles long and drains about 35 square miles. The natural stream gradient is about 7.4 feet per mile. The lower reaches share a common floodplain with the Neosho River where Wolf Creek's gradient approximates 3.7 feet per mile. The stream channel is well defined and meanders considerably within rather stable banks.

The Wolf Creek watershed is characterized by undulating to level topography with moderate drainage gradients (approximately 38 feet per mile) near its headwater region. Differential erosion of westward-dipping limestone and intervening shales and sandstones created the hilly terrain.

There are several farm ponds located in the watershed, both natural and man-made. These are used particularly during dry periods when stored water is all that is available; they also serve as floodwater impoundments. The ponds are otherwise too small to affect the hydrologic characteristics of the watershed.

Precipitation near the site has varied considerably from year to year. The nearest precipitation measurement station to the site is at Burlington. Data on average and maximum precipitation at this station are presented in Table 2.5-1. The recorded precipitation averages about 38.0 inches annually with snowfall averaging about 15.2 inches.

2.5.1.1.2 Neosho River Basin

The Neosho River originates in Morris County, Kansas, and flows south-southeastward through the state and eventually joins the Arkansas River near Muskogee, Oklahoma. The major tributary to the Neosho River above the site is the Cottonwood River, which rises near the McPherson-Marion County line and joins the parent stream about 6 miles east of Emporia, Kansas. Three major tributaries to the Neosho River immediately downstream of the site are Long Creek, Big Creek, and Turkey Creek (Figure 2.5-1). They each drain areas greater than 70 square miles and join the main river in the vicinity of Le Roy, Kansas.

The Neosho River drains 5,793 square miles and flows more than 300 river miles in Kansas alone. The headwater reach of the basin is approximately 30 miles wide, then increases to about 80 miles to include the drainage system of the Cottonwood River, and then decreases to about an average of 25 miles in width at the state line. The floodplain of the Neosho River has attained a maximum width of about 5 miles in the vicinities of Neosho Rapids and Le Roy, immediately upstream and downstream of the site area, respectively. However, a natural constriction is located in the valley area near Burlington, where the floodplain narrows appreciably to approximately three-quarters of a mile (Kansas Water Resources Board, 1961; and U.S. Army Corps of Engineers, 1965).

In the upper reaches of both the Neosho and Cottonwood Rivers, stream gradients exceed 8 and 6 feet per mile, respectively, but then decrease to less than 2 feet per mile near Emporia, Kansas. Near the site area, the channel gradient remains at about 1.5 feet per mile, being largely controlled by outcropping limestone and shale (Kansas Water Resources Board, 1961; and U.S. Army Corps of Engineers, 1965). Some parts of the headwater area are at elevations over 1500 feet above mean sea level (MSL), while the river channel at the state line is 757 feet above MSL. The river-channel elevation near the mouth of Wolf Creek is about 978 feet above MSL. The river banks are rather stable and usually covered with brush and trees (U.S. Army Corps of Engineers, 1965).

Mean annual precipitation over the Neosho River basin area in Kansas varies from about 28 inches near the headwater region of the Cottonwood River to about 42 inches near the state line (U.S. Army Corps of Engineers, 1965). The average annual snowfall in the Upper Neosho River Basin is about 18 inches (U.S. Army Corps of Engineers, 1958).

Council Grove, Marion Lakes, and John Redmond Reservoir are three major surface water impoundments within the Upper Neosho River Basin which exist for flood control and low-flow augmentation. A fourth reservoir, Cedar Point Lake, is now in the final stages of design and will be constructed sometime in the future. There are numerous farm ponds in the site region, but they do not affect the hydrologic regime of the Neosho River.

2.5.1.2 Flow Characteristics

2.5.1.2.1 Wolf Creek

Wolf Creek is ungaged, and no records of streamflow are available. Streamflow in Wolf Creek was extrapolated from U.S. Geological Survey gaging records obtained at Council Grove, Strawn and Iola on the Neosho River, and at Madison on the Verdigris River, taking into consideration the proper adjustments for the respective drainage areas. The gaging stations are in the adjacent general 1
area of the Wolf Creek drainage; streamflow data for a sufficient period were available for allowing the extrapolation to be made. The intensities of streamflow at the above gaging stations were computed, and an average intensity was applied to the drainage area of Wolf Creek. Estimated monthly streamflows for Wolf Creek 2
at its confluence with the Neosho River are listed below:

January	- 400 acre-feet	July	- 2,800 acre-feet
February	- 510 acre-feet	August	- 560 acre-feet
March	- 940 acre-feet	September	- 980 acre-feet
April	- 1,050 acre-feet	October	- 805 acre-feet
May	- 1,575 acre-feet	November	- 420 acre-feet
June	- 1,710 acre-feet	December	- 280 acre-feet

The estimated average monthly flow is about 1020 acre-feet (17.0 cubic feet per second).

Though the flow for a part of September may be very low, as noted in Section 2.5.3.1.1.2, Wolf Creek has a higher average streamflow during September than in December, as indicated in the above table. This estimated higher September flow is due to the higher precipi- 1
tation and greater thunderstorm activity in September than in December in the drainage area of Wolf Creek. These relationships are indicated by the monthly average and maximum precipitation at Burlington, Kansas (Table 2.5-1), and the monthly and annual thunderstorms at Wichita, Kansas (Table 2.6-13).

Magnitudes and probabilities of natural daily flows for Wolf Creek were also estimated from calculated daily-flow duration curves developed for Salt Creek (Kansas Water Resources Board, 1959) using the appropriate drainage-area ratio as discussed above. Figure 2.5-3 represents an estimated duration curve for natural daily flows of Wolf Creek at its mouth.

Rather severe droughts of various durations have occurred in the site region. The most severe drought of record lasted from November, 1951 through March, 1957 (Kansas Water Resources Board, 1967a). Wolf Creek ceased to flow altogether during much of this period. Ground water contributes little to sustain streamflow in this region during periods of little or no surface runoff (Kansas Water Resources Board, 1960). The estimated 7-day, 10-year, low flow of Wolf Creek would be 0 cubic feet per second (cfs) (Kansas Water Resources Board, 1960).

Wolf Creek is characterized as an effluent stream (i.e., gaining
water from the ground water system). The ground water and piezo-
metric levels in the geologic units having hydraulic continuity
with Wolf Creek, and underlying and adjacent to Wolf Creek, are
higher than Wolf Creek. Figure 2.5-7 shows a generalized east-
west cross section through the plant site. In this illustration,
the water table in the alluvium and the weathered bedrock slopes
toward Wolf Creek as does the piezometric surface in the Platts-
1 mouth Limestone Member and in the Toronto Limestone Member. The
weathered bedrock and the alluvium are the only two water table
units, and the Plattsmouth Limestone and the Toronto Limestone
Members are the only two artesian strata outcropping along Wolf
Creek that are potential domestic or stock water sources of supply.
The water table and the potentiometric gradients slope toward
Wolf Creek, thus indicating discharge to Wolf Creek. Because of
the low permeability of the weathered and unweathered bedrock
strata, there are only small quantities of ground water leakage to
Wolf Creek.

2.5.1.2.2 Neosho River

Streamflows of the Neosho River near WCGS-1 have been completely
regulated since the operation of John Redmond Reservoir began in
1963. Flows at gaging stations near Iola, Chanute, and Parsons,
about 55, 69, and 138 river miles, respectively, downstream of
Wolf Creek's mouth, reflect this regulation. Natural and regulated
1 streamflow data for the Neosho River are shown in Tables 2.5-1a
and 2.5-1b, respectively. Discharge-frequency curves for the
gaging stations at Iola and Parsons, based on upstream reservoir
regulation, have been developed by the U.S. Army Corps of Engineers
and are reproduced on Figure 2.5-4. Curves for the John Redmond
damsite and for the stage gage at Le Roy are also included. The
channel capacity of the Neosho River near the site is approximately
16,000 cfs; it can be expected that with floods of recurrence
intervals of about 16 years or greater, bankfull discharges would
be exceeded, but due to the topography and expected level of the
floods, the plant or related facilities should not be endangered.

There are no records of severe flooding due to stream or river ice formation in the site region, or of ice-jams affecting reservoir operation. On a historical basis, any severe ice-jam flood potential can be considered minimal.

The Kansas Water Resources Board calculated hydraulic geometry parameters for the Neosho River at two gaging stations downstream of the site for streamflows of 50 and 80 percent duration, and also for average discharges (Kansas Water Resources Board, 1971b). These stream parameters are reproduced in Table 2.5-2 and reflect

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the period-of-record drought, there would have been no change in the down-river flow during the worst part of the drought because the water surface in the John Redmond Reservoir, naturally, would have been below the conservation level. In this case, water is released downstream only for the previous water rights and for water quality purposes which are the same with or without the presence of the Wolf Creek Generating Station.

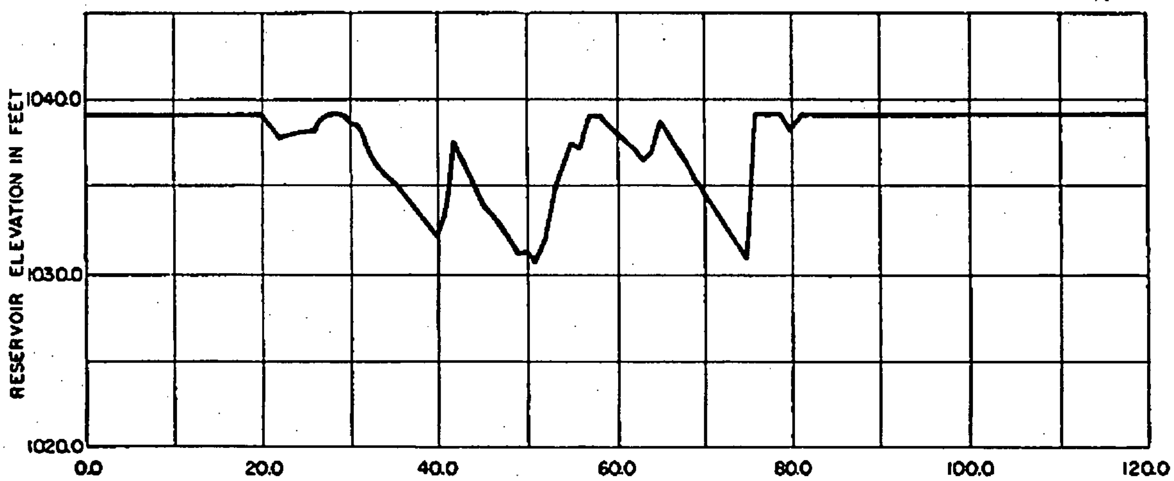

Fig. 5.1. Predicted John Redmond Reservoir water surface elevations with Wolf Creek Generating Station in operation(for the years 1951 through 1960). Source: ER, Fig. 2.5-5a.

Water will be evaporated from Wolf Creek cooling lake at a rate of 35,760 acre-ft/year. The staff estimates that evapotranspiration losses from the area that will be covered by the cooling lake are about 13,390 acre-ft/year. Thus the water losses due to Wolf Creek Generating Station will be 22,370 acre-ft/year. Makeup withdrawal may cause adverse impacts on the biota and water quality of the Neosho River during drought conditions and on the biota of John Redmond Reservoir through entrainment and impingement. Section 5.5.2 addresses these impacts in detail.

Other than the possibility of small reductions in the sport fishery in John Redmond Reservoir, the staff foresees no significant adverse impacts on recreation in the site area. A small area of the east bank of the Neosho River below John Redmond Dam will no longer be available to fishermen and campers because of the location of the makeup facilities.

5.2.2 Groundwater

No groundwater will be used for operation of the WCGS. However, the cooling lake will provide continuous recharge to the rock and soil under and near the site. Groundwater levels will rise. In the case of the Plattsmouth Limestone Member, the applicant calculated a 45.8-ft rise 100 ft from the cooling lake 50 years after filling. Two miles from the site the rise in groundwater would be less than 0.4 ft (ER, Sect. 5.1.7). The calculated times for cooling lake water to move through one mile of Plattsmouth Limestone Member and Jackson Park Shale Member are 6000 years and 1020 years, respectively (ER, Sect. 5.1.7.3). Seepage from the cooling lake may affect groundwater quality. However, due to the slow groundwater movement and water table gradients, the staff concludes that groundwater users outside the site boundary would not be affected.

Table 5.1. Flow rates in the Neosho River immediately downstream of the John Redmond Dam without and with the Wolf Creek generating station

	Flow rates								
	1951	1952	1953	1954	1955	1956	1957	1958	1959
January									
Without WCGS (cfs)	210.1	514.0	68.4	28.0	24.0	25.7	21.0	344.0	310.2
With WCGS (cfs)	90.1	394.0	15.0	28.0	24.0	25.7	21.0	222.3	190.2
Percentage[a]	57	23	78	0	0	0	0	35	39
February									
Without WCGS (cfs)	351.1	347.4	55.0	26.0	15.0	28.0	21.0	519.0	449.7
With WCGS (cfs)	231.1	227.4	15.0	26.0	15.0	28.0	21.0	399.0	312.9
Percentage[a]	34	35	73	0	27	0	0	23	30
March									
Without WCGS (cfs)	571.8	2698	163.8	23.0	27.0	25.8	27.4	3773	418.9
With WCGS (cfs)	451.9	2578	15.0	23.0	27.0	25.8	27.4	3653	298.9
Percentage[a]	21	4	91	0	0	0	0	3	29
April									
Without WCGS (cfs)	1030	3457	100.3	28.0	15.0	15.0	535.1	1545	1025
With WCGS (cfs)	910.6	3337	15.0	28.0	15.0	15.0	138.1	1427	905.1
Percentage[a]	12	3	85	0	0	0	74	8	12
May									
Without WCGS (cfs)	6738	1487	392.0	15.0	15.0	391.0	5343	1273	4027
With WCGS (cfs)	6620	1367	333.5	15.0	15.0	15.0	4964	1153	3908
Percentage[a]	2	8	15	0	0	96	7	2	3
June									
Without WCGS (cfs)	5867	337.7	60.0	311.7	175.1	46.4	2613	1674.6	742.5
With WCGS (cfs)	5757	217.8	44.0	44.0	44.0	46.4	2493	1555	622.5
Percentage[a]	2	36	27	86	75	0	5	7	16
July									
Without WCGS (cfs)	28,270	112.8	56.0	62.8	267.7	41.1	609.8	4117	3452
With WCGS (cfs)	281,150	48.2	56.0	62.8	44.0	41.1	489.8	3998	3332
Percentage[a]	0.4	57	0	0	84	0	20	3	3
August									
Without WCGS (cfs)	2104	153.5	60.0	65.1	67.7	55.0	178.3	715.9	473.3
With WCGS (cfs)	1984	79.7	60.0	65.1	55.0	55.0	65.0	596.6	353.4
Percentage[a]	6	48	0	0	19	0	64	17	25
September									
Without WCGS (cfs)	6465	24.0	40.1	36.3	313.5	36.0	274.8	1301	392.7
With WCGS (cfs)	6345	24.0	40.1	36.3	15.0	36.0	154.8	1192	272.7
Percentage[a]	2	0	0	0	95	0	44	8	31
October									
Without WCGS (cfs)	1282	24.0	26.5	30.2	279.8	24.0	572.1	525.0	2689
With WCGS (cfs)	1162	24.0	26.5	30.2	193.4	24.0	452.1	405.0	2569
Percentage[a]	9	0	0	0	31	0	21	23	4
November									
Without WCGS (cfs)	913.1	15.0	25.3	21.7	24.5	21 0	730.4	563.0	425.8
With WCGS (cfs)	793.1	15.0	25.3	21.7	24.5	21.0	620.4	443.0	305.8
Percentage[a]	13	0	0	0	0	0	16	21	28
December									
Without WCGS (cfs)	513.0	56.9	27.0	21.5	23.7	21.0	278.6	172.5	472.4
With WCGS (cfs)	393.0	15.0	27.0	21.5	23.7	21.0	158.6	86.1	352.4
Percentage[a]	23	74	0	0	0	0	43	50	25

[a]Percentage figures are reductions in flow due to plant operation.

Ground-Water Levels in Kansas

A Briefing to the Kansas Legislature

House Agriculture and Natural Resources Committee

January 17, 2007

Presented By

Brownie Wilson
The Kansas Geological Survey
The University of Kansas

KU KANSAS GEOLOGICAL SURVEY
The University of Kansas

KGS OFR 2007-1

58

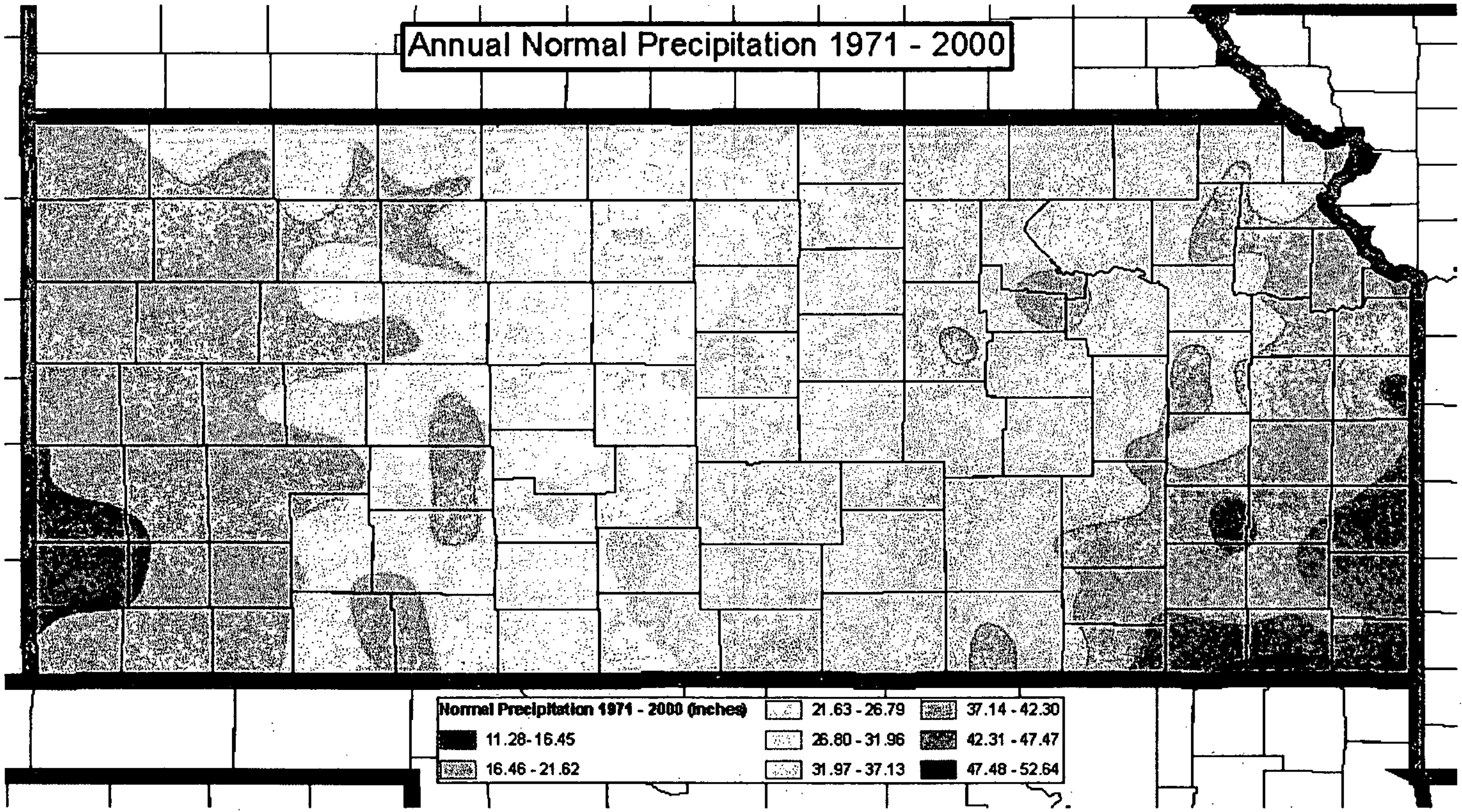

Figure 1 – Annual Normal Precipitation in Kansas (Source: KSU Weather Library). Normal precipitation is defined as the average total precipitation over the last 30 year decal period, in this case, 1971 to 2000. Precipitation patterns in Kansas have major influences on the landscape, water resources, and uses made of water in the state.

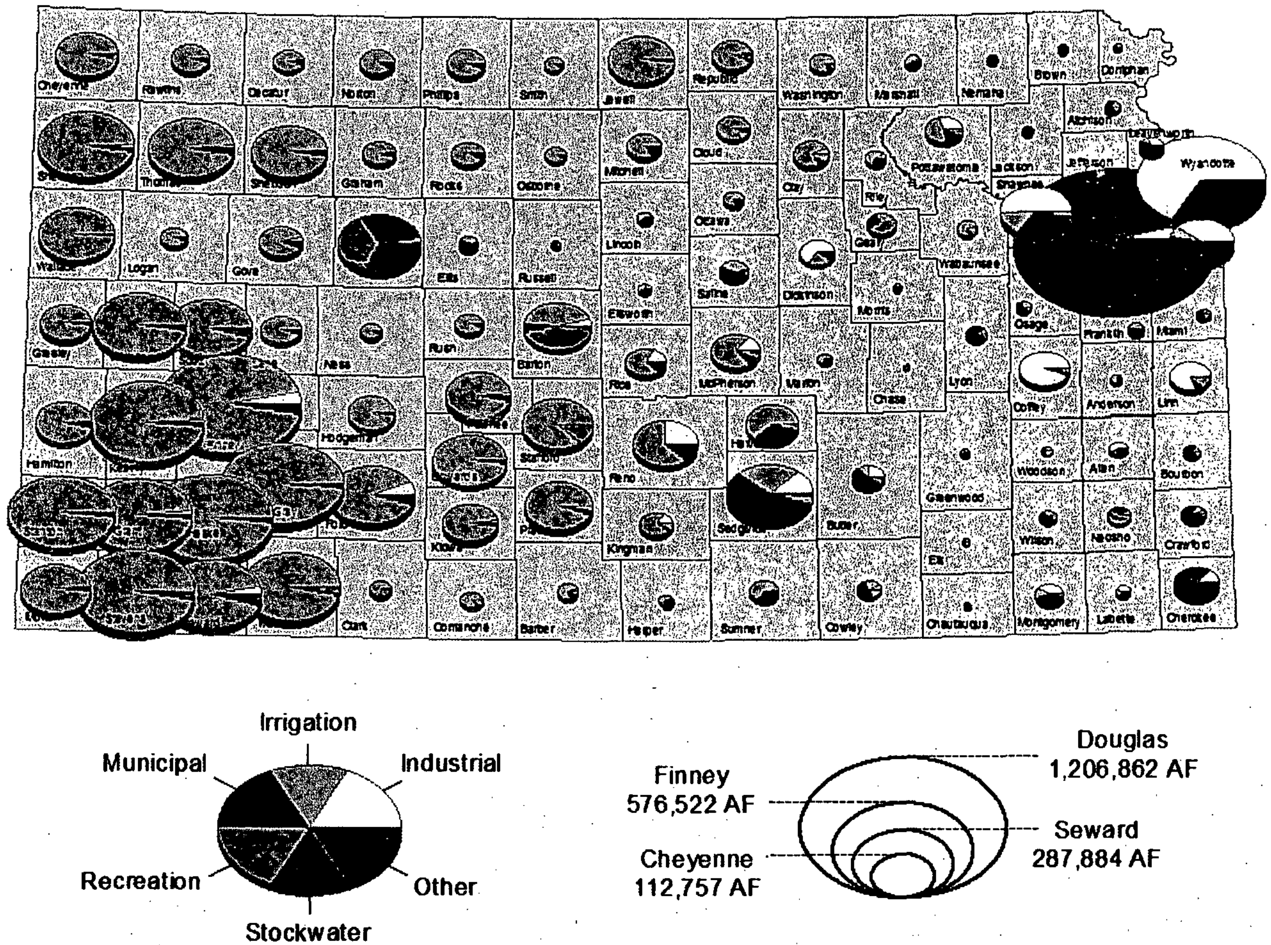

Figure 2 – Total Authorized Water Right Allocations, by County. Water right allocations represent how much water and for what purpose can be diverted each year. In general, municipal and industrial uses are more prevalent in eastern and south-central Kansas while irrigation dominates in western Kansas. Much as this is influenced by the precipitation patterns and available water sources.

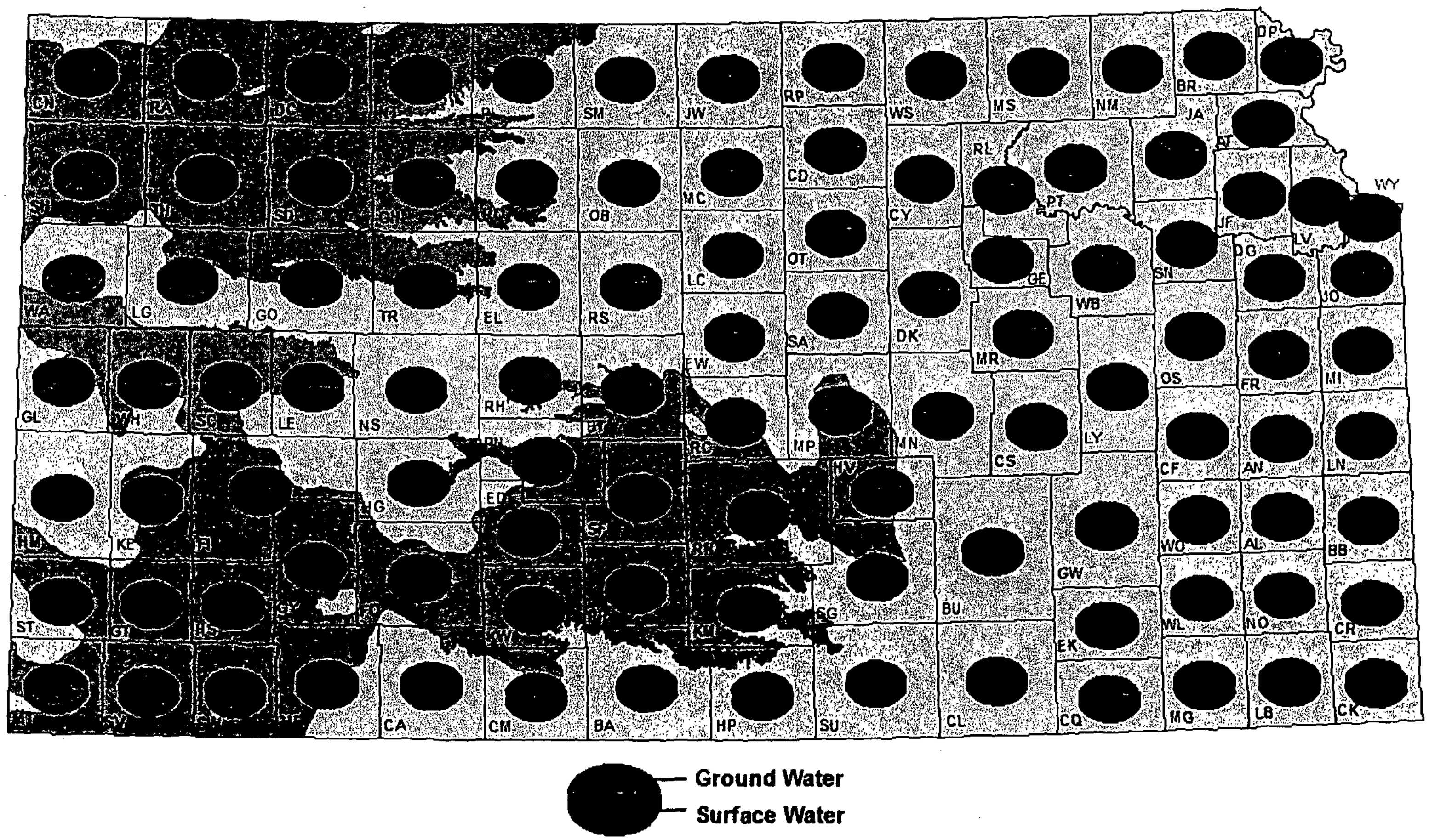

Figure 3 - Proportion of Allocations by Water Source and County. In general, surface water is the primary source in eastern Kansas (red) and with ground water in western Kansas (blue). The gray shaded area in western and south-central Kansas is the primary saturated extent of the High Plains (HP) aquifer. The HP aquifer is the primary water source for virtually all uses in this area.

59. Regarding water use conflicts at Wolf Creek, although the ER Section 4.1 indicates no surface water use conflicts, our Generic Environmental Impact Statement (GEIS) for license renewal says (section 4.4.2.1, p. 4-52): "Two nuclear power plants, the Braidwood Station and Wolf Creek Generating Station, have already experienced wateruse conflicts." Furthermore, the GEIS on p. 4-53 (left column, first full para) uses WCGS as an example of potential water use conflicts. Water use conflicts at Wolf Creek are also cited in section 4.4.3, p. 4-57, left column. Although there seems to be a discrepancy, perhaps all water use conflicts have been solved. If so, Wolf Creek should provide this information.

• Historical information on how the water withdrawal controls have been implemented in the past. If there have never been any incidents where low water levels in the reservoir or low flow in the river have resulted in water withdrawal restrictions, then state this. If there have been incidents where the rights of any user (WCGS or any other user) have been restricted, provide information on the cause of the incident, length of duration, restrictions placed on which users, and any other relevant information.

• Please provide actual historical data on water withdrawal volumes from the Neosho River.

• Groundwater levels were predicted to rise 45.8 feet within 100 feet of the site 50 years after the filling of CCL. The height of the ground water table was predicted to rise 0.4 feet, 2 miles from the site after the lake was filled. Please provide the elevation of the water table before the lake was filled and the current water table elevation.

• The groundwater flow direction was noted to be generally SW from WCGS to the Neosho River. Are there any localized groundwater flow directions to Wolf Creek (below CCL)?

• Regarding water use conflicts at Wolf Creek, although the ER Section 4.1 indicates no surface water use conflicts, our Generic Environmental Impact Statement (GEIS) for license renewal says (section 4.4.2.1, p. 4-52): "Two nuclear power plants, the Braidwood Station and Wolf Creek Generating Station, have already experienced wateruse conflicts." Furthermore, the GEIS on p. 4-53 (left column, first full para) uses WCGS as an example of potential water use conflicts. Water use conflicts at Wolf Creek are also cited in section 4.4.3, p. 4-57, left column. Although there seems to be a discrepancy, perhaps all water use conflicts have been solved. If so, Wolf Creek should provide this information.

• An assessment of the impact of population increases attributable to the proposed project on the public water supply, as per 10 CFR 51.53(c)(3)(ii)(I).

Aquatic Ecology

Audit Needs request #114

> "Regarding water use conflicts at Wolf Creek, although the ER Section 4.1 indicates no surface water use conflicts, our GEIS for license renewal says (section 4.4.2.1, page 4-52): "Two nuclear power plants, the Braidwood Station and Wolf Creek Generating Station, have already experienced water-use conflicts." Furthermore, the GEIS on p. 4-53) left column, first full para) uses Wolf Creek Generating Station as an example of water use conflicts. Water use conflicts at Wolf Creek are also cited in section 4.4.3, p. 4-57, left column. Although there seems to be a discrepancy, perhaps all water use conflicts have been solved. If so, Wolf Creek should provide this information."

The "water-use conflict" referenced from the Generic Environmental Impact Statement (GEIS, NUREG-1437) for WCGS is in regard to potential impacts to the Neosho River that may be caused by makeup water withdrawals during a severe and prolonged drought. Effect of reduced flows on the river's fishery, including the threatened Neosho madtom, was a concern. As identified in the attached correspondence (WCNOC 1990), the Final Environmental Statement-Operating License Stage (FES-OLS, NUREG 0878) expected that water withdrawal by WCGS during severe drought condition would reduce reservoir storage and downstream river flows, potentially prolonging or exacerbating a drought's impact on the river's fisheries. Such river water use conflicts have not occurred to date ~~(see Audit Needs Request # 110).~~

As stated in the ER (Operating License Renewal Stage) section 4.1, the State of Kansas can limit withdrawal rates and volumes to ensure water flows in the Neosho River, thus providing local regulatory oversight during drought conditions. In addition, the withdrawal rates modeled and used for the FES-OLS evaluations were greater than actual make-up pumping capabilities experienced. These operational and procedural limitations on makeup water are detailed in "An Assessment of the Potential Impacts on the Flow of the Neosho River Related to the Operating License Renewal for Wolf Creek Generating Station, Unit No. 1", which is attached.

In summary, the water use conflicts identified in the GEIS have not occurred, but are considered as potential impacts. State of Kansas water use contract and appropriation criteria are in place to minimize impacts to the river. And finally, actual makeup water diversion procedures reduce diversion rates to less than used for initial environmental impact assessment.

Literature Cited:

WCNOC. 1990. Response to Oak Ridge National Laboratory Relicensing Survey, ET 90-0106. Letter from F. T. Rhodes, WCNOC, to H. L. Spiker KDHE. Dated 6/25/1990.

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Forrest T. Rhodes
Vice President
Engineering & Technical Services

June 25, 1990

ET 90-0106

Harold L. Spiker
Bureau of Environmental Health Services
Kansas Department of Health and Environment
Forbes Field
Topeka, KS 66620

Reference: Letter dated June 4, 1990 from H. L. Spiker (KDHE) to B. S. Loveless (WCNOC)
Subject: Wolf Creek Nuclear Operating Corporation's Response to the Oak Ridge National Laboratory Relicensing Survey

Dear Mr. Spiker:

Attached are the responses you requested (see reference) from Mr. Brad Loveless (WCNOC) to aid you in completing the Oak Ridge National Laboratory relicensing survey. Each item on the list of potential or known impacts to fish and wildlife resources was addressed as it pertains to the operation of Wolf Creek Generating Station. All pertinent items on the list were reviewed during licensing of this plant and we have no operational data to indicate significant impacts beyond those considered in the Operating License Stage Final Environmental Statement for our period of operation thus far, nor for beyond the currently licensed time frame.

If you have any question on these responses, please contact Brad Loveless at (316)364-4168.

Very truly yours,

Forrest T. Rhodes
Vice President
Engineering & Technical Services

FTR/jra

LIST OF IMPORTANT FISH AND WILDLIFE RESOURCES AND POTENTIAL OR KNOWN IMPACTS IN THE VICINITY OF WOLF CREEK GENERATING STATION

1) **Important sport and commercial fisheries and level of harvest**

At this time, the cooling lake at Wolf Creek Generating Station (WCGS) is not open for sport or commercial fishing. The Neosho River, from which WCGS pumps cooling lake makeup water, is considered an important sport fishery. During normal hydrologic conditions, WCGS is not expected to impact the river's fishery. During a severe and prolonged drought WCGS water withdrawal could result in reduced flows in the Neosho River. Water storage in John Redmond Reservoir, which regulates flow in the river, could also be reduced from WCGS makeup pumping. Thus, the Final Environmental Statement-Operating License Stage (FES-OLS) expected that water withdrawal by WCGS during severe drought conditions will reduce reservoir storage and downstream river flows, potentially prolonging or exacerbating a drought's impact on the river's fisheries. However, long term impacts on the sport fish populations in the river are not probable as popular species (i.e. channel catfish and flathead catfish) are expected to repopulate relatively quickly after normal flows return.

2) Important spawning, nursery, or other habitats for aquatic fauna

The spawning, nursery, or other habitats for aquatic fauna in the cooling lake are not expected to be significantly impacted by WCGS operations. As pointed out above and in the FES-OLS, little or no Neosho River flows during severe drought will stress riffle obligate species. Cooling lake makeup water pumping could prolong this effect.

3) Impacts of entrainment, impingement, or thermal and chemical releases on aquatic biota

Potential entrainment and impingement impacts of the WCGS' cooling system were evaluated as acceptable in plant licensing documents. As a result, no specific monitoring in these areas has taken place.

As expected, thermal discharge has greatly influenced the immediate cooling water discharge area of the cooling lake. Mobile species, primarily fish, avoid this area during summer lake conditions. During winter conditions, these species are attracted to the area and could experience thermal shock in the event of a rapid plant shutdown. Fish kills from such occurrences were expected and have occurred infrequently since plant operations began. These fish kills were evaluated and were within the limits reviewed in the licensing documents and none significantly impacted the cooling lake fishery.

Impact potential from chemical discharges to the lake is primarily from the use of chlorine. It is used to prevent biofouling in the plant's cooling system. The FES-OLS concluded that appreciable mortality among chlorine-sensitive species of aquatic biota could occur in the immediate vicinity of the discharge outlet to the lake.

However, it was also determined that these potential impacts would not meaningfully affect the overall biological productivity of the cooling lake. No adverse chlorine impacts have been observed to date. This and other chemical releases are regulated by the plant's NPDES permit and no environmental impacts are expected.

Entrainment and impingement impact potential to the aquatic biota of the Neosho River exists during makeup water pumping activities. Entrainment loss was evaluated in the FES-OLS and was not considered a significant impact. Impingement rates were monitored during the lake filling stage and impacts to the Neosho River fishery as a whole were not significant.

Thermal and chemical releases from WCGS to the Neosho River would be from discharges from the cooling lake. Cooling lake releases are subject to specifications of the plant's NPDES permit which is designed to protect the biota of the river.

4) Adverse effects of water withdrawals or discharges on water quality and water use

No potential adverse effects due to water withdrawals from or discharges to the Neosho River are known other than those discussed above. For the cooling lake, intake and discharge for cooling purposes will add corrosion products and water treatment chemicals. Water treatment additions are regulated within the scope of the station's NPDES permit. Corrosion products may tend to be concentrated in the lake due to forced evaporation. In the FES-OLS it was concluded that corrosion products attributable to WCGS operation, however, are not expected to adversely affect aquatic biota, even during periods of prolonged drought which would tend to concentrate these parameters to higher than normal levels.

5) Other sources of impacts (e.g. other power plants, industrial discharges, agricultural runoff) that could contribute to cumulative impacts to aquatic resources

There are no other sources of impacts to the fish and wildlife resources of the cooling lake known at this time. Municipal and industrial water withdrawal, discharge, stormwater runoff, and mainstem dams likely contribute to cumulative impacts to the aquatic resources of the Neosho River.

6) Construction impacts

No specific construction activities at WCGS are expected to occur as a result of relicensing that would potentially affect the environment.

7) Aquatic or terrestrial flora and fauna that are listed as threatened or endangered

There are no threatened or endangered populations of aquatic flora or fauna known to exist in the cooling lake. No threatened or endangered terrestrial plants are known occur in WCGS controlled property. Terrestrial threatened or endangered species on the federal list that have been observed around WCGS include the bald eagle, peregrine falcon, and the interior least tern. An additional species on the Kansas list that has been observed in the vicinity is the white-faced ibis. Bald eagles use the cooling lake as a winter feeding and roosting site. The greatest potential for impact to these eagles is from transmission line collision mortality. The frequency of these events were expected to be low and monitoring has detected no collisions thus far. The remaining threatened or endangered species are occasional or rare migrants through the area and continued station operation is not expected to impact them.

Along the Neosho River, there are no threatened or endangered plant or terrestrial animal species which WCGS operations may impact. However, the Neosho madtom is a threatened fish species which WCGS may potentially impact. As discussed above, pumping activities for cooling lake makeup could prolong severe drought conditions in the riffle habitats of the river downstream of John Redmond Reservoir. The Neosho madtom depends on riffles and the loss of these habitats for a period of time would likely impact this species.

8) Salt drift and icing impacts on vegetation as a result of cooling towers or cooling ponds

   There are no cooling towers at WCGS. Limited icing does occur in the immediate vicinity of the cooling system discharge to the cooling lake, however, it is infrequent and short-lived. No impact to the vegetation occurs.

9) Bird mortality due to collision with power lines and natural draft cooling towers

   Transmission line collision mortality was discussed in the FES-OLS and the need to determine the significance of this to bird populations using the cooling lake was identified in the Environmental Protection Plan (Appendix B to the Facility Operating License). Monitoring of collision events revealed that these do occur, but at a low frequency. No difference was detected between collision rates before and after WCGS began operations. No specimen found was a threatened or endangered species. Given similar usage of the cooling lake by migrating or wintering waterfowl in the future, transmission line collision mortality is not expected to be significant.

10) Impacts on fauna as a result of vegetation cutting and herbicides in power-line corridors

   Transmission line corridors associated with WCGS are easements purchased from affected landowners. Except where the towers or poles are located, land use in the easements is not altered by the power-lines. Little or no vegetation is cut or sprayed in these areas beyond that normally associated with rangeland and cropland practices common to the region. Where the lines cross wooded streams, the right-of-ways are sprayed where cutting is impractical. Because of the small acreage of these required clearings, no significant impacts from transmission line maintenance are expected.

11) Rare plant communities

There are no rare plant communities in the vicinity of WCGS that are threatened by continued plant operations.

12) Bird colonies

There are no breeding colonies of birds in the vicinity of WCGS that may be impacted by continued plant operations.

13) Bird roosts (e.g. raptors)

There are no bird roosts in the vicinity of WCGS vital to the survival of bird species in the region. Raptors, bald eagles, and waterbirds such as double-crested cormorants do take advantage of flooded trees in the cooling lake as roost sites, however these are not considered critical. Continued plant operations is not expected to alter this.

14) Waterfowl staging area

The WCGS cooling lake provides late winter habitat for migrating or wintering waterfowl. The lake serves as a refuge site and enhances other waterfowl habitats available at John Redmond and other local federal reservoirs. The cooling lake is not, however, considered a major waterfowl staging area and station operation is not expected to impact this.

15) Wetlands

There are no potential wetland areas other than the cooling lake that continued WCGS operation has the potential to impact.

16) Breeding/strutting/wintering grounds for big game or certain gallinaceous birds

There are no major big game breeding or wintering grounds in the vicinity of WCGS. Booming grounds or leks of the greater prairie chicken are present on lands controlled by WCGS. These lek sites are not scarce in this region of Kansas and continued operation of WCGS is not expected to impact local sites.

State of Kansas
Mike Hayden, Governor

Department of Health and Environment
Division of Health

Stanley C. Grant, Ph.D., Secretary
Landon State Office Bldg., Topeka, KS 66612-1290
(913) 296-1343
FAX (913) 296-6231

90-01135

June 4, 1990

BRAD LOVELESS
SUPERVISOR
ENVIRONMENTAL MANAGEMENT
WOLF CREEK NUCLEAR OPERATING CORPORATION
PO BOX 411
BURLINGTON KS 66839

Dear Brad:

As per our recent telephone conversation, please find enclosed a copy of a request from Oak Ridge National Laboratory (ORNL) for information regarding environmental impacts resulting from the continued operation of the Wolf Creek Generating Station.

For the most part, our radiological environmental monitoring program at Wolf Creek Generating Station does not assess the kinds of impacts that ORNL is requesting information on. I am therefore asking for your assistance in addressing those impacts listed for which you have information. Some of them are obviously not applicable. Any information you have on these impacts as they relate to Wolf Creek Generating Station would be greatly appreciated. It appears that references to the pre-licensing EIS would be appropriate for a number of the impacts listed.

ORAU is requesting that the information be provided to them by June 30, 1990. I will need any information that you may have by June 25, 1990 in order to prepare an appropriate reply.

If you have any questions or need additional clarification, please do not hesitate to contact me at 913/296-1561.

Sincerely,

Harold L. Spiker

Harold L. Spiker
Public Health Physicist
Bureau of Environmental Health Services
Radiation Control Program

HLS/psw

Enclosure

FOX -
Jim wants you to
coordinate with
Gerald Snyder.
Thanx
Cf...

OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

May 7, 1990

Stanley C. Grant, Secretary
State Department of Health and Environment
Land and State Office Building
900 SW Jackson, Rm 901
Topeka, KS 66612-1290

5/10
C → HLS

Dear Mr. Grant:

Oak Ridge National Laboratory is developing a report for the U.S. Nuclear Regulatory Commission that will evaluate environmental impacts of relicensing of nuclear power plants. Information on 118 reactors at 74 sites in the U.S. is being gathered to evaluate potential impacts from relicensing and an additional 20 or more year relicense period (beginning 40 years after original license).

The results of this study will be used to modify 10 CFR 51 "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." These modifications may result in some issues no longer being considered for nuclear plants in NEPA evaluations at their time of relicensing. Therefore, it is important that we obtain information from your office to help in evaluating any impacts of nuclear plants in your state with regard to fish and wildlife resources.

We would appreciate any information you may have on existing impacts and on the presence of important fish and wildlife resources that may be affected by continued operation of the Wolf Creek Generating Station and its power lines. For your convenience, a list of such resources and potential impacts is attached.

We would like to have your response by June 30, so that we can use the information in preparing the draft report. Thank you for your assistance.

Sincerely,

Glenn Cada

Glenn F. Cada
Aquatic Ecologist
Bldg. 1505, MS-6036
Phone: 615/574-7320

R. Kroodsma

Roger L. Kroodsma
Terrestrial Ecologist
Bldg. 1505, M.S. 6038
Phone: 615/574-7310

RECEIVED
MAY 10 1990
DIRECTOR OF ENVIRONMENT
DEPARTMENT OF HEALTH & ENVIRONMENT

cc: J. A. Power

LIST OF IMPORTANT FISH AND WILDLIFE RESOURCES AND POTENTIAL OR KNOWN IMPACTS

-- important sport and commercial fisheries and level of harvest

-- important spawning, nursery, or other habitats for aquatic fauna

-- impacts of entrainment, impingement, or thermal and chemical releases on aquatic biota

-- adverse effects of water withdrawals or discharges on water quality and water use

-- other sources of impacts (e.g., other power plants, industrial discharges, agricultural runoff) that could contribute to cumulative impacts to aquatic resources

-- construction impacts (construction for relicensing is expected to be relatively minor and entirely contained within existing site boundaries)

-- aquatic or terrestrial flora and fauna that are listed as threatened or endangered

-- salt drift and icing impacts on vegetation as a result of cooling towers or cooling ponds

-- bird mortality due to collision with power lines and natural draft cooling towers

-- impacts on fauna as a result of vegetation cutting and herbicides in power-line corridors

-- rare plant communities

-- bird colonies

-- bird roosts (e.g., raptors)

-- waterfowl staging areas

-- wetlands

-- breeding/strutting/wintering grounds for big game or certain gallinaceous birds

An Assessment of the Potential Impacts on the Flow of the Neosho River

Related to the Operating License Renewal for Wolf Creek Generating Station, Unit No. 1

INTRODUCTION

This is an assessment demonstrating that potential water use impacts to the Neosho River during the license renewal period of Wolf Creek Generating Station (WCGS) operation will be no greater than or less than identified during original licensing evaluations. This assessment is in support of discussion presented in the Environmental Report – Operating License Renewal Stage (ER-OLRS, Section 4.1). Considered during this assessment are conclusions presented during original licensing, available literature and research since original licensing, water withdrawal permits from the State of Kansas, and operational experience since WCGS operation began.

Description of the Neosho River Basin

The instream biota within the Neosho River has been described and is characterized in the ER-OLRS, Section 2.2. Most of the riparian habitat along the Neosho River and its tributaries can be described as riparian woodland. Detailed descriptions of the upstream and downstream riparian habitat, and the wildlife present in the area are available in United States Army Corp of Engineers (USACE 2002), Section 3.4. These habitats represent long-term climax vegetation types, and are not expected to change appreciably during the license renewal period.

CONSUMPTIVE WATER USE IMPACTS

Consumptive water use resulting from license renewal is not expected to change appreciably from that evaluated in Final Environmental Statement related to the operation of WCGS (Nuclear Regulatory Commission, NRC 1982). Basically, water stored in the Coffey County Lake (CCL, sometimes referred to as Wolf Creek Cooling Lake) will be subject to evaporation losses, both natural and forced (NRC 1982, Section 5.3). This water will be a loss from the Neosho River system. Total volume of makeup diversion to CCL will be somewhat less, based on the assessment below. As stated in the ER-OLRS (Section 3.4), license renewal at WCGS will not necessitate a large increase in work force, thus indirect demands on the Neosho River system from increased domestic water needs, and any resulting adverse impacts to aquatic and riparian organisms, will not occur.

MAKEUP DIVERSION IMPACTS

The NRC concluded that withdrawal of water for makeup of Coffey County Lake (would not cause unacceptable effects on Neosho River biota under normal hydrological conditions (NRC 1982). However, under severe drought conditions, river flow reductions were predicted in effect to extend the duration and severity of low flow conditions, and thus stress aquatic communities of the Neosho River.

To understand makeup withdrawal during normal hydrological conditions, a review of surface water use at WCGS in necessary. The CCL is a 5090-acre lake formed by a dam across Wolf Creek, an intermittent stream. Natural runoff from the Wolf Creek watershed, and direct precipitation on the CCL is not typically sufficient to maintain the lake at its normal operating level of 1087 feet mean sea level (msl, NRC 1982). Consequently, rights to makeup water have been obtained from the natural flows of the Neosho River, and water stored in the conservation pool of nearby John Redmond Reservoir (JRR). This makeup water is transferred via a pumping station (Makeup Water Screen House, MUSH) located on the east bank of the Neosho River immediately downstream of the JRR dam. This water is pumped through underground piping and discharged to CCL approximately 2.5 miles east of the MUSH. Water to be pumped from the conservation storage in JRR is released to the Neosho River through the JRR dam as detailed in the ER-OLRS, Section 4.1.

The State of Kansas regulates the surface water use at WCGS. To summarize, WCGS has been authorized by the State to obtain makeup water via two primary methods. These include water appropriations and a contract for stored water in JRR.

Appropriation Water

Appropriation refers to the use of natural water flows for beneficial use permitted by the Kansas Department of Agriculture, Division of Water Resources (DWR), as provided for in Kansas Statutes Annotated (KSA) 82a-703. At WCGS, three such appropriations apply to CCL water. These are:

1. Water appropriation (file number 20,275) for all natural flows of Wolf Creek upstream of the CCL dam, (State of Kansas 1977a)

2. Water appropriation (file number 14,626) for withdrawal via MUSH of natural flows in the Neosho River at a diversion rate of $\leq$ 55 cubic feet per second (cfs) and a quantity $\leq$ 25,000 acre-feet per calendar year (State of Kansas 1977b).

3. Water appropriation (file number 19,882) for withdrawal via MUSH of natural flows in the Neosho River at a diversion rate of $\leq$ 170 cubic feet per second (cfs) and a quantity $\leq$ 57,300 acre-feet per calendar year (State of Kansas 1977c).

Wolf Creek Flow Appropriation

Impoundment of the natural flows of Wolf Creek, which is a tributary of the Neosho River, is not expected to have measurable impacts to the stream related habitat and riparian ecological communities of Neosho River. This is due to the creek's small flow contribution to the river. Using the estimated average monthly stream flow (NRC 1982, Table 4.3). The total annual flow for Wolf Creek is approximately 12,985 acre-feet, or 18 cfs. The average annual flow of the Neosho River at Burlington (USGS Station 07182510, 1963 –2004 annual mean), upstream of Wolf Creek, was 1603 cfs, and at Iola (USGS Station 0718300, 1899-2004 annual mean) was 1865 cfs (Putnam and Schneider 2005). Using these estimates, annual flows of Wolf Creek represents 1.1 and 1.0 percent of the Neosho River flows at Burlington and Iola, respectively. Actual percentage of flows would be less than these estimates because only the flows upstream of the CCL dam are impounded, and all flows above elevation 1088 feet msl will pass over the CCL spillway and flow to the Neosho River. Precipitation inputs to Wolf Creek below the CCL dam will not be impacted.

Neosho River Appropriations

The remaining two appropriations for water are for natural flows in the Neosho River, diverted via MUSH. Makeup water diverted under the conditions in these appropriations are not expected to cause adverse impacts the instream and riparian ecological communities because of the flow requirements stated within them (State of Kansas 1977b and 1977c). As stated previously, both have maximum diversion rates and annual quantity limits. However, the primary reason that will ensure that makeup withdrawals under these appropriations will not cause adverse impacts are the minimum flows required before diversion is allowed. Both require that withdrawals of natural flows shall be made only at such times and under such conditions that a minimum flow of at least 250 cfs remains in the Neosho River immediately downstream from the intake structure. In practice, makeup withdrawals using these appropriation are only used when greater than 250 cfs, plus the withdrawal volume, as metered at the MUSH, is being discharged from the JRR dam. Due to physical operational limitations, minimum flow typically needs to be 320 cfs or 370 cfs, depending on MUSH pumping status. These conditions are typically during normal or above normal hydrological conditions in the river. The NRC concluded that withdrawal of water for makeup would not cause unacceptable effects on the Neosho River biota under such conditions (NRC 1982).

Minimum desirable stream flows are maintained by the State of Kansas "for instream uses relative to fish, wildlife, water quality, general aesthetics and downstream domestic and senior water rights" (State of Kansas 2006). The minimum desirable steam flow for the Neosho River, as measured at Iola, downstream of the makeup diversion, has been specified by Kansas legislative action as 40 cfs during all months, with 60 cfs in April, and 200 cfs in May and June maintained as spawning flows to be managed if reservoirs (ie JRR) are in flood pool (KSA 82a-703c). Thus, the minimum of 250 cfs immediately downstream of the MUSH required before use of the allocated river water will ensure that flows will support the instream and riparian habitats along the Neosho River.

There are provisions in Neosho River water appropriations where WCGS can request of the Chief Engineer of the DWR to allow withdrawal during times when flows at the makeup diversion point are less than 250 cfs. Only flows not needed to satisfy vested rights, prior appropriations, and prior applications for permits to appropriate water for beneficial use may be requested. The Chief Engineer may permit such withdrawal to the extent that is found to be in the public interest. However, the Chief Engineer shall withhold from appropriation that amount of water deemed necessary to establish and maintain the desired minimum stream flow (KSA 82a-703a). Thus, such requests for makeup withdrawal will not include flows necessary to maintain a minimum of 40 cfs (greater during fish spawning season if available) at Iola. With these considerations, makeup withdrawals using appropriated water will not cause adverse impacts to the Neosho River instream and riparian habitats.

Contract for Stored Water

In addition to the appropriated natural flows of the Neosho River, a portion of the water stored in the conservation pool of JRR has been contracted for with the Kansas Water Resources Board (State of Kansas 1976), now called the Kansas Water Authority. Basically, this stored contract water can only be accessed for CCL makeup purposes when JRR is at or below its conservation pool level of 1039 feet msl. At this level, downstream flows are less than 250 cfs criteria used to divert appropriated water, indicating that the Neosho River system would either be in a low flow period, or drought condition. A greater detailed review of this contract is provided in the ER-OLRS, Section 4.1, and in the Final Environmental Statement related to the Operation of WCGS, Section 4.3.1.1 (NRC 1982).

Impact Baseline

The NRC determined that during a severe and prolonged drought, the withdrawal of the stored contract water at 41 cfs, will cause a marked drawdown of water levels within the reservoir and reduced flows in the river would occur. Such conditions would stress aquatic communities, including fish populations (NRC 1982, Section 5.5.2.1). These conclusions were based on hydrologic modeling and makeup diversion during CCL lake operations that were expected during the initial operating license process for WCGS (Sargent and Lundy Engineers 1974; NRC 1975, 1976, and 1982).

Unavailable during environmental impact assessment was actual operational conditions of CCL, and makeup diversion procedural limitations. These considerations will demonstrate that impacts will be less than those forecasted. Consequently, WCGS makeup withdrawal impacts to the Neosho River, and by extension, to the riparian areas of its watershed during the license renewal period will not be likely.

The predicted impacts involve comparing Neosho River stream flows with and without expected makeup withdrawals (NRC 1975, Section 5.2.1, and NRC 1976). The analysis used meteorological conditions present for the period from January 1951 through December 1959. During this period occurred a record drought having a two percent chance of occurrence in any given year, or a one in 50 year drought. Among other factors, the projections accounted for CCL blowdown for water quality management, and sufficient makeup to replace this blowdown.

The results of the NRC (1975) analysis were summarized in Table 5.1, and as amended slightly in NRC (1976) Attachment M. These tables clearly indicate decreased Neosho River flows and modeled JRR capacity from July 1952 through April 1957, the analyzed drought period. Attachment M (NRC 1976) indicated this analysis was for makeup for two reactor units at WCGS. Only one unit is present at WCGS, and only impacts from this unit, which will be correspondingly less, are being addressed in this assessment.

The NRC analysis (NRC 1975, 1976) states that there would be no change in the down-river flow during the worst part of the drought because the JRR water surface would have been below the conservation level. The JRR conservation pool is stored between elevation 1020 and 1039 feet msl (U. S. Army Corp of Engineers, USACE, 2002), so presumably this would mean that JRR would be below 1020 feet msl. The conservation pool is where the water contracted from the KWRB is stored. During such conditions, water is released downstream only for the previous water rights and for water quality purposes, which are the same with or without WCGS. This circumstance would have occurred during 42 of the 58 months included in the drought analysis, and are identified in Table 1 attached.

The NRC (1976) analysis concluded that 15 of the 58 drought months in which downstream river flow would be reduced because of WCGS. As shown in Table 1, percent flow diverted was large during some months, with the highest being 95 percent during September 1955. It was also shown that downstream flows would be maintained throughout such drought conditions, thus long term instream and riparian habitats should not be adversely impacted. However, during drought-induced low flows, makeup withdrawal could in effect extend the duration and severity of low flow conditions, and thus may stress aquatic communities. The NRC (1976) concluded that such impacts would be acceptable.

License Renewal Period Impacts

Using the baseline conditions for considering impacts, makeup diversion during the license renewal period is expected to have less potential for harmful impacts to occur to the instream and riparian habitats of the Neosho River. This is based on the following:

(1) State of Kansas administration of water purchase contract (State of Kansas 1976) effectively limits diversion of stored water to a maximum of 70 cfs.

(2) Operations controls limits the maximum MUSH diversion rate to 120 cfs.

(3) The reduction in need for CCL blowdown, and subsequent makeup diversion to maintain water chemistry.

Purchase Contract Limiting Factors

The water purchase contract for water stored in JRR allows a maximum flow rate of 120 cfs, which in reality is two operating MUSH pumps. The maximum design flow of the bypass pipe through which the contract storage water is obtained is approximately 130 cfs (USACE 1996). However, the actural metered flow capacity through the bypass pipe has been approximately 95 cfs. When JRR is not discharging through its spillway, the only method for obtaining the stored water is through the bypass pipe supplying water to the MUSH. In practice, administration of the purchase contract prevents diverting stored makeup via the MUSH at rates greater than can be obtained through the bypass pipe (approximately 95 cfs). By default, this limits MUSH diversion pumping to one pump only, or 70 cfs.

Some of the largest portions of Neosho River flows predicted to be diverted by makeup pumping included times when only stored contract water could have been accessed (Table 1). Considering 40 cfs minimum desirable streamflow at Iola downstream of the diversion point required 40 cfs from JRR, and 70 cfs minimum capability for makeup diversion, 110 cfs would be needed to provide for makeup diversion using the contract conditions. Eleven of 58 evaluated drought months had such flows. Applying 70 cfs as a monthly diversion average to the predicted flows in Table 1 would change the range of percent diverted from 110 to 95 (predicted) to a range of percent diverted from 14 to 62 percent. In addition, essentially those months when the average Neosho River flow was predicted to be less than 110 cfs (Table 1), contract and allocation permitting likely would not have allowed makeup water to be pumped.

Consequently, during low flow or drought conditions, actual access to the stored water would be lower than originally predicted. This would tend to decrease the drawdown rate of JRR during such conditions. In addition, partial recharge of the JRR conservation pool during the assessed drought could not be diverted as quickly as originally modeled, further decreasing the duration and severity of makeup diversion impacts to JRR and the Neosho River.

Design Limiting Factors

At the MUSH, there are three makeup pumps rated at approximately 60 cfs individually, but due to friction losses, design net total flow ranges from approximately 60 cfs with one pump operating to 120 cfs with three pumps operating (WCGS 2002, Section 3.1.1). In addition, the design flow for the makeup water piping is 120 cfs (Sargent & Lundy Engineers, 1979, Section 3.4.1). By design, the maximum diversion rate is limited to 120 cfs.

Actual operating experience using flow data metered during makeup diversion indicates that one pump will divert up to approximately 70 cfs, and two pumps up to approximately 120 cfs. With the design makeup piping rated at 120 cfs, operating three pumps simultaneously is not likely due to economic and efficiency considerations. This effectively limits the maximum diversion rate to 120 cfs. Since, as has been established, the maximum rate of diversion of contracted storage water is 70 cfs, two pump operation (120 cfs) will only be possible using water allowed for in the appropriations (State of Kansas 1977b and 1977c). Consequently, a minimum of 370 cfs discharging from the JRR dam would be necessary to provide for the required 250 cfs downstream plus the 120 cfs diversion rate. During the evaluated 50-year drought, such flows existed only two of 58 months (Table 1). Using the 120 cfs maximum as a monthly average, this would have increased the portion of flow diverted for May 1953 from 11 to 68 percent, but decreased percentage for April from 86 to 24 percent.

It must be clarified that the predicted flow rates in Attachment M (NRC 1976), and by extension in Table 1, were monthly averages, which should be interpreted with caution. Such data summary may tend to mask extremes in high and low flows. They do, however, provide a means to assess general magnitude of effects, which are valuable in evaluating potential impacts that may be expected during the license renewal period.

CCL Blowdown Reductions

Less makeup diversion will be required due to the reduction or absence of the need to replace blowdown water from CCL. During normal operations, increases to total dissolved solids (TDS) due to CCL evaporation was expected, especially during drought conditins (NRC 1982). Expected to be contributing to this was sulfates, a by-product of using sulfuric acid for scale control on condenser tubes. Water treatment processes were also considered as a source of artificial inputs to TDS in CCL. To control TDS buildup, periodic blowdown and subsequent makeup was expected to maintain water chemistry to support operations, and to ensure discharges from CCL would meet water quality standards.

During actual WCGS operations, sulfuric acid addition for condenser scale control was not instituted. Scaling is currently being controlled using agents that contribute considerably less to the TDS constituents to CCL. Physical scale removal with condenser cleaning balls is also being used, which is a method that will not artificially add TDS in CCL. In addition, recent changes in water treatment and condensate polisher regenerations have further reduced, or eliminated WCGS artificial inputs of TDS. Consequently, blowdown for water chemistry control has not been necessary, and the need for such is expected to be even less during the license renewal period. This will reduce makeup diversion accordingly, and further decrease the potential for increasing the duration and severity of drought conditions, and ensure the lack of adverse impacts to the instream and riparian communities of the Neosho River.

BENEFICIAL REGIONAL EFFORTS

There are two important efforts that are currently in process that will beneficially impact long-term water availability and quality in JRR and the Neosho River watershed. These include reallocating water storage space in JRR, and targeted conservation programs in the Neosho River watershed upstream of JRR.

Reallocation of water storage in JRR will in effect raise the conservation pool elevation from 1039 feet msl to 1041 feet msl. This will provide for an equitable redistribution of the storage remaining between the flood control and conservation pools due to uneven distribution of sediment. Congress has directed the USACE to conduct the study on this reallocation, and a Supplemental Final Environmental Impact Statement has been completed (USACE 2002). This document is in draft form, and is expected to be completed and implemented in the near future.

Throughout Kansas there are conservation efforts underway to address a variety of water and natural resource concerns on a watershed basis. Examples include water quality, public water supply reservoir protection, flooding issues, and wetland and riparian habitat restoration and protection. A Watershed Restoration and Protection Strategy (WRAPS) is a process engaging watershed stakeholders to identify needs and goals, then create and implement the strategy. Common and innovative watershed conservation practices are a result (Kansas Natural Resources Sub-Cabinet 2006). Currently, there are five such WRAPS at varying degrees of completion upstream of JRR. Three are in the implementation phase, and these are above Marion Reservoir, Council Grove Lake, and in the Eagle Creek watershed, which empties into the Neosho River immediately upstream of JRR (Coffey County Regional WRAPS, Marion Reservoir Water Quality Project, and the Twin Lakes Don Snethen, Chief, Watershed Management Section, Kansas Department of health and

Environment, 2006, personal communication). Two WRAPS efforts are in the initial investigation and stakeholder engagement stages. One will include the Neosho River watershed above JRR, and the other the Cottonwood River watershed, the largest tributary to the Neosho River upstream of JRR. WCNOC has participated as an interested stakeholder in these efforts. An important aspect of these WRAPS will be to reduce sediment contribution from land use practices in the watershed, thus reduce sedmintation in JRR, and increase its usable water storage into the future.

These regional efforts will serve to increase the availability in the JRR – Neosho River system, thus ensure the water quantity and quality necessary to support the instream and riparian habitats during periods of severe drought, and during the license renewal period.

CONCLUSION

Because instream flows are not affected, license renewal for WCGS will not cause water use impacts to the Neosho River instream biota and riparian habitats. This is due to the permit and contract criteria governing WCGS use of the makeup water diversion, which effectively limit removals during normal and low flow conditions in the river. Other factors limiting potential water diversion impacts are design limits on makeup pumps, and a reduced need for blowdown from CCL, which necessitates subsequent makeup. In addition, local and regional conservation efforts exist that will improve water and quantity through the license renewal period. Consequenlty, WCGS operations to the Neosho River over the license renewal term will be small, and not warrant mitigation.

Table 1. Predicted flows used to assess the impacts to the Neosho River from makeup water withdrawal during the initial licensing for Wolf Creek Generating Station. Flow impacts were modeled for a once in 50-year period of record drought determined to be actually experienced from July, 1952 through April, 1957.

Month	Flow (cfs)	1952	1953	1954	1955	1956	1957
January	River flow:		64.7	28.0	24.0	25.7	21.0
	Makeup flow:		49.7	0	0	0	0
	Percent flow: diverted		77	0	0	0	0
February	River flow		51.0	26.0	15.0	28.0	21.0
	Makeup flow		36.0	0	0	0	0
	Percent flow diverted		70	0	0	0	0
March	River flow		168.6	23.0	27.0	25.8	27.4
	Makeup flow		153.6	0	0	0	0
	Percent flow diverted		91	0	0	0	0
April	River flow		96.2	28.0	15.0	15.0	494.7
	Makeup flow		61.5	0	0	0	423.7
	Percent flow diverted		64	0	0	0	86
May	River flow		381.0	15.0	15.0	239.4	End of
	Makeup flow		41.0	0	0	224.4	drought
	Percent flow diverted		11	0	0	94	
June	River flow		44.0	286.2	180.2	46.4	
	Makeup flow	Start of	0	242.2	136.2	0	
	Percent flow diverted	drought	0	85	76	0	
July	River flow	(1) 112.8	56.0	54.4	267.7	41.1	
	Makeup flow	(2) 64.6	0	0	223.7	0	
	Percent flow diverted	(1) 57	0	0	84	0	
August	River flow	153.5	60.0	65.1	67.7	55.0	
	Makeup flow	73.8	0	0	12.7	0	
	Percent flow diverted	48	0	0	19	0	
September	River flow	24.0	40.1	36.3	313.5	36.0	
	Makeup flow	0	0	0	298.5	0	
	Percent flow diverted	0	0	0	95	0	
October	River flow	24.0	26.5	30.2	279.8	24.0	
	Makeup flow	0	0	0	86.4	0	
	Percent flow diverted	0	0	0	31	0	
November	River flow	15.0	25.3	21.7	24.5	21.0	
	Makeup flow	0	0	0	0	0	
	Percent flow diverted	0	0	0	0	0	
December	River flow	56.9	27.0	21.5	23.7	21.0	
	Makeup flow	41.9	0	0	0	0	
	Percent flow diverted	74	0	0	0	0	

(1) Neosho River flow values and percent that makeup diversion flow comprises of the total river flow below John Redmond Dam were reproduced from modeled forecasts by the NRC (1976) presented in Attachment M.

(2) Makeup flows were derived from the difference between Attachment M river flows without makeup diversion and with makeup diversion.

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60. An assessment of the impact of population increases attributable to the proposed project on the public water supply, as per 10 CFR 51.53(c)(3)(ii)(I).

[illegible]

• Historical information on how the water withdrawal controls have been implemented in the past. If there have never been any incidents where low water levels in the reservoir or low flow in the river have resulted in water withdrawal restrictions, then state this. If there have been incidents where the rights of any user (WCGS or any other user) have been restricted, provide information on the cause of the incident, length of duration, restrictions placed on which users, and any other relevant information.

• Please provide actual historical data on water withdrawal volumes from the Neosho River.

• Groundwater levels were predicted to rise 45.8 feet within 100 feet of the site 50 years after the filling of CCL. The height of the ground water table was predicted to rise 0.4 feet, 2 miles from the site after the lake was filled. Please provide the elevation of the water table before the lake was filled and the current water table elevation.

• The groundwater flow direction was noted to be generally SW from WCGS to the Neosho River. Are there any localized groundwater flow directions to Wolf Creek (below CCL)?

• Regarding water use conflicts at Wolf Creek, although the ER Section 4.1 indicates no surface water use conflicts, our Generic Environmental Impact Statement (GEIS) for license renewal says (section 4.4.2.1, p. 4-52): "Two nuclear power plants, the Braidwood Station and Wolf Creek Generating Station, have already experienced wateruse conflicts." Furthermore, the GEIS on p. 4-53 (left column, first full para) uses WCGS as an example of potential water use conflicts. Water use conflicts at Wolf Creek are also cited in section 4.4.3, p. 4-57, left column. Although there seems to be a discrepancy, perhaps all water use conflicts have been solved. If so, Wolf Creek should provide this information.

• An assessment of the impact of population increases attributable to the proposed project on the public water supply, as per 10 CFR 51.53(c)(3)(ii)(I).

#115

Please provide an assessment of the impact of population increases attributable to the proposed project on the public water supply, as per 10 CFR 51.53(c)(3)(ii)(I).

RESPONSE: NRC Regulation 10 CFR 51.53(c)(3)(ii)(I) requires the environmental report to contain "...an assessment of the impact of population increases attributable to the proposed project on the public water supply." As described in Section 3.4 of the ER, WCNOC does not plan to increase staff size, either permanently or for outages. Section 4.15 of the ER states, "Because WCNOC has no plans to increase plant municipal water usage or increase employment for license renewal purposes, WCNOC concludes that impacts on public water supply would be SMALL and not require mitigation."

61. Clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Please claarify whether or not the referenced agricultural production areas are within the "Site Boundary" as shown on Figure 2-3. Identify any areas fenced to restrict human access and any areas fenced that may restrict wildlife access.

• Clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Please claarify whether or not the referenced agricultural production areas are within the "Site Boundary" as shown on Figure 2-3. Identify any areas fenced to restrict human access and any areas fenced that may restrict wildlife access.

• Additional data on the avian collision studies that were ceased in 1986. Section 2.4 of the ER (WCGS, 1980) states that sufficient data had been collected by 1986. Provide any documentation of regulatory involvement and concurrence in this determination of sufficiency.

• Details on the power transmission system, including information on the design of the towers, the number and configuration of the lines on the towers within each right-of-way (ROW).

• Details regarding the maintenance procedures used in the transmission line ROWs, including mechanical, chemical, and biological control methods for vegetation management.

• More detailed maps/aerial photos of the transmission line ROWs showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains, and the location of the Sharpe Generating Station.

• Please provide information on the locations of transmission line ROWs crossings with parks, wildlife refuges, or wildlife management areas, or any major lakes (in addition to CCL), ponds, or streams? If so, please provide information on these crossings and their locations.

• Any available studies or other information about the issues raised in the letter from the U.S. Fish and Wildlife Service (November 14, 2005) regarding terrestrial threatened and endangered species.
For example:

-- Any assessments of the transmission lines for conformity with "Suggested Practices for Raptor Protection on Power Lines" (Raptor Research Foundation 1996)? Please provide any such assessments and details of transmission line construction relevant to raptor protection. Also provide a copy of "Suggested Practices," if available.

-- Any special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status.

• Any available maps and aerial photographs of the WCGS plant site and the area within and adjoining the larger site boundary (which encompasses CCL) showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains.

• Any available information identifying natural communities and dominant species of plants and animals that utilize terrestrial habitats of the site and the transmission line ROWs, as well as semiaquatic species such as waterfowl that use Lime Sludge Pond and CCL.

Terrestrial Ecology

Audit Needs request ~~#117~~

> "Please clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Are the referenced agricultural production areas within the "Site Boundary" as shown on Figure 2-3? Which areas are fenced to restrict human access, and are any areas fenced that may restrict wildlife access?

Reference to "(WCGS, 1980)" is unclear. The boundaries at Wolf Creek Generating Station (WCGS) are as follows:

1. The "Site Boundary" encompasses 9818 acres necessary for WCGS, per Section 2.1.1.2 Site Area, of the Updated Safety Analysis Report (USAR) for WCGS. The Site Boundary is within the boundary illustrated in Figure 2-3 of the ER-OLRS. See Audit Needs Request ~~#-86~~ for maps showing this boundary. All land is owned or controlled by the owners of WCGS. There are no specific fences required or existing that are designed to restrict human or wildlife access on this boundary. Agricultural production and wildlife management occurs within the 9818 acres encompassed by the Site Boundary.

2. As indicated in Section 2.1.1.1 of the USAR, the "Plant Site" includes WCGS, and is that which is within the "Site Boundary".

3. The "Owner Controlled Area" (OCA), per procedure AI 07D-001 Resource Management and Ecological Monitoring Programs, includes all properties contiguous to the reactor site and acquired by fee title or easement for WCGS for which public access is limited. The OCA includes the Site Boundary and other lands owned by the owners of WCGS, and shares common borders in many areas (see ~~# 86 for~~ maps). The OCA encompasses approximately 11,300 acres. Agricultural production and wildlife management occurs within this area similar to that within the Site Boundary.

4. The Exclusion Area Boundary (EAB), sometimes referenced as the restricted area boundary, encompasses an area within a 1200-meter radius of the reactor, and includes approximately 1,118 acres (see ~~# 86 for~~ maps). This area is entirely owned in fee title by the owners of WCGS. Agricultural production does not occur within the EAB, however wildlife management activities do occur. There are no fences on this boundary.

5. The Protected Area Boundary includes the area in the immediate vicinity of the reactor, and associated buildings. It is fenced to restrict human, and thus some wildlife, access.

62. Additional data on the avian collision studies that were ceased in 1986. Section 2.4 of the ER (WCGS, 1980) states that sufficient data had been collected by 1986. Provide any documentation of regulatory involvement and concurrence in this determination of sufficiency.

• Clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Please claarify whether or not the referenced agricultural production areas are within the "Site Boundary" as shown on Figure 2-3. Identify any areas fenced to restrict human access and any areas fenced that may restrict wildlife access.

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• Details on the power transmission system, including information on the design of the towers, the number and configuration of the lines on the towers within each right-of-way (ROW).

• Details regarding the maintenance procedures used in the transmission line ROWs, including mechanical, chemical, and biological control methods for vegetation management.

• More detailed maps/aerial photos of the transmission line ROWs showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains, and the location of the Sharpe Generating Station.

• Please provide information on the locations of transmission line ROWs crossings with parks, wildlife refuges, or wildlife management areas, or any major lakes (in addition to CCL), ponds, or streams? If so, please provide information on these crossings and their locations.

• Any available studies or other information about the issues raised in the letter from the U.S. Fish and Wildlife Service (November 14, 2005) regarding terrestrial threatened and endangered species.
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> -- Any special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status.

• Any available maps and aerial photographs of the WCGS plant site and the area within and adjoining the larger site boundary (which encompasses CCL) showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains.

• Any available information identifying natural communities and dominant species of plants and animals that utilize terrestrial habitats of the site and the transmission line ROWs, as well as semiaquatic species such as waterfowl that use Lime Sludge Pond and CCL.

62

Terrestrial Ecology

118	Provide additional data on the avian collision studies that were ceased in 1986. Section 2.4 of the ER (WCGS, 1980) states that sufficient data had been collected by 1986 – was there regulatory involvement and concurrence in this determination of sufficiency?

Transmission line collision monitoring was conducted from 1983 through 1988. This period of time included three years of monitoring following plant start-up in 1985. WCGS staff continued to conduct seasonal surveys of avifauna using the cooling lake through 1996. In 1997, WCNOC notified the NRC (see attached letter WO 97-0048) that the requirement for monitoring wildlife (primarily waterfowl, water birds, and bald eagles) use of the cooling lake, because of potential concerns for transmission line collisions, crop depredation, and disease outbreaks, had been met. It had been determined that there was no sigificant problem with any of the potential concerns. WCGS staff ceased formal wildlife monitoring after 1996. The Kansas Department of Wildlife and Parks (KDWP) had been doing waterfowl, water bird, and bald eagle surveys of the cooling lake since 1981, and they continue to do these surveys. The KDWP surveys are provided to WCGS staff for review to determine if any notable increases in usage might warrant additional monitoring by WCGS. Usage has not changed appreciably and has generally decreased for most species (notably bald eagles) since 1996. A table showing lake usage by selected species through 2006 is attached.

A copy of the 1987-1988 Operational Wildlife Monitoring Report, which addresses the conclusion of transmission line collision monitoring, is attached. A copy of the 1995-1996 Operational Wildlife Monitoring Report, which addresses the conclusion of formal avifauna lake usage monitoring by WCGS staff, is attached. A copy of the Avian Protection Plan at Wolf Creek Generating Station – August 2006, which addresses transmission line collision monitoring, is attached. Finally, a copy of the Wolf Creek Generating Station Annual Environmental Operating Report 2005, which documents notification to the NRC that WCNOC is continuing to review avifauna lake usage data provided by the KDWP, is also attached.

IMAGED 05/22/97

1.5.1

62

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Clay C. Warren
Chief Operating Officer

1.5.1

April 29, 1997

WO 97-0048

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, D. C. 20555

Subject: Docket No. 50-482: Change in Waterfowl Monitoring Program

Gentlemen:

As discussed in NUREG-0878, "Final Environmental Statement Related to the Operation of Wolf Creek Generating Station, Unit 1," Section 5.5.1.2, a general survey program to monitor waterfowl collision events (with plant transmission lines) was recommended for implementation at the beginning of plant operation and conducted for a minimum of two years. This program was incorporated into the wildlife monitoring program discussed in Section 2.2 (e) of Appendix B (Environmental Protection Plan) to Facility Operating License No. NPF-42.

The purpose of this letter is to inform the NRC of changes Wolf Creek Nuclear Operating Corporation has implemented in the methods used to monitor waterfowl collision events. Details on the results of monitoring waterfowl collisions, as well as justification for modifying this portion of the wildlife monitoring program, are provided in the attachment.

If you have any questions concerning this matter, please contact me at (316) 364-8831, extension 4485, or Mr. Brad S. Loveless, at extension 4530.

Very truly yours,

Clay C. Warren

Clay C. Warren

CCW/jad

cc: E. W. Merschoff (NRC)
W. D. Johnson (NRC)
J. F. Ringwald (NRC)
J. C. Stone (NRC)

1

WOLF CREEK GENERATING STATION WATERFOWL MONITORING PROGRAM CHANGES

Reference: 1) NUREG-0878, Final Environmental Statement Related to the Operation of Wolf Creek Generating Station, Unit 1, June 1982
2) Wolf Creek Generating Station, Unit No. 1, Environmental Report, Operating License Stage (ER-OL)

BACKGROUND

Section 4.2.2 of Appendix B to Facility Operating License No. NPF-42 contains a requirement concerning the monitoring of waterfowl usage of the Wolf Creek Lake. The requirement states, "A general survey program shall be accomplished to document significant waterfowl collision events and determine if mitigation is warranted." Section 2.2(e) of Appendix B to NPF-42 states, "The need for a wildlife monitoring program which includes a general survey program for waterfowl collision events be accomplished."

Section 5.5.1.2 of Reference 1 states, "...given that the applicant has committed to monitoring wildlife use of the lake (ER-OL, Sec. 6.2.4.2), the staff recommends that general survey program for waterfowl collision events be incorporated into the proposed monitoring program to determine if mitigation is warranted." Section 6.2.4.2 of Reference 2 states, "Operational monitoring studies will be conducted annually for a minimum of two years following station start-up." Section 6.2.4.2 of Reference 2 also states, "...operational studies will include seasonal waterfowl and water bird censuses of the cooling lake...", and, "Since eagles are known to winter at John Redmond Reservoir, emphasis will be placed on determining eagle use of the cooling lake."

Further references focus on other areas of potential concerns regarding waterfowl and bald eagles. Section 2.2(d) of Appendix B states, "That in the event a serious disease problem involving waterfowl attributable to station operation occurs, the actions specified in the reference will be initiated..." Discussion on potential for waterfowl depredation on local agricultural crops and potential for disease outbreaks can be found in Section 5.5.1.1 of Reference 1. Section 4.1 of Appendix B also states "Any occurrence of an unusual or important event that indicates or could result in significant environmental impact causally related to plant operation shall be recorded and promptly reported to the NRC... examples: excessive bird impaction events, onsite plant or animal disease outbreaks, mortality or unusual occurrence of any species protected by the Endangered Species Act of 1973."

RESULTS OF MONITORING

Seasonal monitoring of waterfowl, waterbird, and bald eagle usage of the cooling lake has been conducted for each of the past eleven operational winters. Dead bird searches under transmission lines adjacent to where the lines crossed over the lake were discontinued after the first two operational winters. It was determined that the number of collisions occurring was insignificant when compared to the number of birds using the cooling lake. It was concluded that further dead bird searches would be unnecessary unless waterfowl usage increased significantly. Operational monitoring (including regularly scheduled waterfowl counts and casual observations of waterfowl flights in the vicinity of the transmission lines) of the cooling lake has shown no trends of increasing usage by waterfowl, waterbirds, or bald eagles. After the 1995-1996 monitoring season, WCNOC again modified the waterfowl monitoring program to discontinue waterfowl counts by WCNOC personnel.

Waterfowl counts are currently conducted by Kansas Department of Wildlife and Parks personnel, and this data is obtained and reviewed by the WCNOC Environmental Management Department.

As noted earlier, two other potential concerns associated with large waterfowl concentrations are disease outbreaks and crop depredation. No disease outbreaks have been documented in the populations of waterfowl, waterbirds, or bald eagles using the cooling lake. There has been some localized crop depredation, but it has not been significant and has been primarily limited to cropland on owner-controlled property. Further, the larger concentrations of geese and mallards (Canada geese, snow geese and mallards are the species most likely to cause crop depredation problems, because of their feeding habits and the relatively high number of individuals) in the area typically utilize John Redmond Reservoir more often than Wolf Creek Lake.

REQUIREMENT MET

Appendix B of NPF-42 required that a wildlife monitoring program be conducted for a minimum of two years following station start-up. This requirement has been met. Continued monitoring has further established that transmission line collision mortality is not a significant concern for waterfowl, waterbirds, or bald eagles using Wolf Creek Lake. Crop depredation has not been considered a problem in the area surrounding the lake. No disease outbreaks have been identified in the populations of waterfowl, waterbirds, or bald eagles utilizing the lake. For the aforementioned reasons, it has been determined that regularly scheduled seasonal monitoring is no longer required.

FUTURE MONITORING

Future surveys and/or transmission line collision monitoring may be conducted by WCNOC staff if it appears that atypically high numbers of waterfowl or bald eagles are using Wolf Creek Lake. As required by Section 6.1c of Reference 1, any significant changes in waterfowl usage of Wolf Creek Lake that result in adverse environmental effects will be reported to the NRC.

	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Mallard	1258	1148	2722	1946	713	4505	197	996	1492	2590	1903	187*	3541
Snow Goose	3584	5069	2427	538	3012	1491	1455	29	6284	9200	5153	3358*	13165
Canada Goose	655	460	1181	866	482	964	148	889	1050	460	1210	105*	1178
Bald Eagle	18	2	14	1	1	<1	<1	<1	1	2	2	1*	1

Mean number per survey of selected avian species using Coffey County Lake (* = incomplete data)

	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993
Mallard	5219	527	3035	2803	6206	4751	9067	5087	2632	1719	1082
Snow Goose	90	39	477	336	1457	439	2392	1674	787	2325	8987
Canada Goose	86	115	202	386	470	522	1700	779	498	460	887
Bald Eagle	3	2	4	2	1	15	18	6	8	2	2

Mean number per survey of selected avian species using Coffey County Lake (= incomplete data)*

2

000175
21.9

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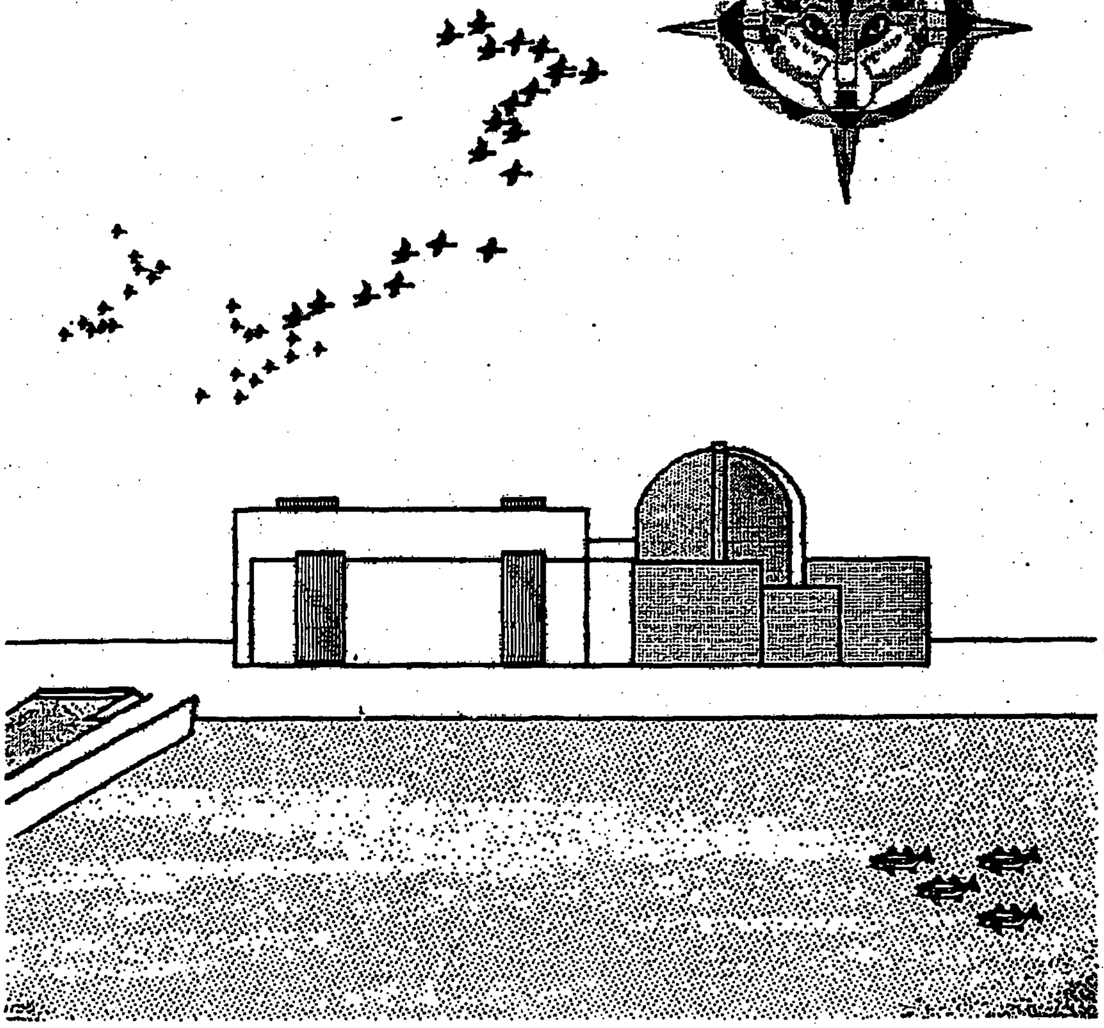
WCNOC-00016

WOLF CREEK GENERATING STATION

1987-1988 OPERATIONAL WILDLIFE MONITORING REPORT

WOLF CREEK NUCLEAR
OPERATING CORPORATION



ENGINEERING AND TECHNICAL SERVICES
ENVIRONMENTAL MANAGEMENT GROUP
NOVEMBER 1988

WCNOC: EM06-88

WOLF CREEK GENERATING STATION

1987-1988 OPERATIONAL WILDLIFE MONITORING REPORT

Daniel E. Haines

Environmental Management Section

Wolf Creek Nuclear Operating Corporation

P.O. Box 411

Burlington, Kansas 66839

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Annual Report for October 1987 - March 1988

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During transmission line collision studies, there has been no increase in impaction mortality as a result of station operations. No threatened or endangered species were found. Inherent biases with making collision estimates using dead bird searches were identified, measured, and results were adjusted. Based on the low percentage that the estimated collision rate comprised of the total usage of WCCL, it was concluded that mortality caused by the transmission facilities associated with the station was not sufficient to be considered problematic thus no mitigative measures were deemed necessary.

Originator's Key Words

Wolf Creek, Operational effects, Wildlife, Threatened and endangered, Bald eagle, Waterfowl, Waterbirds, Heated effluent

REPORT DOCUMENTATION PAGE

Report No.	Report Date
WCNOC EM06-88	November 1988

Title and Subtitle
Wolf Creek Generating Station
1987-1988 Operational Wildlife Monitoring Report

Author(s)
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Performing Organization Name and Address
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Abstract

Waterbird, waterfowl and bald eagle usage and bird collisions with transmission line were monitored on Wolf Creek Cooling Lake (WCCL) from October 1987 through March 1988. This report compares three seasons of operational data with preoperational data.

Thirty nine species of waterbirds and waterfowl were observed with mallard and American coot being most abundant, as was the case during most previous seasons. During the first two operational seasons, increasing numbers of mallards, Canada geese and snow geese were attracted to the ice-free water. However, because the generating station was not continuously operational through the winter of 1987-1988, bird usage was similar to preoperational seasons. During operational winters, the heated effluent provided previously unavailable open water habitat on WCCL which attracted wintering ducks, predominently mallards. This in combination with seclusion and close abundant food supplies, kept ducks on WCCL longer than during preoperational seasons. Significant ($p \leq 0.05$) preferences for areas of WCCL providing these were found for these wintering concentrations. No disease or crop depredation problems were observed.

The bald eagle, an endangered species, was a common winter residents. During the first two operational winters (1985-1986 and 1986-1987), bald eagle usage of WCCL declined from preoperational levels. Responsible for this was the heated effluents from continuous station operations which reduced the quantity of winter-stressed fish, an important eagle food source. Also, the normally prevalent thawing and refreezing of the surface waters exposing these fish were absent further discouraging eagle usage. However, because the plant operated intermittently through much of the 1987-1988 winter, the quantity and to a greater extent the availability of these fish were increased and consequently attracted and held larger numbers of eagles than observed previously.

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Managerial Approval Otto Maynard
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INTRODUCTION

Objectives

This report presents results of the operational wildlife monitoring program conducted in the vicinity of Wolf Creek Generating Station (WCGS) from October 1987 through March 1988. Wildlife studies were initiated in 1973 to fulfill commitments made by Kansas Gas and Electric Company (KG&E) to the Nuclear Regulatory Commission (NRC) as a condition of the construction permit. The WCGS operational program presented here was conducted in accordance with the Final Environmental Statement (NRC 1982) and Sections 2.2 and 4.2 of the Operating License No. NPF-42, Appendix B, Environmental Protection Plan.

The general objectives of the 1987-1988 monitoring program were to document and assess any trends or changes due to station operation from those results reported during preoperational studies. Specific objectives were to:

1. document and assess use of Wolf Creek Cooling Lake (WCCL) by waterfowl, waterbirds, and bald eagles (*Haliaeetus leucocephalus*)

2. document and assess mortality due to collisions by waterfowl, waterbirds, and bald eagles with transmission facilities in the vicinity of WCCL

Description of Study Area

Station Description

Wolf Creek Generating Station is located in Coffey County approximately 5.6 km (3.5 miles) northeast of Burlington, Kansas and is operated by Wolf Creek Nuclear Operating Corporation (WCNOC). The area within the WCGS site boundary encompasses 3973 ha (9818 acres), composed primarily of range, cropland, and woodland habitats typical of southeastern Kansas. Surrounding land-use within five miles of WCGS was composed of 40 percent agricultural land, 40 percent rangeland, nine percent woodland, five percent built-up area, and six percent miscellaneous (KG&E 1981). The power block area, including a switchyard and lime sludge pond, covers nearly 100 ha (250 acres) while the cooling lake inundates 2060 ha (5090 acres) at normal pool. A once-through cooling system pumping water from WCCL is used by the station.

During its second refueling and maintenance outage, WCGS was not operating from September 28, 1987 through January 4, 1988. After achieving and operating at 100 percent, the plant was again shut down for unexpected maintenance on January 22 through February 17, 1988. The plant was then brought on line and operated at or near 100 percent capacity throughout the remainder of the study period.

Wolf Creek Cooling Lake Description

The cooling lake for WCGS was formed by an earth-rolled main dam approximately 3.7 km (2.3 miles) long (Figure 1), with a crest of 331.3m (1100 feet) MSL. The dam, along with five perimeter saddle dams, impounds Wolf Creek approximately 8.8 km (5.3 miles) above its confluence with the Neosho River. The upstream slopes of the main dam and saddle dams were riprapped for protection against wind-generated wave erosion while downstream slopes were seeded with an adapted native grass seed mix.

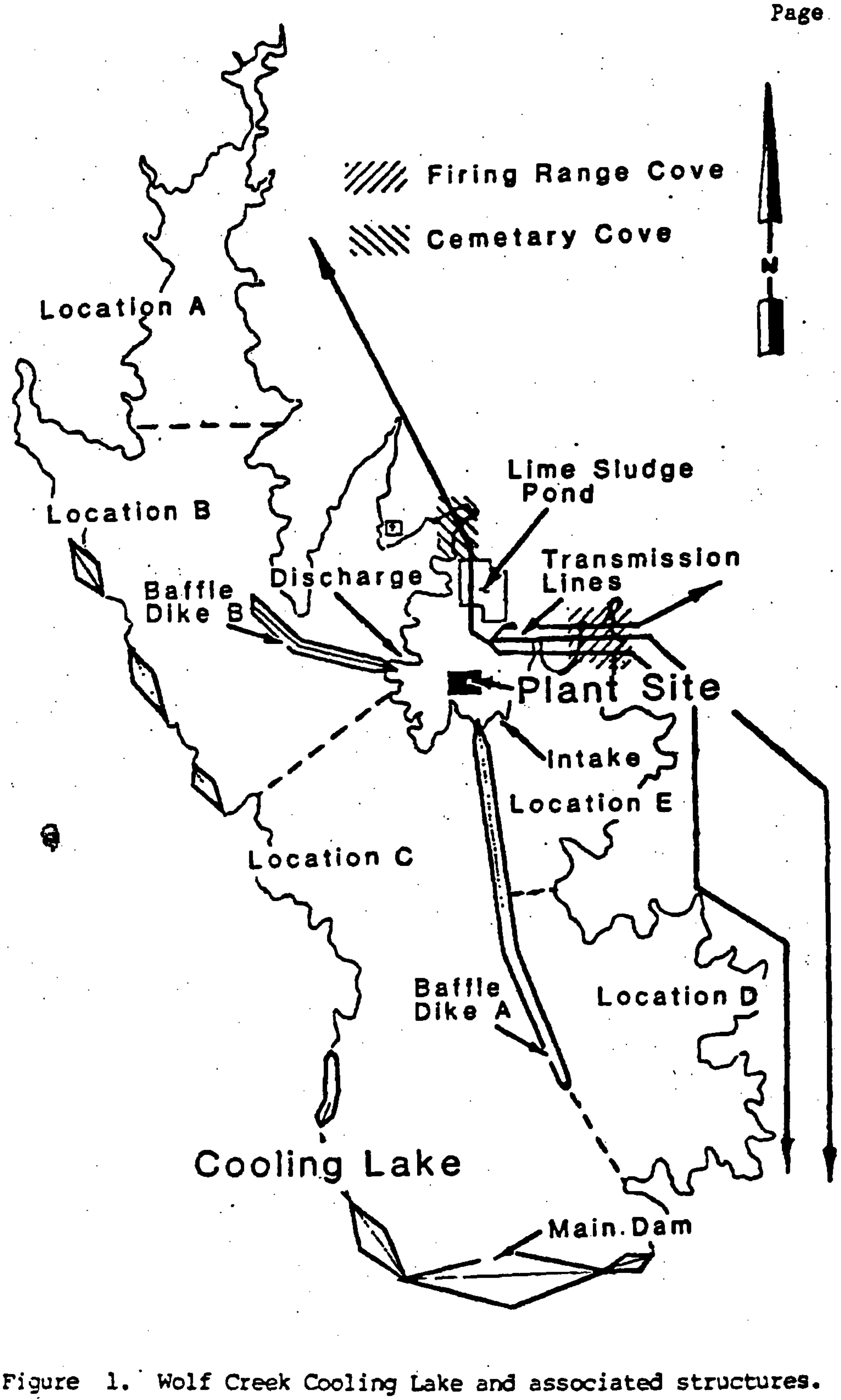

Figure 1. Wolf Creek Cooling Lake and associated structures.

At an elevation of 331.3 m (1087 feet) MSL the cooling lake has a mean depth of 6.6 m (21.5 feet). It has a limited drainage of 50.4 sq km (19.5 sq. miles), not including the surface area of WCCL, which will not provide adequate run-off to maintain the water level during plant operation (KG&E 1974). Additional water is pumped from industrial storage in John Redmond Reservoir (JRR) as needed. However, no appreciable amounts of water were pumped during this study period. The cooling lake has maintained relatively constant levels (less than one foot fluctuation) throughout the study period.

The most influential structures on the cooling lake are associated with the circulating water system for WCGS. Capable of dissipating station operating heat, the system was designed for an expected maximum 17.6 C (30^{0}F) increase in discharge water temperature. Slightly higher discharge temperatures were actually experienced, however the influence on waterfowl and waterbirds was considered undetectable. Baffle Dikes A and B (Figure 1) force heated water to travel nearly the length of WCCL before being pumped through the station again. This allows for maximum heat dissipation thus increasing the cooling lake's efficiency. These dikes provided improved access which allowed for almost complete waterfowl surveys of the lake shorelines.

John Redmond Reservoir, a flood control project controlled by the U.S. Army Corps of Engineers was completed in 1964 on the Neosho River, and lies approximately 5.9 km (3.6 mi) west of the station and, at their closest points, less than 3.2 km (2 mi) from WCCL (Figure 2). John Redmond Reservoir has a surface area of 3,804 ha (9,400 acres) at conservation pool and a total project area of 12,829 ha (31,700 acres). The lake is relatively shallow with an average depth of approximately 1.4 m (4.5 feet). Flint Hills National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service as part of the national migratory waterfowl program, occupies 7,487 ha (18,500 acres) in the upper reaches of the project. For the purposes of this report, all reference to JRR includes the Flint Hills National Wildlife Refuge.

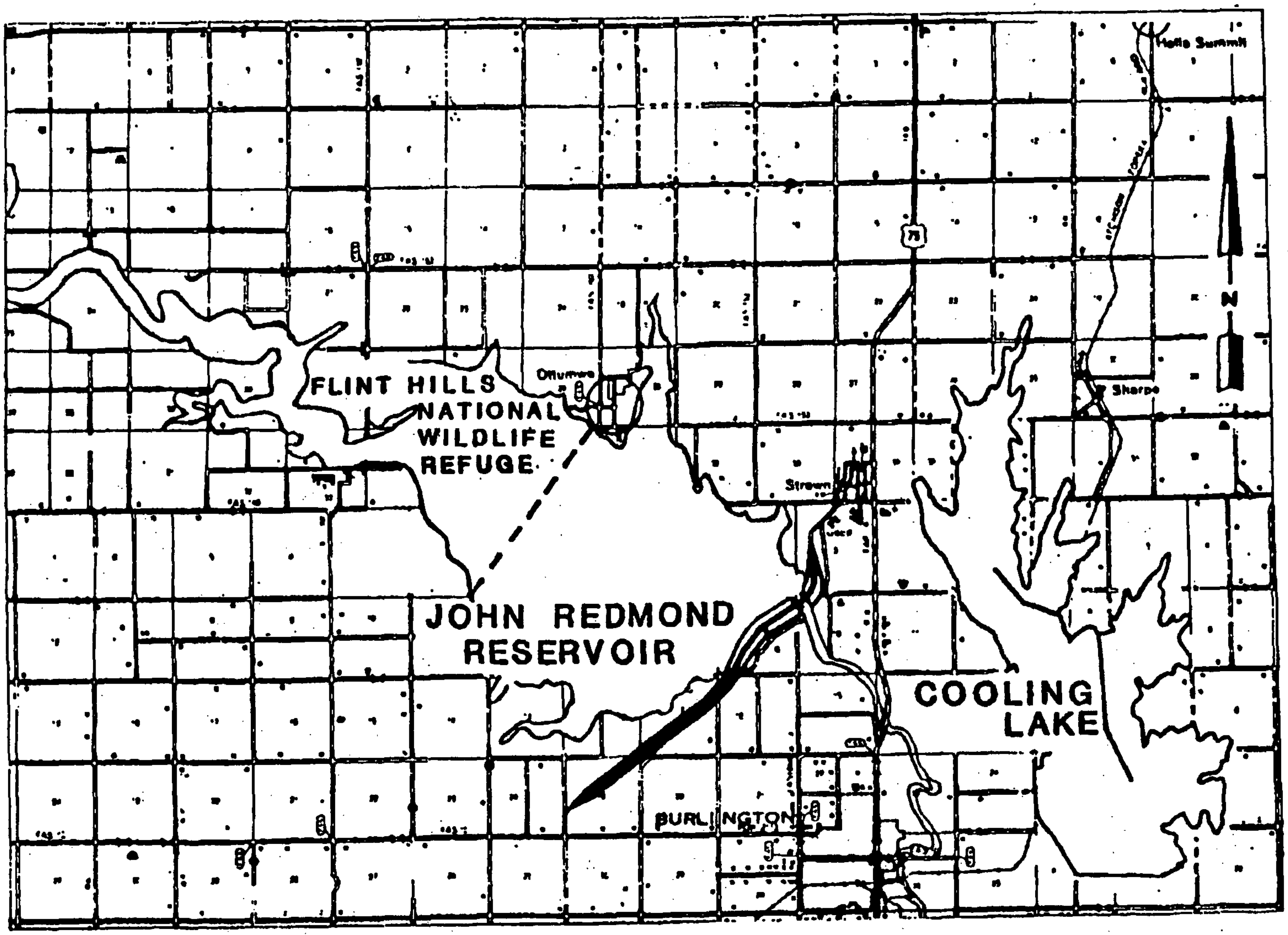

Figure 2. Wolf Creek Cooling Lake and John Redmond Reservoir, Coffey County, Kansas.

Transmission Line Collision Study

Concern was expressed by the NRC (NRC 1982) of possible significant waterfowl collision events caused by the transmission facilities at WCGS. Incidences of bird mortality caused by impaction on transmission lines are widespread and have been studied to varying degrees (Anderson 1978, Meyer 1978, Northern States Power Company 1978, James and Haak 1979, Beaulaurier 1981, Willdan Associates 1982, and Faanes 1987). The need for monitoring the collision potential was identified in the WCGS Operating License. To detect, document, and assess the presence or lack of collision events, systematic dead bird searches were performed prior to the operation of the station. The results obtained from these were compared with those obtained during the first three years of operation to determine if the plant caused any changes.

Study Area Description

Transmission facilities crossing portions of WCCL where collisions by waterfowl and waterbirds were considered most likely to occur consisted of three 345 kv highlines and one 69 kv highline (Figure 1). The upstream portions of two WCCL coves and a lime sludge pond are traversed by these lines. From the plant switchyard, one 345 kv line (Benton line) runs in a northerly direction across the lime sludge pond then turns northwesterly across the "Cemetary Cove" of WCCL. The remaining two 345 kv lines (LaCygne and Rose Hill lines) and the 69 kv line (Wolf Creek tap of Athens - Burlington line) head in an easterly direction and cross the "Firing Range Cove" of WCCL.

The portion of the Benton line of interest to this study consists of three paired transmission wires positioned in two tiers, one pair over two, all of which were under two static wires. These lines are supported through the study area on one side of three double circuit steel towers (Figure 3) and

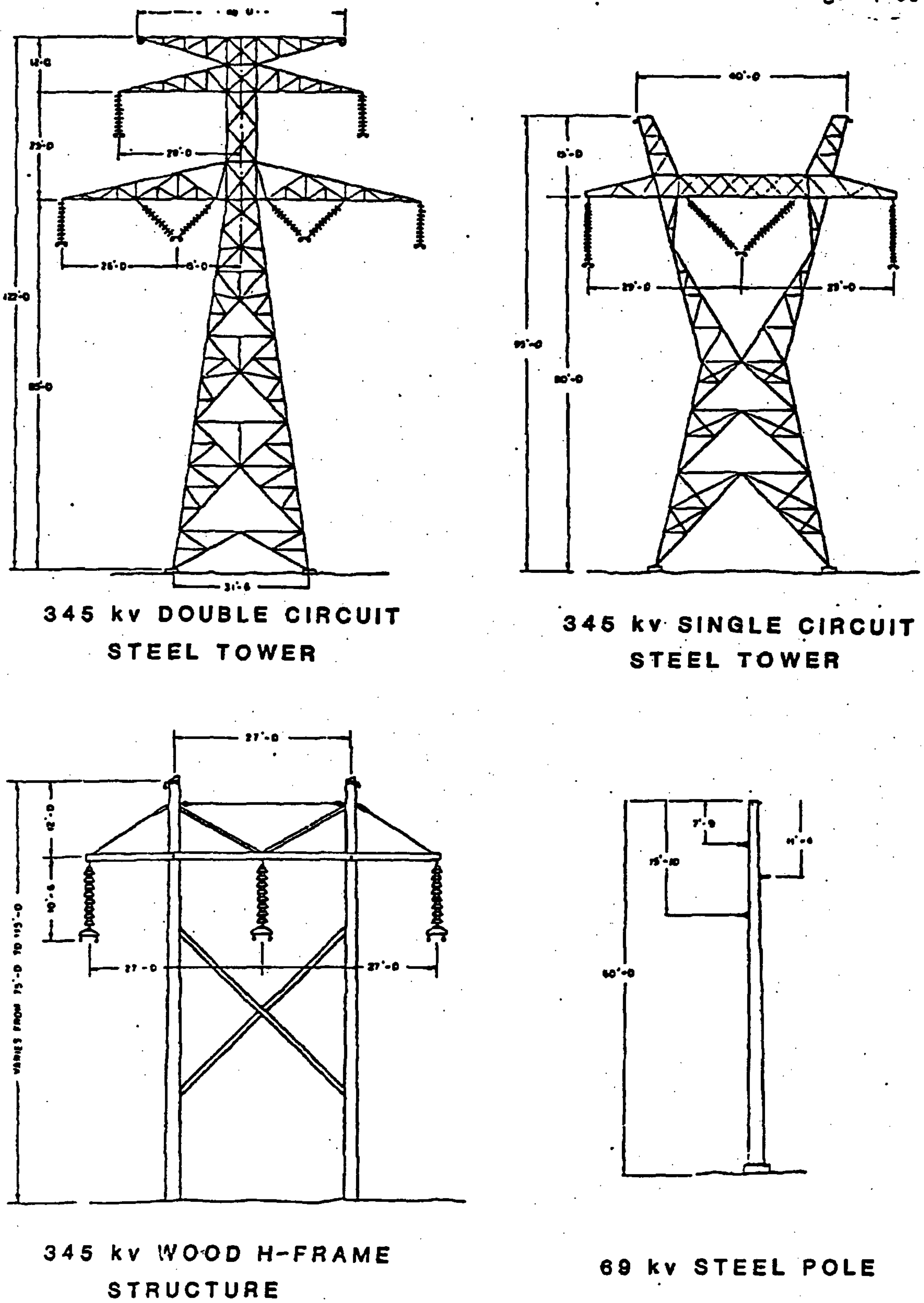

Figure 3. Transmission line tower configurations in the waterfowl collision study areas at Wolf Creek Generating Station.

traverse approximately 214 m (700 ft) of water across the lime sludge pond and 100 m (328 ft) of the "Cemetary Cove". Vegetation surrounding this area consists of trees, unharvested native tall grass, and mowed cool season grasses in approximately equal proportions.

Both the LaCygne and Rose Hill 345 kv power lines are configured identically with each consisting of one tier with three pairs of transmission wires positioned under two static wires. These lines are supported over the study area by five wood H-frame structures and one single circuit steel tower (Figure 3). The Wolf Creek Athens - Burlington 69 kv tap consists of three single transmission wires separated vertically and all under a single static wire and supported by two steel poles (Figure 3). The portions of these three lines of concern during this study were parallel to each other with the 69 kv line the southern-most. The LaCygne and Rose Hill lines traverse approximately 63 m (206 ft) and 88 m (290 ft) of water across the "Firing Range Cove", respectively. The 69 kv crosses 125 m (410 ft) of the same cove (Figure 1). Vegetation surrounding this cove is largely unharvested native tall grass.

METHODS

Bird Usage

Usage of WCCL by waterfowl, waterbirds, and bald eagles was surveyed during the migratory season from October 1987 through March 1988. Waterbird, for the purposes of this report, refers to any bird that lives part of its life in or around water, especially the swimming, diving, and wading birds (Terres 1980), excluding waterfowl (ducks and geese). Four ground counts were scheduled each month. Of the ground surveys, two were morning counts completed by mid-morning. The remaining ground surveys were evening counts starting during mid-day and continuing through the evening hours. Individual species, total numbers, and distribution on the cooling lake and adjacent shoreline areas were determined with the aid of binoculars or a spotting scope. Estimates were made when large numbers prohibited actual counts of individuals. To allow for comparisons between JRR and WCCL bird usage, ground count data of JRR was obtained from the Kansas Department of Wildlife and Parks and the U.S. Fish and Wildlife Service. These counts were usually bi-weekly morning counts conducted from September 1987 through March 1988.

To test for differences between waterfowl usage between WCCL and JRR, 95 percent confidence intervals (Sokal and Rohlf 1981) were computed. Intervals were figured for the species present in large numbers or for those which were of greatest concern with respect to station operation.

Wolf Creek Cooling Lake was divided into five separate locations, identified as A through E (Figure 1), to assess waterfowl and waterbird usage. With Duncan's New Multiple Range Test (Duncan 1955), preferences for these WCCL locations were tested using ground count results. All count totals to be tested were converted to number of birds per acre. Location preferences were evaluated for species that were present in large numbers or were considered most likely to cause disease, crop depredation, or collision problems.

Transmission Line Collision Surveys

Waterfowl and waterbird collisions with transmission facilities (Figure 1) were monitored as scheduled in Table 1. Each study area was searched for dead or wounded birds three times per month. The cove shorelines were searched as well as portions under each transmission line adjacent to the lake. The areas under the lines were searched by one observer walking in a zig-zag fashion under one side of the line and returning on the other. For each specimen found, the location, cause of death or injury if possible, and degree of scavenging were recorded. Feather spots (feathers left after bird was consumed or removed from study area by scavengers) was treated equally with whole specimens as a collision event.

Search bias and scavenger removal rates were estimated for each study area. A known number of dead birds were randomly planted under the lines and along the shorelines to simulate actual collisions. The principal observers, not knowing the locations, then searched the areas. The number of birds found of the total placed provided an estimate of how many birds that observers normally were unable to find. The same planted birds were subsequently monitored for three consecutive days and again on the sixth and ninth days to determine the rate of scavenger removal. Data collected were used to refine collision estimates from the dead bird searches. Formulas used were adapted from Faanes (1987) and were as follows:

TABLE 1. WILDLIFE MONITORING SCHEDULE, OCTOBER 1987 THROUGH MARCH 1988.

	Oct	Nov	Dec	Jan	Feb	Mar
Waterfowl, Waterbird and Bald Eagle Survey (A)	X	X	X	X	X	X
Transmission Line Collision Survey (B)		X	X	X	X	

(A) Includes four ground surveys per month
(B) Includes three surveys per month

<u>Search bias</u>

$$SB = \frac{TDBF}{PBF} - (TDBF)$$

where

SB = search bias

TDBF = total dead bird found

PBF = proportion of birds found of those placed during the bias study

<u>Removal bias</u>

$$RB = \frac{TDBF + SB}{PNR} - (TDBF + SB)$$

where

RB = removal bias caused by scavengers

PNR = proportion of the planted birds not removed by scavengers during the bias study

<u>Crippling bias</u>

$$CB = \frac{TDBF + SB + RB}{PFA} - (TDBF + SB + RB)$$

where

CB = Crippling bias

PBK = Proportion of birds killed and fell within the study area.

<u>Estimated total collisions</u>

$$ETC = TDBF + SB + RB + CB$$

where

ETC = Estimated total number of birds colliding based on dead birds found plus the study biases.

To identify any possible correlation between the number of collisions and the number of birds using the lake, all waterfowl and waterbirds were counted before each dead bird search. Only the birds in the coves in close proximity with the study areas were counted.

RESULTS AND DISCUSSION

Thirty-nine species of waterfowl and waterbirds were observed during ground surveys (Table 2). Species diversity ranged from 18 species during February to 25 in October. Comprising 58 and 14 percent, respectively, mallard (Anas platyrynchos) and American coot (Fulica americana) were the most abundant species observed (Table 3). This compares closely to 54 and 18 percent respectively for mallards and coots observed during the 1986-1987 monitoring period.

WCCL Bird Usage

Twenty-five ground counts were completed during the 1987-1988 program. Two morning and two evening counts were performed each month from October 1987 through March 1988, except December. Three morning and two evening surveys were completed during that month. All morning surveys were initiated during the first hour following sunrise, and ranged from 65 to 160 minutes in duration for an average of 118 minutes. All evening surveys were initiated between 1230 and 1530 hours, and ranged from 60 to 180 minutes for an average of 100 minutes.

Of the five WCCL locations designated to assess area preferences by birds, each had unique components. Location A represents the northern and upstream reaches of WCCL. It has a surface area of 142 ha (352 acres) which includes approximately 28 ha (70 acres) of inundated deed timber. Shorelines are associated primarily with cropland and grassland. Prominent aquatic macrophytes consisted of narrow-leafed pondweed (Potamogeton foliosus), American pondweed (P. nodosus), and smartweed (Polygonum sp.). Approximately, seven percent (9.8 ha, 24.4 acres) of the surface area was

TABLE 2. WATERBIRD AND WATERFOWL CENSUS DATA COLLECTED DURING GROUND SURVEYS OF WOLF CREEK COOLING LAKE, FROM OCTOBER 1987 THROUGH MARCH 1988.

	1987						1988					
Species	Oct		Nov		Dec		Jan		Feb		Mar	
Common loon	1	1	1	7	1	3[1]	-	-	-	-	-	4
Pied-billed grebe	7	5	19	1	1	10	12	-	1	-	-	6
Horned grebe	-	-	-	-	-	-	-	-	-	-	2	5
Eared grebe	-	-	-	-	-	-	-	-	-	-	1	2
White pelican	-	-	19	-	-	-	-	-	-	-	-	-
Dbl.-crested cormorant	119	160	15	10	15	11	-	1	-	1	20	49
Great blue heron	13	15	-	2	-	-	-	-	-	-	-	-
Great egret	16	8	-	-	-	-	-	-	-	-	-	-
Tundra swan	-	-	-	-	-	1	-	-	-	-	-	-
Gr. white-frtd. goose	-	-	39	215	37	31	5	21	-	100	-	-
Snow goose	-	1	338	1	85	660	1392	1255	-	1425	-	-
Canada goose	109	17	240	578	417	877	1178	770	1365	528	14	-
Green-winged teal	35	31	48	11	17	37	-	9	-	-	4	46
Black duck	-	-	-	1	1	-	-	1	-	-	-	-
Mallard	129	659	1331	6283	8732	12471	5326	7430	9602	1113	20	60
Northern pintail	6	2	1	27	13	33	13	-	-	-	-	40
Blue-winged teal	3	1	-	-	-	-	-	-	-	6	-	12
Northern shoveler	-	1	4	2	-	2	-	-	-	-	-	12
Gadwall	-	2	34	3	1	9	-	10	-	-	8	626
American wigeon	-	190	70	17	5	13	1	2	-	-	-	254
Canvasback	-	60	58	1	3	9	3	2	1	-	-	-
Redhead	-	1	12	4	-	12	-	-	-	32	14	-
Ring-necked duck	-	6	12	-	-	-	8	-	-	-	-	-
Lesser scaup	-	-	-	-	-	1	-	-	-	-	5	4573
Common goldeneye	-	-	1	21	4	20	4	10	5	14	1	1
Bufflehead	-	6	5	47	15	8	10	16	10	21	7	8

TABLE 2. (Cont.)

Species	1987						1988					
	Oct		Nov		Dec		Jan		Feb		Mar	
Hooded merganser	-	-	4	29	21	48	12	34	35	26	2	-
Common merganser	-	-	-	3	4	364	338	594	310	148	12	13
Red-breasted merganser	-	-	-	-	-	-	-	-	-	1	-	-
Ruddy duck	-	-	-	1	-	-	-	-	-	-	5	-
Unidentified duck	143	115	55	39	-	7	95	-	-	-	2	65
Osprey	-	2	-	-	-	-	-	-	-	-	-	-
Bald eagle	-	-	1	3	7	10	32	39	40	46	9	1
American coot	10763	1559	255	61	13	-	18	-	-	2	131	1120
Killdeer	8	-	8	-	-	-	-	-	-	-	4	14
Long-billed dowitcher	1	-	-	-	-	-	-	-	-	-	-	-
Common snipe	1	1	-	-	-	-	-	-	-	-	-	-
Franklin's gull	4731	498	364	-	-	-	-	-	-	-	-	-
Ring-billed gull	36	69	172	354	729	154	36	30	9	552	53	132
Number of Species	25		28		22		20		18		24	

(1) Mean of two weekly surveys
(2) Mean of three weekly surveys

TABLE 3. GROUND COUNT FREQUENCY AND PERCENT COMPOSITION OF WATERFOWL AND WATERBIRDS USING WOLF CREEK COOLING LAKE FROM OCTOBER 1987 THROUGH MARCH 1988.

Species	Total Count Frequency	% Total
Mallard	118,777	58
American coot	27,845	14
Canada goose	13,058	6
Franklin's gull	11,184	5
Snow goose	10,974	5
Ring-billed gull	4,804	2
Lesser scaup	4,630	2
Common merganser	3,935	2
American wigeon	1,539	1
Gadwall	1,516	1
Gr. Wh.-ftd. goose	928	<1
Unidentified duck	904	<1
Double-crested cormorant	784	<1
Green-winged teal	549	<1
Misc. ducks	526	<1
Hooded merganser	471	<1
Misc. waterbirds	425	<1
Bald eagle	384	<1
Bufflehead	316	<1
Northern pintail	301	<1
Canvasback	283	<1
Total	204,133	<96

covered by these plants. The area is protected from harsh winds, especially from the north, and ice cover during the 1987-1988 winter was 50 to 100 percent from the December 29, 1987 through the February 16, 1988 surveys.

Location B is the area of WCCL which was expected to be and was most affected by thermal discharges and flow during WCGS operations. The surface area is 500 ha (1234 acres) and has approximately 12 ha (30 acres) of flooded trees and brush. Shorelines are adjacent primarily to cropland and grassland. Aquatic macrophyte growth consisted of narrow-leafed pondweed, American pondweed, trace amounts of Chara spp., and smartweeds. These made up about six percent (31.1 ha, 76.9 acres) of the total surface area. Wind-protected areas are numerous in this area. Heat and flow from the circulating water discharge kept greater than 95 percent of the area ice-free during the first two operational winters. During the 1987-1988 winter, it was kept mostly open, however, when WCGS was not operational during January and February 1988, a short-lived ice cover approached 95 percent on February 9, 1988.

Location C is the largest location (913 ha, 2,255 acres) and represents the main body of the lake. There is very little inundated timber and all of the shorelines are either adjacent to grassland, including native and domestic, or rip-rap. Macrophyte growth consisted of narrow-leafed and American pondweed. These weed beds made up approximately one percent (9 ha, 22.3 acres) of the total surface area. Few wind-protected areas exist within this location. Thermal discharge inputs and wave action kept this location virtually ice free during the first two operational seasons. Ice cover development during this season was approximately 50 percent or more from the January 13 through January 27, 1988 surveys.

Location D comprises 331 ha (817 acres) in the southeast part of WCCL and consists of approximately 49 ha (20 acres) of flooded timber. Large areas of cropland surround this area and much of the location is protected from north winds. Macrophyte composition was narrow-leafed and American pondweed. Surface area of these weeds was approximately five percent (17.8 ha, 44.1 acres) of the total area. Station thermal inputs during the first two operational years kept a large portion of this area ice-free during the mild winters experienced. Only recessed, wind protected portions (less than 25 percent) formed an ice cover. During the 1987-1988 season, greater than 50 percent ice cover was noted from January 5 through February 9, 1988.

Location E is the area of WCCL which was expected to be most affected by circulating water intake flows. This area encompasses 175 ha (432 acres) and has little flooded timber. Pondweed beds were well developed in this area with almost all of the shoreline and littoral areas supporting some growth. Composition of the aquatic plants was narrow-leafed and American pondweed and Chara sp. Weed surface area was about seven percent (13 ha, 32 acres) of the total surface area. Native grasslands border much of this location. Refuge areas from most winds are abundant. Approximately 75 percent of this area froze during earlier operational winters. Ice cover during the 1987-1988 monitoring was relatively extensive with 50 to 100 percent cover present from January 5 through February 16, 1988.

Threatened and Endangered Species

Since 1973, several threatened and endangered birds have been observed. These include the white-faced ibis (Plegadis chihi), bald eagle, peregrine falcon (Falco peregrinus), and interior least tern (Sterna antillarum). The prairie falcon (Falco mexicanus), previously listed as threatened and observed within the WCGS area, was removed from the threatened list as of May 1, 1987 (Kansas Administrative Regulations 1987). Similarly the white-faced ibis was added. During the 1987-1988 winter, only the bald eagle was confirmed on the site environs. The ibis was observed on WCCL during

September of 1983, however not since that time. Only the bald eagle used WCCL consistently during the winters. The others may be expected to be occasional visitors in the future and station operation is not expected to impact this.

The bald eagle, considered endangered on Kansas and federal lists (Kansas Administrative Regulations 1987, U.S. Department of Interior 1987), was a common winter resident on WCCL. They were first observed during mid-November 1987 with the largest count being 48 observed on February 5, 1988. A peak count of 104 were counted on the JRR and Neosho River area on February 23, 1988. Of the birds observed on WCCL, adults and juveniles comprised 57 and 43 percent, respectively. There was a higher percentage of juvenile birds than observed during previous monitoring.

Eagle usage of WCCL prior to plant operation was as a feeding and loafing site. In this respect, use during operational monitoring did not appear to change. During the first two years of operations, eagle numbers declined (WCNOC 1987a). However, eagle numbers increased during the 1987-1988 monitoring enough (Figure 4) that when averaged with the previous operational seasons, an overall increase is obvious (Figure 5). Average operational usage on WCCL approached that on JRR. Peak numbers, occurring during February, were still greater on JRR, but because the count totals for JRR comprising the average presented (Figure 5) were variable, no statistical differences ($p \leq 0.05$) could be detected.

Three primary components of eagle winter habitat includes communal nocturnal roost sites, diurnal perch (loafing) sites, and a readily available food source (Steenhof 1978). No nocturnal nest sites have been identified on or around WCCL. Diurnal perch sites are present on both reservoirs and the quantity and quality of these have not changed appreciably after plant operation. Since these two winter habitat uses or requirements have been consistent throughout preoperation and operation, they were not considered to have contributed to changes in eagle usage of WCCL.

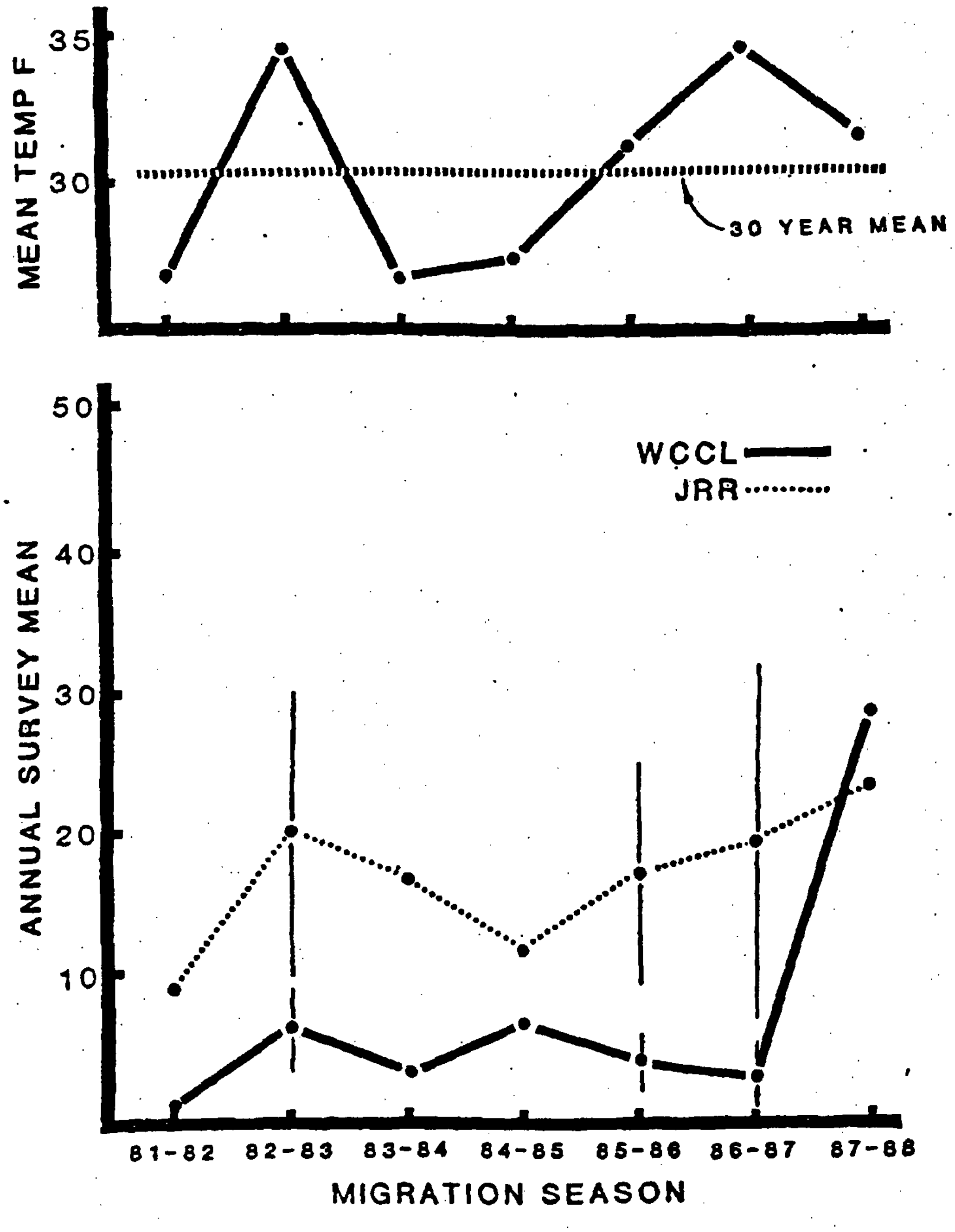

Figure 4. Bald eagles per survey for Wolf Creek Cooling Lake and John Redmond Reservoir compared with mean winter air temperatures and the 1951-1980 30 year mean (December through February) in Topeka, Kansas. Temperature data obtained from the National Weather Service. Confidence limits for the bald eagle data were illustrated only if significantly ($p \leq 0.05$) different.

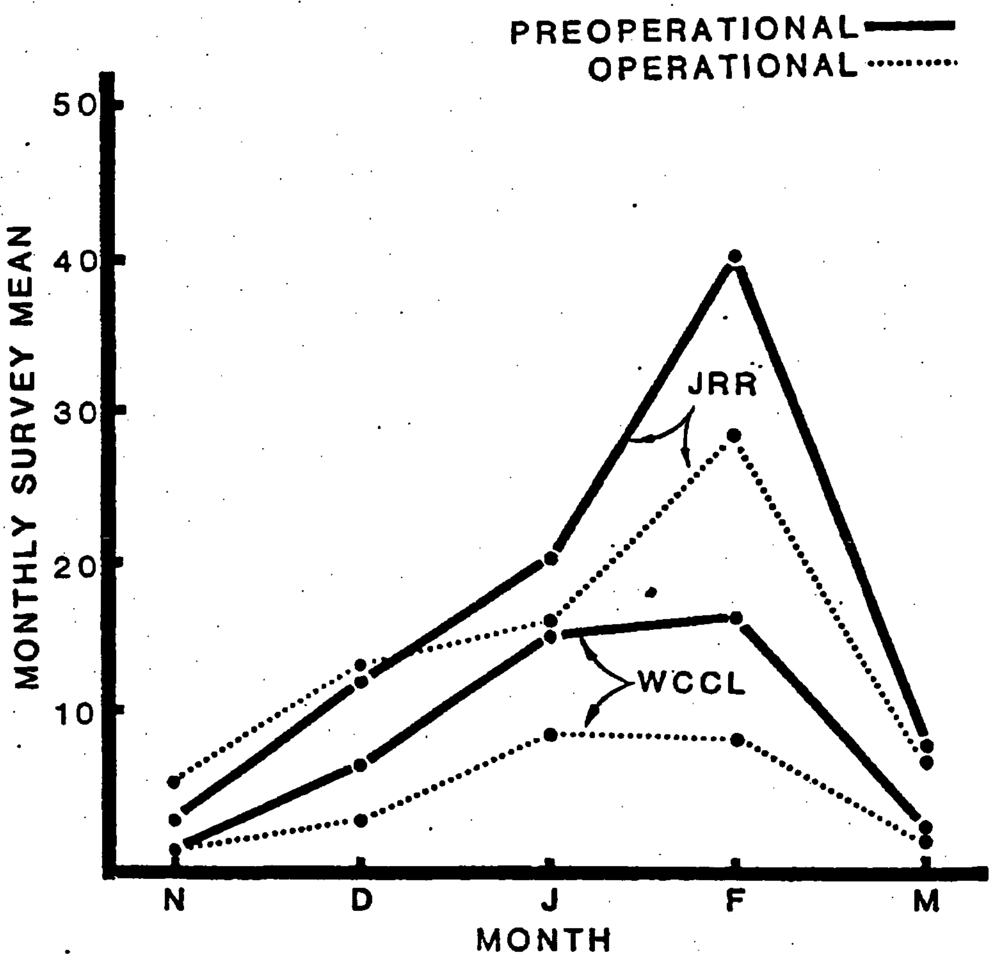

Figure 5. Preoperational and operational (three year means) bald eagle usage of Wolf Creek Cooling Lake and John Redmond Reservoir. Confidence limits not illustrated were not significant ($p \leq 0.05$).

Of the requirements, food availability between the reservoir areas differed the most. Bald eagles have opportunistic foraging habits with waterfowl and fish being major components. Eagles often shift from one to the other during the course of a winter (Southern 1963, 1964, Lish and Lewis 1975, Steenhof 1978, Meyer 1980, Griffin et al. 1982, Ecological Analysts 1983, Griffin and Basket 1985, Kiester et al. 1987).

Waterfowl should not be overlooked although they probably weren't as important as fish in the distribution of eagles during operation. As referenced above, eagles commonly exploit waterfowl resources, but usually only when fish become unavailable. Bald eagles seem to be inefficient predators on healthy waterfowl (Steenhof 1978, Griffin et al. 1982) although weakened, crippled,and dead waterfowl are readily taken (Lish and Lewis 1975, Griffin et al. 1982, Steenhof 1978, Todd et al. 1982, Kiester et al. 1987). The frequency of crippled waterfowl, especially hunter-caused was not known in the study area, but because hunting was permitted in the JRR area, except park areas and large portions of the Flint Hills National Wildlife Refuge, and not allowed on the WCCL proper, it may be assumed that greater numbers were available to eagles on JRR. However, because waterfowl hunting seasons closed for most species during January, the importance of hunter crippled waterfowl during February, when eagle numbers were greatest (Figure 5) should have been reduced. Also, fluctuations in waterfowl numbers on WCCL during the operational winters were not necessarily followed by corresponding changes in eagle numbers further indicating that waterfowl as a food source was not of primary importance for this wintering bald eagle population.

Fish appear to be preferred when available. Gizzard shad (Dorosoma cepedianum) in this region are susceptible to winter kill and this species occurs in much greater numbers in JRR and the Neosho River than WCCL (WCNOC 1987b). Shad are highly preferred by bald eagles, probably because of its vulnerability especially during winter in the ice-free head waters and tailwaters of lakes (Lish and Lewis 1975, Steenhof 1978, Ecological Analysts 1983). Fish disoriented or killed as they pass through flood gates below dam projects are easy prey for eagles. John Redmond and the associated Neosho River reaches provide these types of areas. The cooling lake, on the other hand, does not have a major drainage stream flowing into it, thus continuous discharges below the dam exposing these fish are not present. In addition, the availability to eagles of winter-killed fish, mainly shad, increases in the main bodies of reservoirs as the ice cover thaws (Steenhof 1978, Meyer 1980, Griffin et al. 1982). Since the addition of heated effluents from plant operations, this condition is almost lacking on WCCL while still prevalent on JRR. Thus, during the first two years of operations, it was evident that fish resources for eagles occurred in both greater concentrations and, because they were more vulnerable, were easier to obtain on JRR and the Neosho River than WCCL.

The 1987-1988 winter was not appreciably colder nor warmer than the previous two operational seasons (Figure 4). It was shown that during mild winters combined with the heated effluents, WCCL did not provide as readily available forage as did JRR (WCNOC 1987a). This was because of the relatively short-lived ice-cover on JRR during those winters which continuously thawed and refroze exposing winter killed shad on the main-body of the reservoir. Changes in availability of food between the reservoirs was likely responsible for the large increase of eagles observed during the 1987-1988 winter. Ice-cover was much more extensive on WCCL during this winter due to the absence of continuous heated effluents. When JRR was ice-covered, circulating water flows and intermittent heated discharge from the station forced the ice-cover on WCCL to thaw, break-up, and refreeze at varying intensities throughout the winter. As stated above, winter-killed fish which are continuously exposed like this are known to attract bald eagles. In addition, the power level transients experienced by WCGS during January and February, attracted and concentrated gizzard shad in WCCL where normal winter shad mortality combined with the open water/ice-cover interspersion likely increased attractiveness to those eagles. A documented fish kill, cause suspected to be cold shock, during mid-February in the circulating water discharge area undoubtably provided easily obtained and abundant food resources for bald eagles. The presence of shad remains under perch trees used for feeding by the eagles in this area supports this assumption. These factors were the most obvious differences in food availability during the 1987-1988 winter from the previous operational years. Bald eagles, having very opportunistic feeding habits, took advantage of these circumstances.

The discharge area (Location B) had higher eagle usage, significantly ($p \leq 0.05$) greater to all other areas except Location A (Table 4). The lack of any consistent location significantly attracting eagles from year to year demonstrates that usage was variable around the lake. The usage during 1987-1988 shows that numbers were much greater than past seasons in an area most vulnerable to station operational impacts. It is expected that during normal to mild winters, continuous operation will not attract these numbers. During colder winters, the JRR eagles will likely be forced to range over a greater area to find food thus usage of WCCL may become greater while at the same time become more variable on JRR. This will cause statistical differences to be harder to detect. It appears, based on the above discussions, that intermittent plant operations which attract and concentrate WCCL fishes, possibly exposing them to cold shock, will attract area bald eagles. This will be especially true if JRR maintains an ice-cover for an extended period. Usage during severe winters with the plant operating cannot be determined at this time. It has been shown, however, that heated water was not of greater importance to wintering bald eagles during cold as opposed to mild winters (Ecological Analysts 1983).

TABLE 4. SIGNIFICANT DIFFERENCES BETWEEN RANK LOCATION MEANS OF BALD EAGLES USING WOLF CREEK COOLING LAKE.

Winter	Total Counted	Location Preference
1983-1984	51	A C B D E
1984-1985	115	E B C A D
1985-1986	82	C B D A E
1986-1987	44	C B E A D
1987-1988	395	E C D A B

(1) Line underscores ranked (lease to greatest) location means that were not significantly different ($p \leq 0.05$).

Duck Usage

Total ducks counted on WCCL and JRR during the 1987-1988 season was simlar to that observed during most winters monitored (KG&E 1983, 1984, 1986a, 1986b, and WCNOC 1987a; Figure 6). Although JRR attracted higher annual averages than WCCL, the differences were not significant ($p \leq 0.05$) except during the 1983-1984 winter. ' Due to severe weather conditions during December 1983 (Table 5) the normally high late winter concentrations (predominantly mallards) were not present on WCCL during that winter. Conversely, better than normal waterfowl habitat conditions existed on JRR during that season which attracted many earlier migrating ducks.

Of the ducks observed on WCCL, 92 percent were dabblers, seven percent divers, and one percent unidentified ducks (Table 6). This is very similar to past seasons. As during all past monitoring seasons, mallard was most common comprising 89 percent of total. Lesser scaup (Aythya affinis), common merganser (Mergus merganser), American wigeon (Anas americana), and gadwall (Anas strepera) were other common ducks observed, however, making up collectively only eight percent of the total.

As during preoperational monitoring, John Redmond attracted the largest portion of fall (October and November) migrating ducks (Figure 7). On WCCL most of these ducks were comprised of blue-winged teal (Anas discors), American wigeon, and gadwall. These species plus large numbers of northern pintail (Anas acuta) were present on JRR. The attraction to JRR over WCCL of larger numbers of ducks during the fall represents a pattern obvious during all years monitored. Although more prevalent in past seasons, natural lake level increases during the fall of 1987 were present (Figure 8) which provided higher quality duck habitat than the constant lake level of WCCL. The increasing levels of JRR created newly flooded shallow areas. Water bodies with these recently flooded areas have been found to be preferred by waterfowl over those with stable water levels (Chabreck et al. 1974, Gasaway et al. 1977, Johnson and Swank 1981).

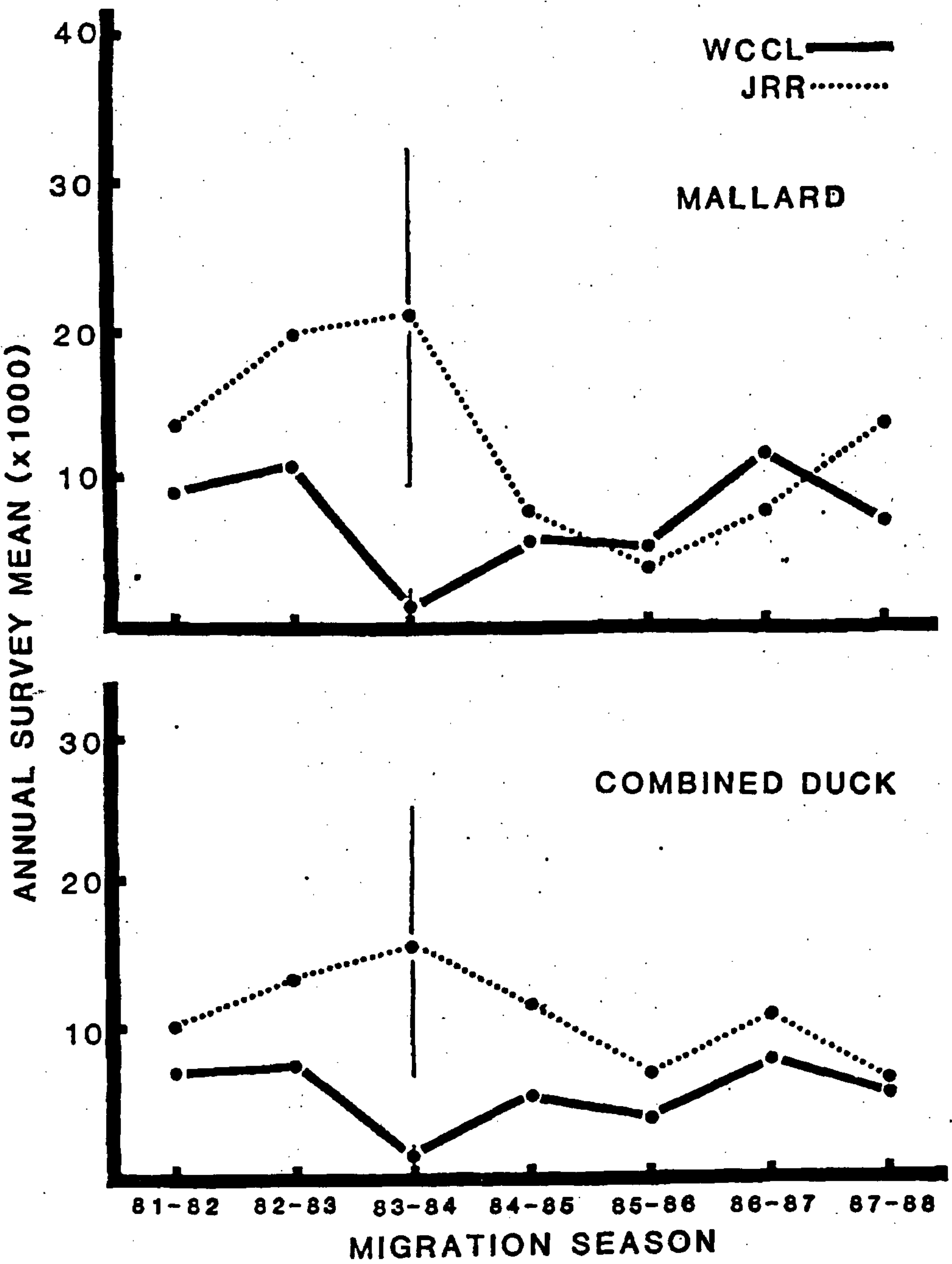

Figure 6. Annual combined duck and mallard usage comparisons between John Redmond Reservoir and Wolf Creek Cooling Lake. Confidence limits not illustrated were not significant (p=0.05). Combined duck data includes September through March surveys except during 1987-1988 season where October through March surveys were used. Mallard data includes November through February surveys.

Table 5. NATIONAL WEATHER SERVICE MONTHLY AVERAGE AIR TEMPERATURES FOR TOPEKA, KANSAS.

Winter of	Temperature (°F)		
	Dec	Jan	Feb
<u>Preoperational</u>			
1981-1982	30.1 (-1.7)(1)	21.9 (-4.1)	28.5 (-4.0)
1982-1983	35.8 (+4.0)	32.5 (+6.5)	36.1 (+3.6)
1983-1984	14.4 (-17.4)	26.0 (0.0)	40.2 (+7.7)
1984-1985	36.8 (+5.0)	19.9 (-6.1)	25.6 (-6.9)
<u>Operational</u>			
1985-1986	25.1 (-6.7)	35.8 (+9.8)	32.5 (0.0)
1986-1987	34.6 (+2.8)	29.7 (+3.7)	40.3 (+7.8)
1987-1988	35.9 (+4.1)	28.0 (+2.0)	30.8 (-1.7)

(1) Variance from 30 year average, 1951 through 1980.

TABLE 6. GROUND COUNT FREQUENCY AND PERCENT COMPOSITION OF DUCKS USING WOLF CREEK COOLING LAKE FROM OCTOBER 1987 THROUGH MARCH 1988.

Species	Total Count Frequency	% Total
Mallard	118,777	89
Lesser scaup	4,630	3
Common merganser	3,935	3
American wigeon	1,539	1
Gadwall	1,516	1
Unidentified duck	904	1
Green-winged teal	549	<1
Hooded merganser	471	<1
Bufflehead	316	<1
Northern pintail	301	<1
Canvasback	283	<1
Redhead	190	<1
Common goldeneye	181	<1
Ring-necked duck	49	<1
Blue-winged teal	44	<1
Northern shoveler	43	<1
Ruddy duck	13	<1
Black duck	4	<1
Red-breasted merganser	2	<1
Total	133,747	<98

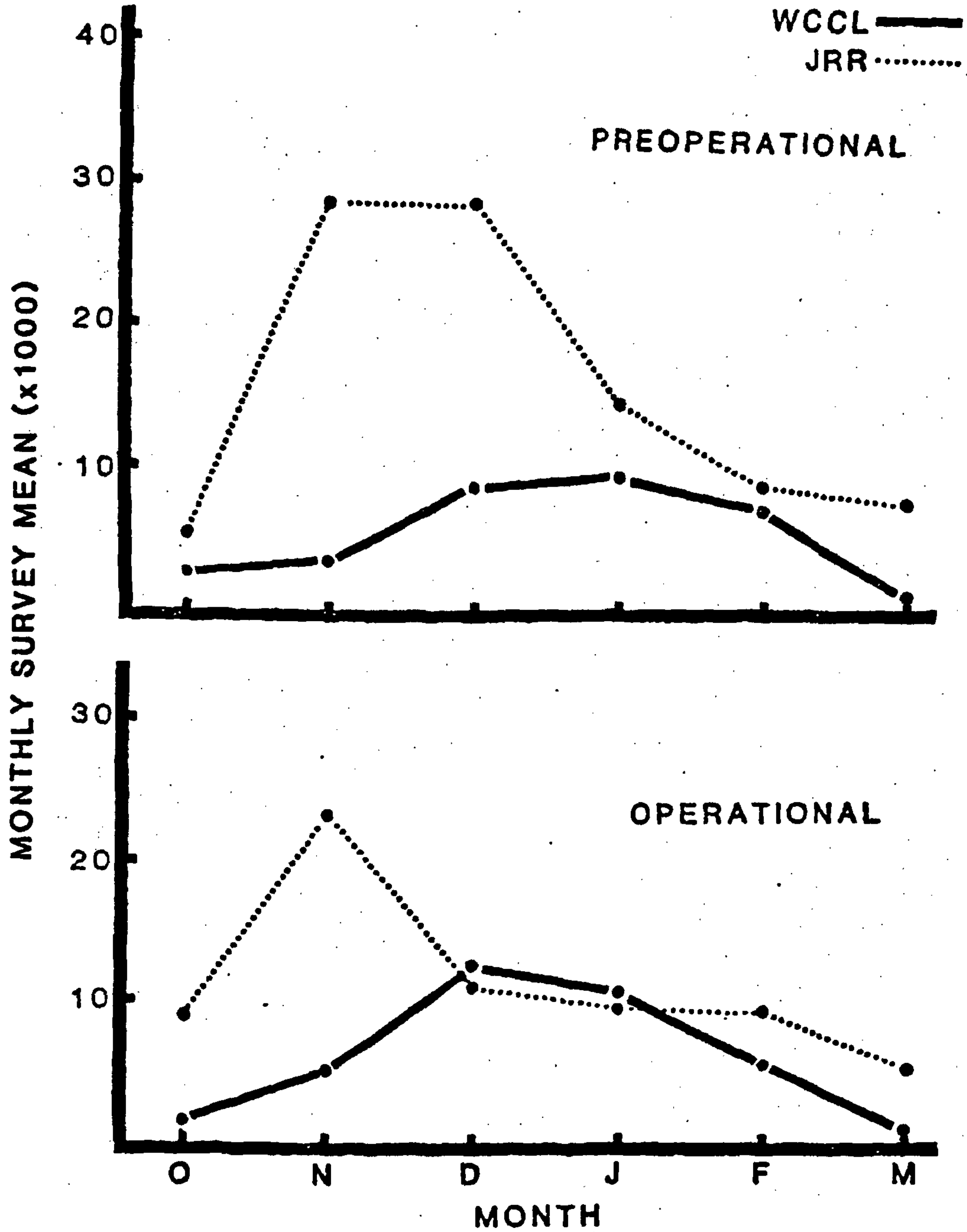

Figure 7. Preoperational and operational (three year means) combined duck usage of Wolf Creek Cooling Lake and John Redmond Reservoir. Confidence limits not illustrated were not significant ($p \leq 0.05$).

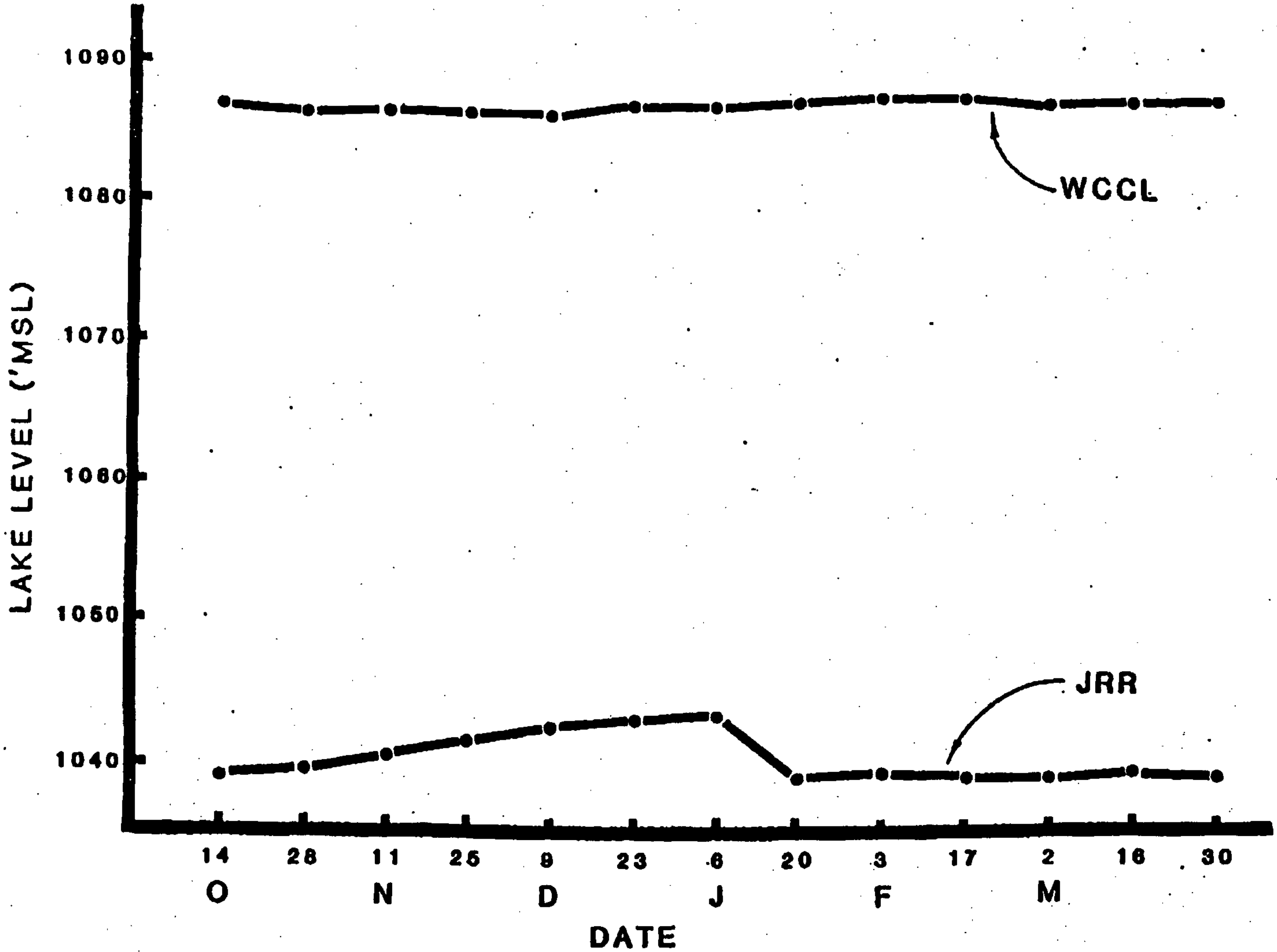

Figure 8. Biweekly lake level elevation ('MSL) averages for Wolf Creek Cooling Lake and John Redmond Reservoir.

An increase of pondweed (Potamogeton spp.) on WCCL was noted during the fall of 1985. The surface area covered by pondweed during the fall of 1986 was similar to that noted during 1985 (KG&E 1986a). Mechanical removal of selected pondweed areas to reduce plant operating problems took place during the fall of 1987. However, because of the relatively small area involved, no waterfowl usage changes were observed. Since pondweed is an important natural food item of the most numerous ducks counted during early fall (Kieth and Stanislawski 1960, Thompson 1973, Duke and Chabreck 1975, Bellrose 1976, Johnson and Swank 1981, Paulus 1982) it was expected that a corresponding increase in early migrant numbers would happen. This was not realized as September and October usage declined 71 percent from 1985 to 1986. Although no September surveys were completed in 1987, October numbers increased by 41 percent of October 1986 numbers. Even with this increase, it is still apparent that the fluctuating water levels provided by JRR was more attractive to early season ducks than the existence of extensive natural aquatic plants offered by WCCL. Greater duck usage, however, would probably occur on WCCL if autumn lake level fluctuations are absent on JRR.

Winter duck usage in the area was almost entirely made up of mallards which will be discussed separately below. Spring usage in the vicinity of WCGS was similar to past studies, preoperational and operational. John Redmond Reservoir attracted most of the ducks in the area (Figure 7). Future station operation is not expected to alter this.

Mallard:

A total of 118,777 mallards was observed during the 1987-1988 monitoring accounting for 89 percent of all ducks observed (Table 6). A peak of 26,510 was counted on December 17, 1987. Contrary to the first two operational winters, the 1987-1988 survey average (November through February) for WCCL was smaller than that on JRR. Although no significant ($p \leq 0.05$) differences were present, mallard usage of the two reservoirs this season was closer to the preoperational winters (Figure 6).

Station operation was expected to preclude ice formation on most of WCCL during the winter and as a result, larger number of some waterfowl species may be induced to remain in the area longer (NRC 1982). Longer usage periods of fall migrating ducks (wigeon, gadwall, blue-winged teal, and others) were not observed during all operational winters. These species left the area, during both preoperational and operational studies before ice-cover preclusion would have played a role, usually during early December. Most ducks having peak uses on both JRR and WCCL during October or November were not present in large numbers when normal weather conditions would cause ice formation (early December). Principal food resources of these species are natural aquatic items (Bellrose 1976), likely Potamogeton spp. in WCCL and these are not as readily available in large quantities as winter progresses, even with heated effluents. Based on this, it is suspected that station operation will not induce most of these species to stay in the area any longer than before. It is reasonable to assume that in this case the birds' inherent need to migrate coupled with declining natural food resources and increasing energy demands played a greater role in the longevity of each species usage of WCCL than did ice-cover preclusion by station operation.

Mallards, however, were present throughout the winter season and have commonly wintered in the area (KG&E 1983, 1984, 1986a, and 1986b). This species relies heavily on cultivated grains during winter and to a lesser extent on natural foods (Bellrose 1976). Since this species occurs in the greatest numbers during winter and does not depend to a large extent on natural food resources, the winter mallard population was considered most likely to be influenced by the lack of ice-cover on WCCL. For the purposes of illustrating this, a winter population was considered present when at least 8,000 were counted for two consecutive counts. A season ended when less than 8,000 birds were counted for two consecutive surveys. Surveys totalling more than 10,000 were used in past studies to illustrate this (WCNOC 1987a), however, because consistent usage greater than 10,000 was not present during the 1987-1988 monitoring, 8,000 was used to better reflect WCCL usage longevity. This was shown for JRR and WCCL data (Figure 9). None of the operational seasons (1985-1986 through 1987-1988) were consistently longer than the preoperational winters (1981-1982 through 1984-1985). Large numbers of mallards have basically stayed throughout the winters, usually on JRR. What is evident is the time the larger mallard concentrations in the area were present on WCCL than on JRR during the operational seasons. This coincided with freeze-up of JRR during 1985-1986. Less than 10 percent of WCCL froze during the same time. Complete ice-cover, though present for a short duration (less than one week) was not as extensive during the 1986-1987 winter on JRR and almost lacking on WCCL, on which only the upstream reaches of the coves developed ice cover. Except for December 1986, monthly average temperatures since plant operation have generally been above normal (Table 5). Even with the relatively mild operational winters, the heated effluents did preclude the formation of extensive ice-cover on WCCL when compared with JRR and this condition greatly influenced the observed increase in late winter mallard attraction to WCCL during the first two operational years. The 1987-1988 mallard usage however, was more similar to preoperational seasons. This was because WCGS was not operating through much of the winter. When the operational average is compared to the preoperational average (Figure 10) it is still apparent that JRR attracts the earlier migrants and WCCL the later migrants and winter residents. This appears primarily a function of ice-free water on WCCL caused by heated effluents from station operation.

Other factors attracting these birds should not be overlooked. These include seclusion, wind protection, and the proximity of available food resources. It should not be inferred here that these factors were not

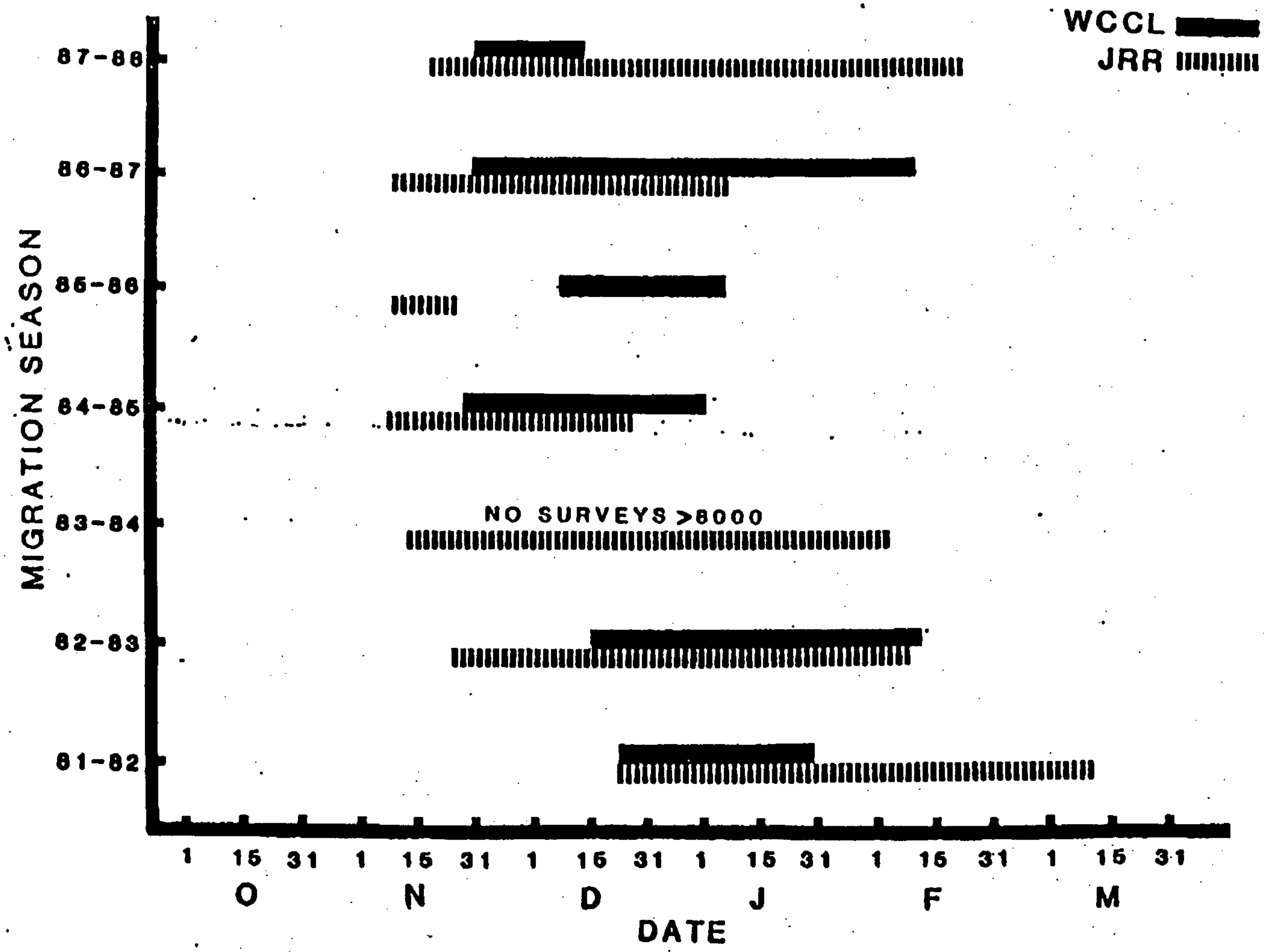

Figure 9. Length of migration season for mallards on Wolf Creek Cooling Lake and John Redmond Reservoir.

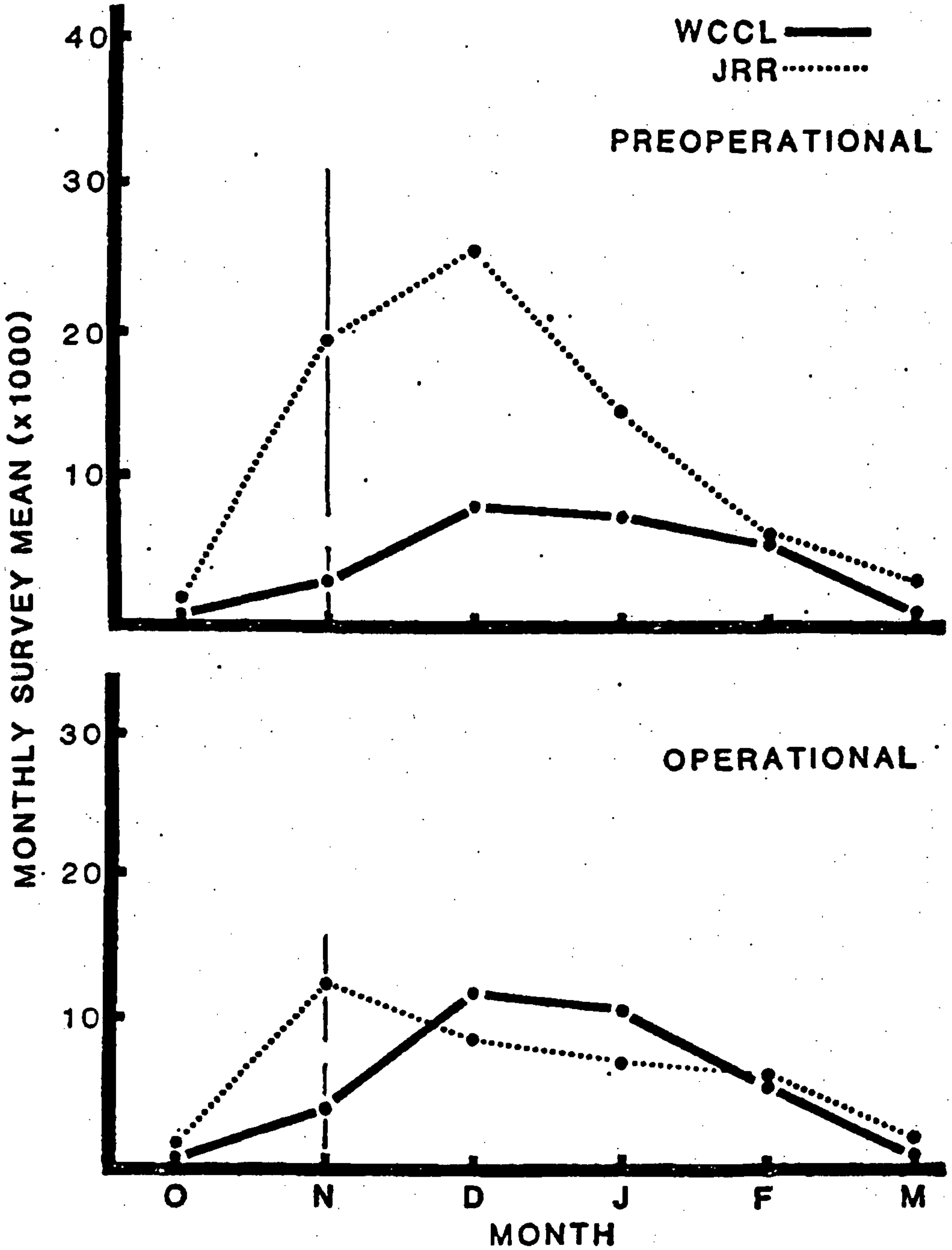

Figure 10. Preoperational and operational (three year means) mallard usage of Wolf Creek Cooling Lake and John Redmond Reservoir. Confidence limits not illustrated were not significant ($p \leq 0.05$).

present or comparable on JRR and the Flint Hills National Wildlife Refuge. In fact, it is probable that these areas provided more of these factors than WCCL. However, these were present on and around WCCL and will be considered as they relate to the cooling lake. Since WCCL was closed to public access, harassment of these mallard concentrations was minimal. The cooling lake served as a refuge for these wintering birds. Aside from the lack of hunter disruption, protection from winter winds were available to mallards since the larger coves offered escape from both north and south winds. Probably most important, however, was the combination of these factors with the presence of an available food supply adjacent to WCCL.

Agricultural crops are heavily used by wintering mallards (Bellrose 1976, Jorde et al. 1983, Baldassare and Bolen 1984). Harvest of fall crops, primarily soybeans, milo, and to a lesser degree, corn was delayed by wet weather accompanied by the lack of substantial ground freezing during the first two operational years. Harvest attempts in some fields were delayed well into January of each season. Many of these fields were within 300 meters (328 yards) from the WCCL shoreline. Weather conditions were closer to normal during the fall of 1987 which allowed harvest to be completed, for the most part, before December. Waste grains were still heavily used, however.

The importance that these factors had in affecting the mallard distribution is reinforced by the area on WCCL these birds used most frequently. Of the five designated areas, Location D was significantly ($p \leq 0.05$) preferred over all other WCCL locations (Table 7) during the first two operational winters. Although not to the same extent, this area was preferred during the 1987-1988 season also. Large wind-protected coves and adjacent cropland characterize this area. Thus, the suggested factors contributing to the late winter mallard attraction to WCCL were present to the greatest degree in the area of WCCL these mallards preferred to be.

TABLE 7. SIGNIFICANT DIFFERENCES BETWEEN RANKED LOCATION MEANS OF MALLARDS AND CANADA GEESE USING WOLF CREEK COOLING LAKE.

Species	Winter	Total Counted	Location Preference
Mallard	1983-1984	16,878	C E B D A
	1984-1985	97,118	C B D E A
	1985-1986	84,103	C E A B D
	1986-1987	192,380	C E A B D
	1987-1988	118,777	C E A B D
Canada goose	1983-1984	3668	C D A E B
	1984-1985	6453	A C B D E
	1985-1986	11,587	C A B E D
	1986-1987	14,584	C B E D A
	1987-1988	13,058	C D B A E

(1) Line underscores ranked (least to greatest) location means that are not significantly different ($p \leq 0.05$)

Goose Usage

The snow goose (Chen caerulescens) and Canada goose (Branta canadensis) were the most common geese observed. This has been consistent with past seasons on both WCCL and JRR. Snows and Canadas on WCCL comprised 44 and 54 percent of the total geese observed (Table 8). The greater white-fronted goose (Anser albifrons) was the only other goose species observed. This species has not been prevalent on WCCL, however, it was present at times in large numbers in the JRR area.

Snow goose usage of WCCL has been low when compared to JRR, especially before plant operation (Figure 10). Use of WCCL can be characterized as being sporadic. Usually one or two large groups used the cooling lake for a short time period compared to consistently using JRR throughout the winters. Since the existence of WCCL until plant start-up, JRR had significantly ($p=0.05$) greater numbers. However, these differences were not significant ($p=0.05$) during the first two operational seasons. The 1987-1988 winter showed numbers closer to preoperational years.

A total of 13,058 Canada geese was observed on WCCL during the 1987-1988 season (Table 8). This represents 10 percent fewer birds than in 1986-1987. The 1987-1988 total on JRR was 3.3 times greater than the previous winter (Figure 11). The increasing trend identified on WCCL (WCNOC 1987a) was not maintained during the 1987-1988 winter. This may be because conditions were closer to those during operational season because WCGS was not producing power during much of the winter. The operational monthly average differences were not as great between the reservoirs signifying increased usage of WCCL after operations began (Figure 12). Present during the preoperational period, however to a much greater degree during operational monitoring, was the late winter Canada increase on WCCL not evident on JRR.

TABLE 8. GROUND COUNT FREQUENCY AND PERCENT COMPOSITION OF GEESE USING WOLF CREEK COOLING LAKE FROM OCTOBER 1987 THROUGH MARCH 1988.

Species	Total Count Frequency	% Total
Canada goose	13,058	54
Snow goose	10,974	44
Gr. wh.-ftd. goose	928	4
Total	24,960	100

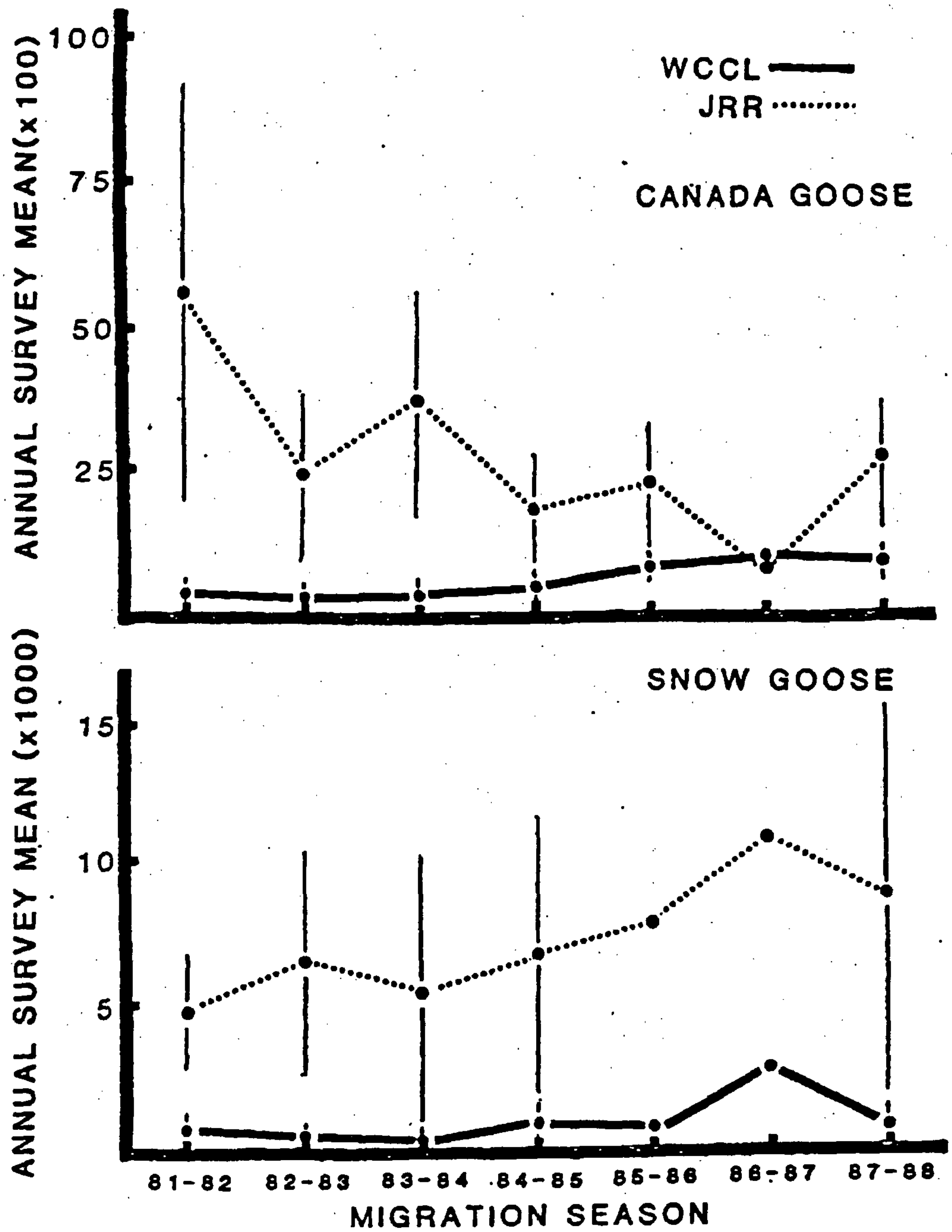

Figure 11. Annual snow goose and Canada goose usage comparisons between Wolf Creek Cooling Lake and John Redmond Reservoir. Data includes November through February surveys. Confidence limits not illustrated were not significant ($p \leq 0.05$).

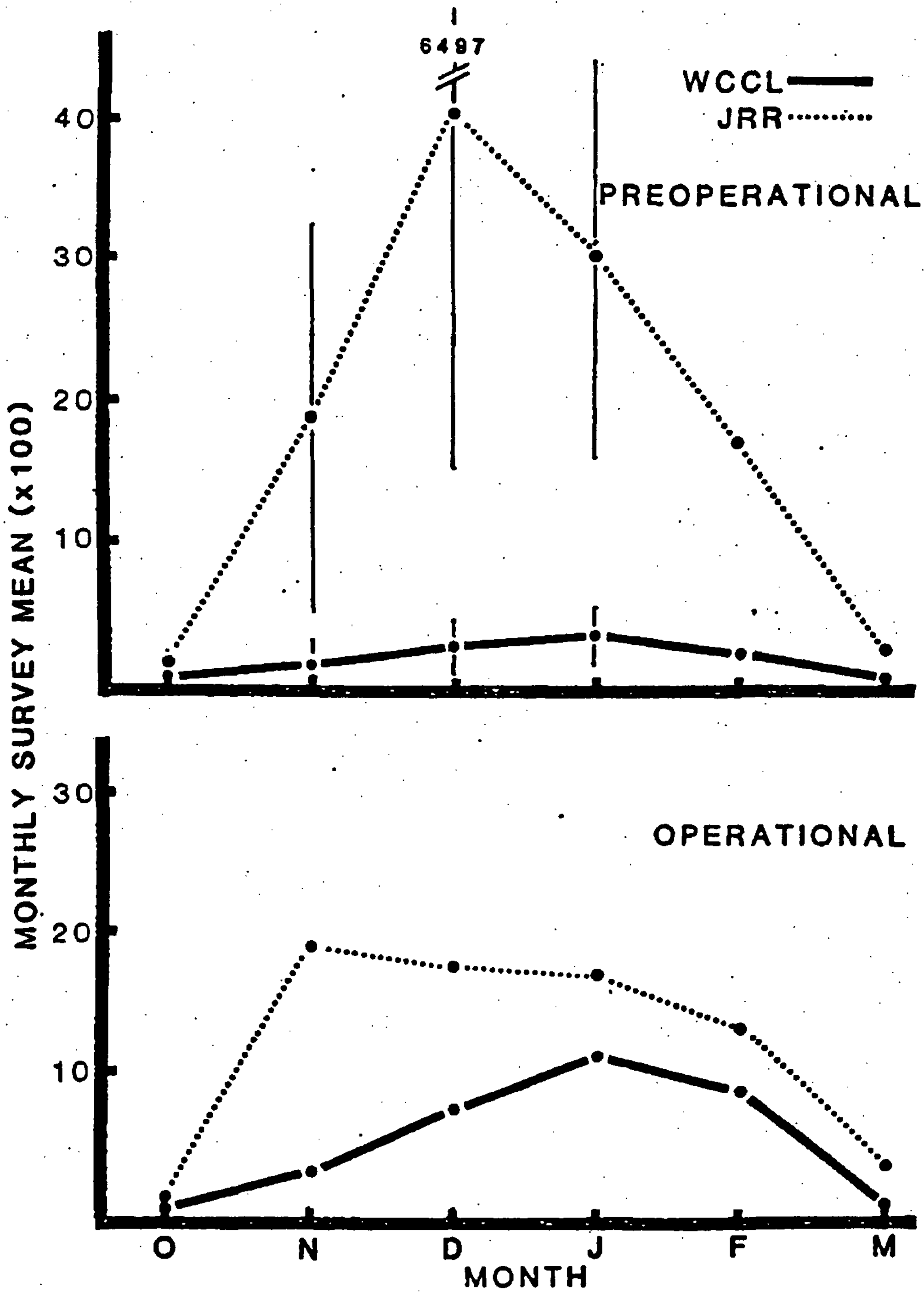

Figure 12. Preoperational and operational (three year means) Canada goose usage of Wolf Creek Cooling Lake and John Redmond Reservoir. Confidence limits not illustrated were not significant ($p \leq 0.05$).

Agricultural grains are used heavily by Canadas, even when natural foods are abundant, and especially when these grain fields are large and open with an undisturbed body of water nearby (Bellrose 1976, Craven and Hunt 1984). This type of area was provided by WCCL, especially along the eastern coves. Canadas, however, did not significantly ($p \leq 0.05$) use these areas (Location D and E) of WCCL (Table 7). It appears that Canada usage of the five lake locations was consistent with no single location being preferred significantly year after year. This seems to fit with the way these birds used crop fields surrounding WCCL. Smaller groups, when compared to mallards or snow geese, fed more opportunistically and did not concentrate in any particular area of WCCL for long periods.

Transmission Line Collision Study

A total of 21 carcasses representing 8 species were found during the 1987-1988 monitoring (Table 9). None of these were listed as threatened or endangered species. The most common species found was the mallard. Most specimens were either partially or totally scavenged with some being represented by feathers only. Almost all of the birds found fresh had injuries considered typically caused by colliding with power lines. These included broken necks, various head and breast abrasions, and broken wings. Since the specimens were found under the highlines and assuming worst case, death of all birds, scavenged or not, was considered to have been caused by line impaction unless causes by other means could be identified.

Several variables in monitoring waterfowl collisions by searching for victims were recognized and attempts were made to account for some of these. Search bias, scavenger removal, and crippling bias are inherent variables which tend to cause dead bird searches, like the ones completed at WCGS, to underestimate actual collision mortality (Anderson 1978, Northern States Power Company 1978, Meyer 1978, James and Haak 1979, Beaulaurier 1981, Willdan Associates 1982, and Faanes 1987).

TABLE 9. SPECIES LIST, LOCATION, AND NUMBER OF MORTALITIES OBSERVED DURING COLLISION SURVEYS OF WOLF CREEK COOLING LAKE FROM NOVEMBER 1987 THROUGH FEBRUARY 1988.

Month	Species	Cemetary Cove	Lime Sludge Pond	Firing Range Cove
November	Double-crested cormorant			3
	Black-crowned night heron			1
	Mallard			2
	Duck sp.			1
	Coot	2		1
	Passerine sp.		1	
December	Mallard			1
January	Double-crested cormorant	1		
	Mallard	2		
	Red-winged blackbird			1
February	Double-crested cormorant	1		
	Mallard			1
	Gadwall	1		
	Common crow		1	
	Bird sp.			1
Totals		7	2	12
				21

Search bias refers to the number of collision mortalities that are assumed to be in the area, but the observers normally are unable to find. Seventeen dead birds were planted to measure the searcher recovery in the WCGS studies. Four gadwall, one hooded merganser (Lophodytes cucullatus), two greater prairie chicken (Tympanuchus cupido), and 10 northern bobwhite (Colinus virginianus) were used. Recovery in each area was 37.5, 33.3, and 50.0 percent in the Firing Range Cove, Lime Sludge Pond, and the Cemetery Cove respectively (Table 10). With all areas combined, 41.2 percent of the planted birds were found.

Scavenger removal was measured using the same planted birds. By day six of the removal monitoring, all planted birds were scavenged (Table 11). A high percentage were eaten by the third day. Scavenged birds in all areas vanishing without a trace comprised 58.8 percent. Common mammalian predators or scavengers either seen or leaving tracks in the study areas were coyote (Canis latrans), raccoon (Procyon lotor), opossum (Didelphis marsupialis), and striped skunk (Mephitis mephitis). Red-tailed hawk (Buteo jamaicensis), northern harrier (Circus cyaneus) and bald eagle were common birds of prey frequenting the areas.

Crippling bias refers to the number of birds colliding with the transmission lines and falling outside of the study area. Dead bird searches would not account for these. Formal collision observations were not completed at WCGS. Observed crippling rates reported by Meyer (1978) was 75 percent and by James and Haak (1979) was 73 percent. Both of these studies were completed in Oregon and Washington. Assuming that birds in this area were as likely to sustain similar injuries by striking a transmission line as those reported by those studies, an average between these (74 percent) was used to compute the crippling adjustments for the this study. Based on this, 74 percent of the birds colliding with the lines did not fall in the study areas. Incidental collision sitings by station biologists suggested slightly higher percentages may actually be able to fly away for some distance after colliding.

TABLE 10. SEARCHER RECOVERY OF PLANTED BIRDS DURING COLLISION LINE STUDIES AT WOLF CREEK GENERATING STATION

Location	Number Planted	Number Found	Percent Found
Firing Range Cove	8	3	37.5
Cemetery Cove	6	3	50.0
Lime Sludge Pond	3	1	33.3
All Locations Combined	17	7	41.2

TABLE 11. SCAVENGER REMOVAL RATES OF PLANTED DEAD BIRDS IN THE TRANSMISSION LINE STUDY AREAS AT WOLF CREEK GENERATING STATION.

Location	Days Elapsed	Number Planted	Cumulative Number Scavenged	Cumulative Removed No Trace	Cumulative Percent Removed
Firing Range Cove	1	8	5	3	37.5
	2		5	3	37.5
	3		6	3	37.5
	6		8	3	37.5
	9		8	3	37.5
Cemetery Cove	1	6	4	4	66.7
	2		5	4	66.7
	3		6	5	83.3
	6		6	5	83.3
	9		6	5	83.3
Lime Sludge Pond	1	3	1	1	33.3
	2		2	1	33.3
	3		2	1	33.3
	6		3	2	66.7
	9		3	2	66.7
All Locations Combined	1	17	10	8	47.1
	2		12	8	47.1
	3		14	9	52.9
	6		17	10	58.8
	9		17	10	58.8

Another possible bias was unsearchable habitat (James and Haak 1979, Beaulaurier 1981, Willdan Associates 1982, and Faanes 1987). This refers to the proportion of habitat in each study area that was not searchable, such as the areas under the lines crossing over water and very dense vegetation. Parts of all study areas at WCGS crossed over water. Those collisions landing in the water were certainly subjected to being blown away from the study areas. On the same token, winds blowing towards the study areas would concentrate collisions along the shorelines which were searched. Also, when ice cover was present, those areas were easily scanned for dead birds.

Dense vegetation was also very prevalent in the study areas. In the Firing Range Cove area, strips were mowed under the transmission lines during the 1985-1986 and the 1986-1987 monitoring. This was done to aid in finding collisions. However, no increase in observed collisions were evident. Also, it was felt that the planted bird study would measure the searchers' abilities to recover collision victims and account for the unsearchable habitat bias. For these reasons and the logic used for birds falling in the water, it was felt that the biases presented by unsearchable habitat was of minor concern at the WCGS study sites.

After making adjustments to the total dead birds found to account for the search bias, scavenger removal bias, and crippling bias, an estimate of the total transmission line collisions can be derived (Table 12). Because many assumptions have to be made when making these adjustments and the sample size used to measure the biases was small, a large amount of variation exists. Care must be taken in relying heavily on these estimates because of this large chance of error involved. However, it is felt that these estimates represent maximum numbers which are worthy to assess the significance of transmission line collision mortality at WCGS.

TABLE 12. TOTAL ESTIMATED TRANSMISSION LINE COLLISIONS AND BIAS ESTIMATES AT WOLF CREEK GENERATING STATION FROM 1984 THROUGH 1988.

Winter of	Location	Dead Birds Found	Search Bias	Removal Bias	Crippling Bias	Estimated Total Collisions	Percent of Count Frequency
1983-1984	Firing Range Cove	23	61.3	50.6	383.9	518.8	-
	Cemetery Cove	1	1.0	10.0	34.2	46.2	-
	Lime Sludge Pond	1	2.0	6.0	25.6	34.6	-
	Combined	25	35.7	86.6	419.2	566.5	0.5
1984-1985	Firing Range Cove	26	43.3	41.6	315.6	426.5	-
	Cemetary Cove	3	3.0	29.9	102.3	138.2	-
	Lime Sludge Pond	1	2.0	6.0	25.6	34.6	-
	Combined	30	42.8	103.9	502.9	679.6	0.2
1985-1986	Firing Range Cove	26	43.3	41.6	315.8	426.7	-
	Cemetery Cove	22	22.0	219.5	749.9	1013.4	-
	Lime Sludge Pond	12	24.0	72.1	307.7	415.8	-
	Combined	60	85.6	207.8	1005.8	1359.2	0.5
1986-1987	Firing Range Cove	9	15.0	14.4	109.3	174.7	-
	Cemetery Cove	6	6.0	59.9	204.6	276.5	-
	Lime Sludge Pond	13	26.0	78.1	333.3	450.4	-
	Combined	28	40.0	97.0	469.6	634.6	0.2
1987-1988	Firing Range Cove	12	20.0	19.2	145.7	196.9	-
	Cemetary Cove	7	7.0	69.8	238.6	322.4	-
	Lime Sludge pond	2	4.0	12.0	51.2	69.2	-
	Combined	21	30.0	72.8	352.4	476.2	0.2

Anderson (1978) reported that 0.2 to 0.4 percent of the peak bird usage on Lake Sangchris, Illinois, were killed by colliding with transmission lines during each fall. Rusz et al. (1986) had similar collision rates at the Midland Energy Center in Michigan as Anderson (1978), however, the percentage of the peak usage count was not reported. For two study seasons, Faanes (1987) estimated that 1332 birds were killed by transmission line collisions. The fall collision percentage of the fall peak count was roughly 6 percent. Meyer (1978) at Lower Crab Creek in Washington estimated 40 birds collided with the highlines and a maximum of 9000 were estimated to be using the area. The estimate represents 0.4 percent of this peak. At Bybee Lake in Oregon, (Meyer 1978) estimated that a maximum of about 12,500 birds were using the area and estimated 28 ducks collided in the study area. This represents about 0.2 percent. James and Haak (1979), Beaulaurier (1981) and Willdan Associates (1982) all reported similar results as Meyer (1978).

At WCGS the collision estimated percentage of the total birds counted using WCCL each year ranged from 0.2 to 0.5 percent (Table 12). These rates are similar to those referenced above, however they are not presented as a percent of peak usage, but as the percentage of the sum of all counts. These are considered comparable because no correlation was present between the number of birds using each study area and the number of dead birds found. Increasing bird usage did not correspond to increased collision mortality. Likewise, greater evidence of collisions was not necessarily during peak usage periods. Anderson (1978) did find such relationships. Aside from this, care must also be taken when comparing the studies above with each other and with this study. Weather conditions, transmission line positions to waterfowl concentrations and flights, species compositions, among other factors were likely to have been different from study to study. However, it is felt that they do show that the order of magnitude of the estimates are close, which implies that they are somewhat useful in comparing similarities.

The significance of the estimated collisions to the waterfowl and waterbird populations using WCCL is not considered very great. Stout and Cornwell (1976) contributed only 0.1 percent of the total of non-hunting waterfowl mortality to collisions. Disease and poisons were responsible for 87.7 percent. Humberg et. al. (1983) also contributed a large portion of the non-hunting waterfowl mortality to disease and lead poisoning, however, transmission lines were not involved with the study. A total first year mortality rate of 60 to 70 percent for juvenile ducks and a subsequent rate of loss of 35 to 45 percent was reported by Bellrose (1976). Based on the small percent that the estimated collisions at WCGS comprised of the total population on the cooling lake and the high mortality percentage normally experienced by waterfowl and waterbird populations, it was concluded that deaths caused by WCGS transmission facilities was insignificant. No substantial increases or decreases were noticed between preoperational and operational seasons. Since no threatened or endangered species were found during the dead bird searches, WCGS transmission facilities have not posed any threat to those populations. A comparatively larger number of bald eagles, however, were observed in the Cemetery Cove area during the 1987-1988 winter than the previous winters. No problems with collisions or near misses were observed. Eagles seemed to use the ice-free areas south of the highlines and did not routinely cross the lines. Because bald eagles have keen eyesight, fly relatively slow, and maneuver well, highline collisions should be reduced. However, as noted by Kroodsma (1978), they often fly during poor visibility and may not be attentive when concentrating on hunting causing their collision potential to increase. Steam fog from station operation is common in the Cemetery Cove study site which would reduce visibility thus further tend to increasing collision potential. Despite these factors, no eagle mortality from WCGS lines have been observed and given similar WCCL usage in the future, no problems with collision mortality is expected.

CONCLUSIONS

Avian density and diversity observed during operation of WCGS were similar to preoperational studies. Establishment of WCCL has resulted in an increase in species diversity observed in the local area. Annual species diversities have increased approximately 50 percent above those observed prior to lake filling. This was expected as the lake provided numerous waterbird habitats while upland areas supported similar bird populations that were present prior to lake filling. Detectable differences due to station operation were not found.

Threatened or endangered species observed since 1973 included the White-faced ibis, bald eagle, peregrine falcon, prairie falcon, and interior least tern. Bald eagles were common winter residents using WCCL primarily as a feeding and loafing site. The prairie falcon was removed and the white-faced ibis was added to the Kansas threatened list as of May 1987. These species migrate through or infrequently visit the area and can be expected to be observed in the future.

Bald eagle usage on WCCL declined initially since plant operation began while remaining constant on JRR. A large increase was observed during the 1987-1988 winter. Initial operational usage on WCCL declined primarily because of the two mild winters which caused gizzard shad, a more vulnerable and preferred food resource, to be more available on JRR than WCCL. Because WCGS was not operating during much of the 1987-1988 monitoring, usage tended to be influenced by the continuous freezing and thawing of the ice-cover on WCCL. This exposed winter killed gizzard shad not usually abundant on WCCL. Intermittent operations through a normal winter period appears to cause WCCL to be an attractive bald eagle feeding location. Bald eagle usage during severe winter periods with WCGS operating continuously could not be characterized.

Waterbird usage between the two lakes was similar to past years. American coots used WCCL to a much greater extent than JRR. Pondweed development was thought to be the primary reason for this. Double-crested cormorants used both lakes similarly. It was apparent that JRR provided easier foraging habitat while WCCL supplied roosting and nesting sites.

Of the ducks observed on both reservoirs, fluctuating water levels on JRR appeared to greatly influence the distribution between the lakes of early fall migrants. During periods of little fluctuation on JRR, WCCL with its aquatic macrophyte growth appeared to attract these ducks, especially during the 1984-1985 preoperational study. Continued heavy use of these weed beds was not evident during operational studies. With high water levels on JRR, this influence was over-shadowed by the attractiveness of JRR. The operation of WCGS greatly influenced the duck distribution between the two lakes during late winter. The heated effluent kept most of WCCL ice-free, providing previously unavailable late winter habitat. This, in combination with seclusion and close abundant food supplies, appeared to keep ducks on WCCL longer than during preoperational seasons. Because WCGS did not operate continuously during the 1987-1988 monitoring, this pattern was not as distinct. Spring ducks were attracted to JRR almost exclusively over WCCL as during preoperational seasons.

Goose distribution between the two reservoirs was similar to preoperational seasons. The increasing trend evidenced during previous years was not continued during the 1987-1988 operational year possibly because WCCL reflected preoperational conditions.

It was shown that WCCL usage, mallards, snow geese, and to a lesser extent, Canada geese increased initially after operations during winter periods when ice formation on JRR was present. However, usage during the 1987-1988 study compared to preoperational studies due to an extended plant outage. Although ice-free condition was probably a major factor, it was evident that wind protection, hunter refuge, and/or high food availability contributed. The area where these factors were most prevalent on WCCL was preferred by mallards and snow geese. These types of waterfowl concentrations are known to cause problems with crop depredations and disease outbreaks (Bellrose 1976, Hawthorne 1980, Frederick and Klaas 1982, Kahl and Samson 1984, Frederick et al. 1987). However, the concentrations as of this report have not reached levels high enough to cause wide-spread crop depredation problems. Given similar usage patterns in the future, mallards and snow geese may be expected to have the greatest potential for causing depredation problems around WCCL. This is because these species occur in large concentrations. Although snow geese usage from year to year has been highly variable, they have crowded in areas of WCCL at times when late-harvested crops were most vulnerable. Canada geese, although using the same crop types and present on the lake during the same time periods, at this time should not cause problems because they have tended to occur in smaller concentrations around the cooling lake. Any Canada depredation problems would likely be highly localized. Although waterfowl disease outbreaks have not been observed, potential areas of concern will be similar as for crop depredation events because of the consistent usage of the same areas.

Results of collision surveys revealed similar mortality rates to those previously documented. Eight species were identified during the study. No threatened or endangered species were found during these surveys. Inherent biases were identified and measured. It was concluded that collisions with transmission facilities associated with WCCL during peroperational and operation monitoring did not cause sufficient avian mortality to be considered problematic. Also, it was concluded that because of the collision consistency observed between years, the collision potential of WCGS has been characterized and that no further studies are needed. This statement is valid only if usage of WCCL, especially that of bald eagles, remains similar to that reported.

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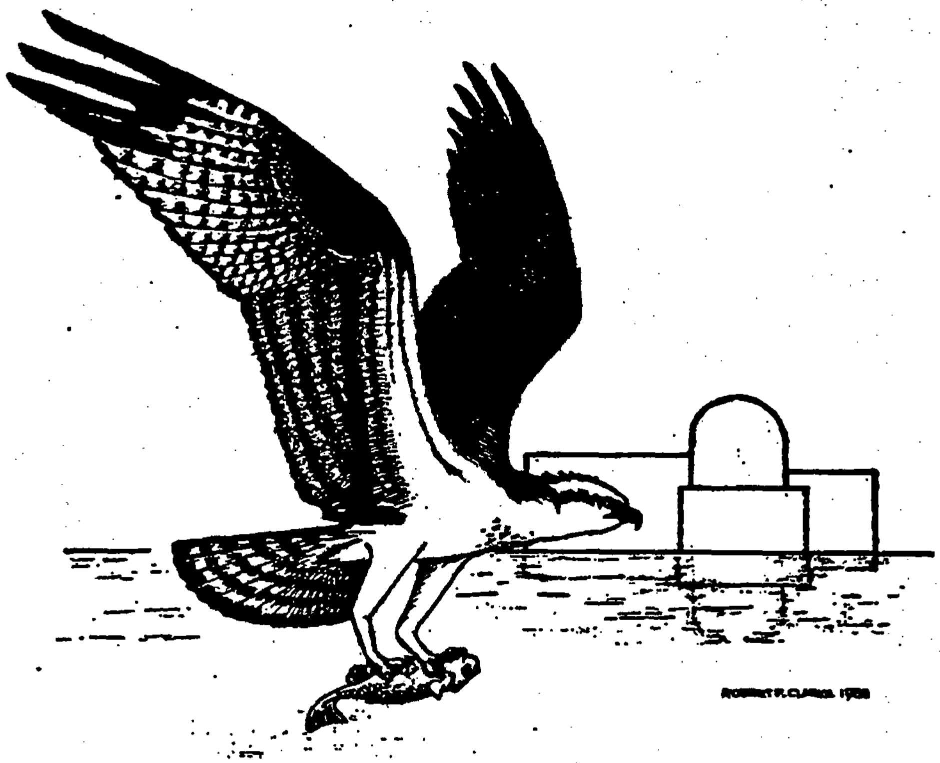
WOLF CREEK GENERATING STATION

1995-1996 OPERATIONAL WILDLIFE MONITORING REPORT

WOLF CREEK NUCLEAR OPERATING CORPORATION



ENVIRONMENTAL MANAGEMENT GROUP
RESOURCE PROTECTION
OCTOBER 1996

WOLF CREEK GENERATING STATION

1995-1996 OPERATIONAL WILDLIFE MONITORING REPORT

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Abstract

Waterbird, waterfowl and bald eagle usage was monitored on Wolf Creek Lake (WCL) from October 1995 through March 1996. This report compares eleven seasons of operational monitoring and characterizes patterns that have developed.

Thirty-four species of waterbirds and waterfowl were observed during the 1995-1996 monitoring period with mallard, snow goose, and Canada goose being most abundant. No disease or crop depredation problems were observed during the 1995-1996 monitoring season. No significant transmission line collision events nor increased potential for such were observed.

During operational winters, the heated effluent has provided previously unavailable open water habitat on WCL. This, in combination with seclusion and close abundant food supplies, has made WCL attractive to waterfowl during cold winters when other area lakes are frozen over. Significant ($p \leq 0.05$) preferences for areas of WCL providing these factors have been found. The relatively mild winters of the past several years have negated the attractiveness of WCL resulting from the heated effluent. Mallard usage of John Redmond Reservoir (JRR) has been consistently higher than usage of WCL during these mild winters.

During operational winters, WCL does not normally attract a disproportionate number of area bald eagles. The seasons of highest usage are associated with plant trips or power reductions causing cold shock fish kills resulting in a food resource not typically available in such quantity at WCL. Even then, eagles have sometimes utilized JRR nearly as much or more than they did WCL. Recent trends seem to indicate that area bald eagles prefer JRR over WCL even when JRR is ice-covered and WCL is largely ice-free. Thus, WCL does not appear to be affecting the area bald eagle population so as to attract such high numbers that transmission line mortality could be a problem.

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INTRODUCTION

This report presents results of the operational wildlife monitoring program conducted at Wolf Creek Generating Station (WCGS) from October 1995 through March 1996. This program was conducted by Wolf Creek Nuclear Operating Corporation (WCNOC) to monitor wildlife issues identified in the WCGS Environmental Protection Plan (EPP), which is Appendix B of the Facility Operating License. This program represents further refinements to the operational monitoring efforts committed to in the Final Environmental Statement (U. S. Nuclear Regulatory Commission 1982).

The general objectives of the program were to document and assess any trends or impacts that may be due to station operation. The greatest potential for impacts is to migrating or wintering populations of waterbirds, waterfowl and threatened or endangered species. Use of Wolf Creek Lake (WCL) by these birds may expose them to transmission line collision mortality or to disease outbreaks. Damage to local agricultural crops by large waterfowl concentrations using WCL is also a concern. To document and assess such occurrences or increased potential for such, specific objectives of the program were to monitor how many and where waterbirds, waterfowl, and threatened and endangered species used WCL during the winter migration season and compare these to the norm observed since station operation began.

Section 4.2.2 of the EPP specifies that a general survey program shall be accomplished to document significant waterfowl collision events and determine if mitigation is warranted. Upon analysis of data collected during the 1987-1988 dead bird searches, it was concluded that enough data had been collected to sufficiently characterize line impaction mortality of birds using WCL. The conservatively estimated collision mortality rate was not considered significant (WCNOC 1988). As a result, dead bird monitoring has not been conducted as a separate activity since 1988. Instead, collision monitoring has been covered by the general waterfowl usage surveys. The results presented in this report satisfy EPP collision monitoring requirements.

Description of Study Area

WCGS is located in Coffey County approximately 5.6 km (3.5 miles) northeast of Burlington, Kansas and is operated by WCNOC. The area within the WCGS site boundary encompasses 3,973 ha (9,818 acres) composed primarily of range, cropland, and woodland habitats typical of southeastern Kansas. Surrounding land-use within five miles of WCGS is composed of 40 percent agricultural land, 40 percent rangeland, nine percent woodland, five percent built-up area, and six percent miscellaneous (Kansas Gas & Electric 1981). The power block area, including a switchyard and lime sludge pond, covers nearly 100 ha (250 acres) while the cooling lake inundates 2,060 ha (5,090 acres) at normal pool. A once-through cooling system pumping water from and back into WCL is used by the station.

The cooling lake for WCGS was formed by an earth-rolled main dam approximately 3.7 km (2.3 miles) long (Figure 1). The dam, along with five perimeter saddle dams, impounds Wolf Creek approximately 8.8 km (5.3 miles) above its confluence with the Neosho River. At an elevation of 331.3 m (1,087 feet) MSL the cooling lake has a mean depth of 6.6 m (21.5 feet). It has a limited drainage of 50.4 sq. km (19.5 sq. miles) not including the surface area of WCL, which will not provide adequate run-off to maintain the water level during plant operation (Kansas Gas & Electric 1974). Additional water is pumped as needed from industrial storage in John Redmond Reservoir (JRR). The cooling lake is maintained at a relatively constant level (within a two foot range) throughout the year. The most influential structures on the cooling lake are associated with the circulating water system for WCGS. Baffle Dikes A and B (Figure 1) force heated discharge water to travel nearly the length of WCL before being pumped through the station again. This allows for maximum heat dissipation thus increasing the lake's cooling efficiency. These dikes provided access which allowed for almost complete waterfowl surveys of the lake shorelines.

Of the five WCL locations designated to assess area preferences by birds, each had unique components. Location A represents the northern and upstream reaches of WCL. It has a surface area of 142 ha (352 acres) which includes approximately 28 ha (70 acres) of flooded dead timber. Shorelines are associated primarily with cropland and grassland. Prominent aquatic macrophytes include cattails (Typha sp.), narrow-leafed pondweed, (Potamogeton foliosus), American pondweed (P. nodosus), Lotus (Nelumbo lutea) and smartweed (Polygonum sp.). The area is protected from harsh winds, especially from the north.

Location B is the area of WCL which is most affected by thermal discharges and flow during WCGS operation. The surface area is 500 ha (1,234 acres) and has approximately 12 ha (30 acres) of flooded trees and brush. Shorelines are adjacent primarily to cropland and grassland. Aquatic macrophyte growth includes narrow-leafed pondweed, American pondweed, cattails, trace amounts of Chara spp., and smartweeds. Wind-protected areas are numerous in this area. Heat and flow from the circulating water discharge keep this location generally free of ice when WCGS is operating.

Location C is the largest location (913 ha, 2,255 acres) and represents the main body of the lake. There is very little inundated timber and all of the shorelines are either adjacent to native and domestic grassland or rip-rap. Macrophyte growth consists of narrow-leafed and American pondweed. These weed beds cover less than one percent of the total surface area. Few wind-protected areas exist within this location.

Location D comprises 331 ha (817 acres) in the southeast part of WCL and includes approximately 49 ha (20 acres) of flooded timber. Large areas of cropland surround this area and much of the location is protected from north winds. Macrophyte composition is narrow-leafed and American pondweed.

Location E is the area of WCL which was expected to be most affected by circulating water intake flows. This area encompasses 175 ha (432 acres) and has little flooded timber. Pondweed beds are well developed in this area with most of the shoreline and littoral areas supporting some growth. Composition of the aquatic plants was narrow-leafed and American pondweed and Chara sp. Native grasslands border much of this location. Refuge areas from most winds are abundant.

JRR, a flood control project which is controlled by the U. S. Army Corps of Engineers, was completed during 1964. This reservoir, which is on the Neosho River, lies approximately 5.9 km (3.6 miles) west of the station. At their closest points, JRR is less than 3.2 km (2 miles) from WCL (Figure 2). JRR has a surface area of 3,804 ha (9,400 acres) at conservation pool and a total project area of 12,829 ha (31,700 acres). The lake is relatively shallow with an average depth of approximately 1.4 m (4.5 feet). Flint Hills National Wildlife Refuge, managed by the U. S. Fish and Wildlife Service (USFWS) as part of the national migratory waterfowl program, occupies 7,487 ha (18,500 acres) in the upper reaches of the project. For the purposes of this report, all reference to JRR includes the Flint Hills National Wildlife Refuge.

METHODS

Bird Usage

Usage of WCL by waterfowl, waterbirds, and bald eagles (Haliaeetus leucocephalus) was surveyed during the migratory season from October 1995 through March 1996. Waterbird refers to a bird that lives part of its life in or around water, especially the swimming, diving, and wading birds (Terres 1980). For the purposes of this report, waterbirds will exclude waterfowl (ducks and geese). Two ground counts were conducted each month. Two additional counts were completed in January and February to increase statistical accuracy during peak usage periods by bald eagles. Counts were timed to coincide with surveys completed by the Kansas Department of Wildlife and Parks (KDWP) and the USFWS on JRR. All usage data for JRR were supplied by these two agencies. Individual species, total numbers, and distribution on the cooling lake and adjacent shoreline areas were determined with the aid of binoculars or a spotting scope. Estimates were made when large numbers prohibited actual counts of individuals.

To detect annual usage trends for WCL and JRR, the average numbers of selected species counted on each survey were compared. To determine the changes in seasonal patterns the monthly survey averages for the 1994-1995 season were compared to the combined monthly averages of prior operational seasons. Ninety-five percent confidence intervals (Sokal and Rohlf 1981) were used to determine if differences between both annual and monthly averages were significant.

WCL was divided into five separate locations, identified as A through E (Figure 1), to assess waterfowl and waterbird usage. With Duncan's New Multiple Range Test (Duncan 1955), preferences for these WCL locations were tested. All count totals to be tested were converted to number of birds per acre.

Species selected to assess station impacts were the bald eagle, mallard (Anas platyrhynchos), Canada goose (Branta canadensis), and snow goose (Chen caerulescens). These were used because they regularly occur in relatively high numbers, are a threatened or endangered species using WCL consistently, or have the greatest potential for serious disease outbreaks, significant transmission line collision events, or to cause serious crop depredation problems. All other species observed were recorded and any unusual concentrations or occurrences were noted.

Collision mortality events had the greatest potential in areas of WCL traversed by the transmission lines (Figure 1). These areas were targeted during past dead bird searches (WCNOC 1988). Usage patterns were observed in these areas during the waterfowl surveys to determine if changes might be taking place which would increase collision potential. Observers focused on such things as feeding flight patterns, excessive loafing under the lines, land use changes, and/or unusual traversing or concentrating of bald eagles in these areas to determine if further study or mitigative action may be required.

RESULTS AND DISCUSSION

WCL Bird Usage

Sixteen ground counts were completed during the 1995-1996 program. Surveys ranged from 60 to 135 minutes and averaged 93 minutes in duration. Thirty-four species of waterfowl and waterbirds were observed during ground surveys (Table 1). Species diversity ranged from 18 species in February 1996 to 25 in January 1996. Comprising 37, 33 and 16 percent respectively, mallard, snow goose, and Canada goose were the most abundant species observed (Table 2).

Threatened and Endangered Species

Threatened and endangered species observed in the past around WCGS include the white-faced ibis (Plegadis chihi), bald eagle, peregrine falcon (Falco peregrinus), and interior least tern (Sterna antillarum). Of these species, only the bald eagle was observed on the site environs during the 1995-1996 winter. The other species may be expected to be occasional visitors in the future, and station operation is not expected to impact this.

The bald eagle, considered endangered by the state of Kansas (Kansas Administrative Regulations 1989) and threatened by the United States government, (U. S. Department of Interior 1995), has been a common winter resident on WCL. Migrating eagles are usually first observed during mid-November. A peak count of 82 bald eagles was made on February 6, 1996 for WCL. The largest single count on JRR indicated 8 bald eagles present on January 5, 1996. Of the birds observed on WCL, adults and juveniles each comprised 50 percent of the total.

Eagle usage of WCL prior to plant operation was primarily as a feeding and loafing site. In this respect, use during operational monitoring has not appeared to change. The flooded timber provides numerous daytime perch sites. Although not verified, roosting overnight probably also occurs. Normal operation of WCGS does not appear to affect bald eagle usage of WCL. While it had been thought that the open water, present because of the heated discharge, may attract eagles when JRR is ice-covered, this does not appear to be the case. WCL usage rates, while usually lower than JRR usage rates, typically follow the same annual and seasonal patterns as JRR's (Figures 3 & 4). This apparent preference for JRR can probably be attributed to the higher availability of gizzard shad (Dorosoma cepedianum) at JRR during the winter. The management of the WCL fishery results in a depleted gizzard shad population during the winter.

In order to better understand the differences in usage between the two reservoirs, bald eagle habitat requirements should be discussed. Three primary components of eagle winter habitat include communal nocturnal roost sites, diurnal perch (loafing) sites, and a readily available food source (Steenhof 1978). Nocturnal and diurnal perch sites are present on both WCL and JRR reservoirs and the quantity and quality of these have not changed appreciably since monitoring began. Since these two winter habitat resources have been consistent throughout preoperation and operation, they were not considered to have been factors in eagle usage of WCL and JRR.

Of the requirements, food availability between the reservoir areas differed the most. Bald eagles have opportunistic foraging habits, with fish and waterfowl being major components. Eagles often shift from one to the other during the course of a winter (Southern 1963, 1964, Lish and Lewis 1975, Steenhof 1978, Meyer 1980, Griffin et al. 1982, Ecological Analysts 1983, Griffin and Baskett 1985, Keister et al. 1987). Waterfowl probably weren't as important as fish in the distribution of eagles during operation. Eagles commonly exploit waterfowl resources, but usually only when fish become unavailable. Bald eagles seem to be inefficient predators on healthy waterfowl (Steenhof 1978, Griffin et al. 1982, Frenzel and Anthony 1989) although weakened, crippled, and dead waterfowl are readily taken (Lish and Lewis 1975, Griffin et al. 1982, Steenhof 1978, Todd et al. 1982, Keister et al. 1987).

The frequency of hunter crippled waterfowl was not known in the study area, but because hunting was permitted in several areas of JRR and only in one small area of WCGS property, it may be assumed that greater numbers were available to eagles on JRR.

However, since hunting seasons closed for most species during January, the importance of hunter crippled waterfowl during February should have been reduced. Also, fluctuations in waterfowl numbers on WCL during the operational winters were not necessarily followed by corresponding changes in eagle numbers. This indicates that waterfowl as a food source was not of primary importance for this area's wintering bald eagle population.

Fish appear to be the preferred food source, when available. Gizzard shad in this region are susceptible to winter kill, and this species occurs in much greater numbers in JRR and the Neosho River than in WCL (EA Engineering, Science, and Technology Inc. 1988, WCNOC 1991a). Shad are highly preferred by bald eagles, probably because of their vulnerability, especially during winter in the ice-free headwaters and tailwaters of lakes (Lish and Lewis 1975, Steenhof 1978, Ecological Analysts 1983). Fish disoriented or killed as they pass through flood gates below dam projects are easy prey for eagles. JRR and the associated Neosho River reaches provide these types of areas. The cooling lake, on the other hand, does not have a major drainage stream flowing into it. Consequently, continuous discharges below the dam exposing these fish are not present. In addition, the availability to eagles of winter-killed fish, mainly shad, increases in the main bodies of reservoirs as the ice cover thaws (Steenhof 1978, Meyer 1980, Griffin et al. 1982). Since the addition of heated effluents, ice cover has been almost lacking on WCL during mild winters while still prevalent on JRR. Relatively low gizzard shad numbers and available warm water are also factors contributing to the reduced food availability at WCL. Thus, during station operation, it has been evident that fish resources for eagles occurred in greater concentrations at JRR and because they were more vulnerable, were typically easier to obtain on JRR and the Neosho River than on WCL. However, when annual usage of the two lakes is compared (Figure 4), there does not initially appear to be a consistent pattern of favoring one lake or the other from year to year. Even considering the severity of the winter (Table 3), which factors in the availability of open water at JRR, no correlation is evident between this and bald eagle usage of the two reservoirs.

There does, however, appear to be a correlation between increased bald eagle usage of WCL and winters when cold-shock events affected the fishery in WCL. These cold-shock events occur when the temperature of the circulating water discharge drops suddenly as a result of a plant trip or a rapid reduction in power generation. Documented fish kills caused by cold-shocks or events that likely resulted in fish kills provided abundant and easily obtained food resources for eagles during the winters of 1987-1988, 1988-1989, 1989-1990, 1990-1991, 1993-1994, and 1995-1996. The presence of shad and other fish remains under perch trees used for feeding by the eagles supports the assumption that bald eagles took advantage of these circumstances. The impact of cold-shock events is limited to the circulating water dischage area (Location B), therefore, it would be expected that bald eagle concentrations occur at Location B or Location A, which provides the nearest abundance of perching sites for feeding or loafing behavior.

During the 1995-1996 study period, Location A received the most usage by bald eagles, followed by Location B (Table 4), although there was no significant ($p > 0.05$) difference in usage among any of the five locations. During the six winters when cold-shock events occurred, Location B either received the highest usage by eagles or was second and not significantly ($p > 0.05$) lower than the location receiving the highest usage. During the seven winters when cold-shock events were not a factor, Location D received the most use by bald eagles five of those years and was second for one of the remaining two years.

Higher bald eagle numbers at WCL increase the chances for transmission line collision problems. No bald eagles were found during routine dead bird searches done in past seasons (WCNOC 1988). When the large concentrations were present during the 1988-1989 and 1993-1994 seasons, several eagles were observed flying over, with some actually passing through, transmission lines. The line most frequently crossed was the LaCygne-Benton 345 kV as it heads northwest from the power plant across the eastern coves of Location B (Figure 1). Because of these observations, a dead bird search was conducted during the 1988-1989 season to determine if bald eagle collision events were occurring. No evidence of bald eagle collisions was found. Usage patterns observed during the 1995-1996 monitoring period revealed no differences which increased collision potential over past seasons. Considering these monitoring results, collision mortality of bald eagles from WCGS transmission lines has not been and is not expected to become a serious threat to them.

During the 1992-1993 winter, a pair of bald eagles constructed a nest structure on WCL. No attempt at nesting was observed during the spring of 1993. However, during the winter of 1993-1994, construction of the nest continued, and in March 1994, a pair of adult bald eagles were observed exhibiting incubating behavior. This pair of eagles succeeded in hatching and fledging two eaglets. The eaglets were banded, by the U. S. Fish and Wildlife Service (USFWS), before they left the nest The pair of adults has remained at WCL since the initial nesting. They constructed a new nest during the 1994-1995 winter and successfully raised one eaglet in 1995 and two eaglets in 1996 from that nest. These eaglets were also banded by the USFWS.

<u>Duck Usage</u>

The duck total counted on WCL during the 1995-1996 winter was up from the previous year and was at the highest number since the 1990-1991 season (Figure 5). Total duck usage was much higher for JRR. Of the ducks observed on WCL, 91 percent were dabblers and 9 percent divers (Table 5). Mallards accounted for 89 percent of the total.

The total number of ducks using JRR during the 1995-1996 season was down slightly from the previous season (Figure 5), and mallard numbers were down accordingly (Figure 6). Total duck usage was higher at JRR than WCL throughout the season except for January (Figure 7). JRR was completely or partially ice covered in January while WCL remained mostly ice-free.

Station operation was expected to preclude ice formation on most of WCL during the winter, and as a result, larger numbers of some waterfowl species were anticipated to remain in the area longer (U. S. Nuclear Regulatory Commission 1982). Longer usage periods of fall migrating ducks, such as American wigeon (<u>Anas americana</u>), gadwall (<u>A. strepera</u>), blue-winged teal (<u>A. discors</u>), and others, have not been observed during any operational winters. These species left the area during both preoperational and operational studies before ice-cover preclusion would have played a role, usually during early December. Most ducks having peak usage on both JRR and WCL during October or November were not present in large numbers when normal weather conditions would cause ice formation. Principal food resources of these species are natural aquatic items (Bellrose 1976) such as <u>Potamogeton</u> spp. in WCL which are not as readily available in large quantities as winter progresses, even with heated effluents. Because of this, it is suspected that station operation will not induce most of these species to stay in the area any longer than before. It is reasonable to assume that in this case the birds' inherent need to migrate coupled with seasonally declining natural food resources and increasing energy demands played a greater role in the length of time waterfowl used WCL than did ice cover preclusion by station operation.

In contrast to these fall migrating species, mallards have commonly wintered in the area. They rely heavily on cultivated grains during winter and to a lesser extent on natural foods (Bellrose 1976). The annual average at WCL for 1995-1996 was down from the previous year and was at its highest point since the 1989-1990 season (Figure 6). A major difference since operation began has been how these birds are distributed between WCL and JRR as each winter progresses. Past monitoring has shown that, since the addition of heated effluent, local mallards tend to concentrate on WCL when other area reservoirs freeze (WCNOC 1991b). Until the 1994-1995 season, monthly averages had shown that mallard numbers typically peaked on JRR during November, but not until December on WCL. For the last two winters, mallard usage of JRR has peaked in December. Mallard usage of WCL also peaked in December during the 1994-1995 winter, but peaked in January during this monitoring period (Figure 8). January was the only month, during the 1995-1996 winter, when mallard usage was higher on WCL than on JRR. JRR was completely or mostly frozen over for most of January , while WCL was mostly ice-free.

Mallard usage was highest at Location B, and Location A had the next highest usage (Table 6). Mallards may be attracted to Locations A and B, at least in part, because of the ice-free effects from heated effluent. Other factors do contribute, and these include seclusion, wind protection, and the proximity of available food resources.

Since only one small area around WCL was open to hunting, harassment of mallards at WCL was minimal. The cooling lake served as a refuge for these wintering birds. Aside from the lack of hunter disruption, protection from winter winds was available to mallards since the larger coves offered escape from both north and south winds. Probably most important, however, was the combination of these factors with the presence of an available food supply adjacent to WCL.

Agricultural crops are heavily used by wintering mallards (Bellrose 1976, Jorde et al. 1983, Baldassarre and Bolen 1984). This is typically represented by utilization of waste grains in harvested fields. Large wind-protected coves and adjacent cropland characterize Locations A, B, and D. Thus, the factors suggested to be contributing to the late winter mallard attraction to WCL are present to the greatest degree in the areas of WCL these mallards generally prefer.

<u>Goose Usage</u>

The snow goose and Canada goose were the most common geese observed (Table 2). This has been consistent with past seasons on both WCL and JRR. The greater white-fronted goose (<u>Anser albifrons</u>) was the only other goose species observed. It has not been prevalent on WCL, but in the JRR area it has been present in large numbers at times.

Snow goose usage of WCL had been consistently lower than usage of JRR until the 1993-1994 winter when it was higher. Usage of WCL was again higher than usage of JRR for the 1994-1995 and 1995-1996 winters (Figure 9). Snow goose usage has typically peaked on JRR during the first half of the monitoring period and has peaked on WCL during the last half of the monitoring period. 1995-1996 usage of the two reservoirs was consistent with this pattern as snow goose usage peaked on JRR in November and on WCL in January (Figure 10).

A total of 18,905 Canada geese was observed on WCL during the 1995-1996 season (Table 2). This represents a marked increase from the previous year and represents the second highest total recorded, second only to the 1988-1989 monitoring period when 20,395 Canada geese were counted during that winter (Figure 11). Normally, more Canadas have used WCL during January (Figure 8), when ice-free waters were more prevalent on WCL than on JRR. During the 1995-1996 monitoring period, once again, January was the month of peak usage for Canada geese on WCL (Figure 12).

Location A was used by Canada geese more than any other location, although there was no significant ($p > 0.05$) difference in usage among any of the five locations (Table 7) during the 1995-1996 season. Location A has been ranked first for Canada usage eight of the last ten years and was second for the two other years. Agricultural grains are heavily used even when natural foods are abundant. This has been shown to be especially true when these grain fields are large and open with an undisturbed body of water nearby (Bellrose 1976, Craven and Hunt 1984). This seems to fit with the way these birds used crop fields surrounding WCL. As with mallards, proximity to grain fields and shelter from north winds appear to be key factors for location usage preference by Canadas at WCL. Location A provides very good shelter from north winds and proximity to grain fields. Smaller groups, when compared to mallards or snow geese, fed more opportunistically and did not concentrate in any particular area of WCL for long periods. It appears that, although heated effluent may be a factor, other winter habitat resources available around WCL may be more important in determining usage by Canada geese.

Transmission Line Collision Mortality

The usage patterns of waterfowl and waterbirds in the WCL coves traversed by transmission lines did not change sufficiently to increase collision potential. The collision estimates made from past dead bird monitoring (WCNOC 1988) remain valid for the bird usage observed during this study period. Consequently, no mitigative actions were necessary.

CONCLUSIONS

Bald eagle usage of WCL during the 1995-1996 monitoring period was at the third highest level recorded since monitoring began in 1981-1982. This represented a sharp increase in usage from the previous winter. Bald eagle usage of JRR, on the other hand, was comparable to the previous year's usage. Usage data from previous study periods suggests that JRR usage is typically higher than that of WCL, as a result of increased prey availability at JRR. The exception to this pattern has occured when localized fish kills have occurred at WCL as a result of cold shock events. The sudden concentration of the bald eagles' primary food source attracts a majority of the eagles wintering in the area. There continues to be no evidence of transmission line collisions or of increased potential for such. Additionally, operation of WCGS does not appear to be affecting the area's wintering bald eagle population so as to attract such high numbers that transmission line collision mortality could be a problem.

The operation of WCGS does influence the duck distribution between the two lakes during late winter. The heated effluent has kept most of WCL ice-free, providing previously unavailable late winter habitat when other area lakes are frozen over. This, in combination with seclusion and close abundant food supplies can make WCL attractive to ducks during cold winters. Fall migrating species have typically used JRR more than WCL. Wintering populations have used JRR early, then switched to WCL. Spring ducks have been attracted to JRR almost exclusively over WCL, as during preoperational seasons. During mild winters, when JRR is not frozen over for any extended period of time, WCL does not appear to have any specific late winter attractiveness for ducks, and JRR receives consistently higher usage throughout the winter. Again, if JRR does freeze over and open water is available on WCL, ducks that had been using JRR may move over to WCL.

It has been shown that WCL usage by mallards, snow geese, and to a lesser extent, Canada geese increased initially after operation during winter periods when ice-cover on JRR was present. Although ice-free conditions contributed, it was evident that wind protection, refuge from hunters, and high food availability were other factors. The areas where these factors were most prevalent on WCL were preferred by mallards and Canada geese. Waterfowl concentrations are known to cause problems with crop depredation and disease outbreaks (Bellrose 1976, Hawthorne 1980, Frederick and Klaas 1982, Kahl and Samson 1984, Frederick et al. 1987). However, the concentrations observed on WCL to date have not caused wide-spread crop depredation problems. Given similar usage patterns in the future, depredation potential will be greatest for mallards and snow geese. This is because these species occur in large concentrations. Although snow geese usage from year to year has been highly variable, they have crowded in areas of WCL at times when late-harvested or fall planted crops were most vulnerable.

Canada geese feed on the same crops and are present on the lake during the same time periods as mallards and snow geese but should not cause as great of a depredation risk because they tend to occur in smaller concentrations. Any crop depredation problems caused by Canadas would likely be highly localized. Although waterfowl disease outbreaks have not been observed, potential areas of concern will be similar as for crop depredation events because of the consistent usage of the same areas.

Transmission line mortality potential did not increase during the 1995-1996 season. No conditions developed that required further investigation. No mitigative actions to prevent or reduce collision events were necessary.

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TABLE 1. WATERBIRD AND WATERFOWL CENSUS DATA COLLECTED DURING GROUND SURVEYS OF WOLF CREEK LAKE, FROM OCTOBER 1995 THROUGH MARCH 1996

	1995						1996									
Species	Oct		Nov		Dec		Jan				Feb				Mar	
Greater white-fronted goose	4			15				6	1							28
Snow goose			650	7200			480	18100	2300	2100	3800	2450	1150	350	160	95
Canada goose	115	60	220	295	137	35	117	8859	570	6963	1400		44	61	15	14
Green-winged teal		5	11		11	6	5		10	6	12				30	
Blue-winged teal	19	51														
Mallard	2	174	2843	2463	2562	1033	2024	16525	2094	10011	3796	9				18
Northern pintail		15														
Gadwall		37	27	79	4			5	2	34	16				8	4
American wigeon	39	142	25	6	14	4		87			4				2	15
Canvasback		2	7	22	8					2						6
Redhead			7	11						1						
Ring-necked duck	8			120			5	2	1							8
Lesser scaup			50	1	4	14		6	3	12					6	10
Common goldeneye					1	2	1	23	12	141	8	4	6	16	23	14
Bufflehead			1	10			3		4		6		13	1	18	12
Ruddy duck		3														
Hooded merganser			22		14		2	6	1	94	46				1	
Common merganser			9	5		50	83	3090	124	298	45	26	5		9	1
Red-breasted merganser				2			2	10	10	6						
American coot	2549	798	20	9	6	1	12	8	9				6	110	240	47
Double-crested cormorant	84	172	269	108	42	60	48	27	13	32	4	15	3	4	1	22
Pied-billed grebe	15	2	1	3				1	1	1						1
Horned grebe		1	1		1											4
Common loon				7	2	1	2		2	3	5		1			
Great blue heron	11	9	1		3	2	1	5	1	5		1				
Franklin's gull	1326															
Ring-billed gull	3	88	117	479	373	7	37	219	320	31		65	39	258	124	392
Herring gull												3	12	12	4	36
Forster's tern			1	1												
Killdeer	1	2														5
Osprey					3		1		1							
Bald eagle			1	1	24	12	8	14	8	9	82	22	26	16	1	2
White pelican				124	272	67	61	82	58	64	37	4	25		87	22
Total Species/Month	19		24		19		25				18				23	

TABLE 2. GROUND COUNT FREQUENCY AND PERCENT COMPOSITION OF WATERFOWL AND WATERBIRDS USING WOLF CREEK LAKE

	Total Count Frequency	Percent Total
Mallard	43,554	37
Snow goose	38,835	33
Canada goose	18,905	16
American coot	3815	3
Common merganser	3745	3
Ring-billed gull	2552	2
Franklin's gull	1326	1
Double-crested cormorant	904	< 1
White pelican	903	< 1
American wigeon	338	< 1
Common goldeneye	251	< 1
Bald eagle	226	< 1
Gadwall	216	< 1
Hooded merganser	186	< 1
Ring-necked duck	144	< 1
Lesser scaup	106	< 1
Green-winged teal	96	< 1
Blue-winged teal	70	< 1
Bufflehead	68	< 1
Herring gull	67	< 1
Greater white-fronted goose	54	< 1
Canvasback	47	< 1
Great blue heron	39	< 1
Red-breasted merganser	30	< 1
Pied-billed grebe	25	< 1
Common loon	23	< 1
Redhead	19	< 1
Northern pintail	15	< 1
Killdeer	8	< 1
Horned grebe	7	< 1
Osprey	5	< 1
Ruddy duck	3	< 1
Forster's tern	2	< 1
Total	116,584	

TABLE 3. NATIONAL WEATHER SERVICE MONTHLY AVERAGE AIR TEMPERATURES FOR TOPEKA, KANSAS (Whitmore 1996)

	Temperature (°F)		
Winter of	**Dec**	**Jan**	**Feb**
Preoperational			
1981-1982	30.1 (-0.7) *	21.9 (-4.8)	28.5 (-3.7)
1982-1983	35.8 (+5.0)	32.5 (+5.8)	36.1 (+3.9)
1983-1984	14.4 (-16.4)	26.0 (-0.7)	40.2 (+8.0)
1984-1985	36.8 (+6.0)	19.9 (-6.8)	25.6 (-6.6)
Operational			
1985-1986	25.1 (-5.7)	35.8 (+9.1)	32.5 (+0.3)
1986-1987	34.6 (+3.8)	29.7 (+3.0)	40.3 (+8.1)
1987-1988	35.9 (+5.1)	28.0 (+1.3)	30.8 (-1.4)
1988-1989	35.5 (+4.7)	38.0 (+11.3)	22.9 (-9.3)
1989-1990	21.0 (-9.8)	37.3 (+10.6)	36.2 (+4.0)
1990-1991	29.6 (-1.2)	25.2 (-1.5)	41.3 (+9.1)
1991-1992	37.4 (+6.6)	37.2 (+10.5)	41.9 (+9.7)
1992-1993	32.6 (+1.8)	26.4 (-0.3)	29.9 (-2.3)
1993-1994	34.8 (+4.0)	26.1(-0.6)	29.9(-2.3)
1994-1995	36.0 (+5.2)	29.3 (+2.6)	37.1 (+4.9)
1995-1996	30.6 (-0.2)	24.5 (-2.2)	34.9 (+2.7)

* Number in parenthesis is the variance from 30 year average, 1966 through 1995.

TABLE 4. SIGNIFICANT DIFFERENCES BETWEEN RANKED LOCATION MEANS OF WINTERING BALD EAGLES USING WOLF CREEK LAKE.

Winter	Total Counted	Location Preference *
1983-1984	51	A C B D E
1984-1985	115	E B C A D
1985-1986	82	C B D A E
1986-1987	44	C B E A D
1987-1988	395	E C D A B
1988-1989	212	E D C A B
1989-1990	89	C A E B D
1990-1991	120	A C E D B
1991-1992	32	C E A B D
1992-1993	32	E C A B D
1993-1994	287	E C D B A
1994-1995	37	E C B A D
1995-1996	226	E C D B A

*Line underscores ranked (least to greatest) location means that were not significantly different ($p \leq 0.05$).

TABLE 5. GROUND COUNT FREQUENCY AND PERCENT COMPOSITION OF DUCKS USING WOLF CREEK LAKE FROM OCTOBER 1995 THROUGH MARCH 1996.

Species	Total Count Frequency	Percent Total
Mallard	43,554	89
Common merganser	3745	8
American wigeon	338	1
Common goldeneye	251	1
Gadwall	216	< 1
Hooded merganser	186	< 1
Ring-necked duck	144	< 1
Lesser scaup	106	< 1
Green-winged teal	96	< 1
Blue-winged teal	70	< 1
Bufflehead	68	< 1
Canvasback	47	< 1
Red-breasted merganser	30	< 1
Redhead	19	< 1
Northern pintail	15	< 1
Ruddy duck	3	< 1
Total	48,888	

TABLE 6. SIGNIFICANT DIFFERENCES BETWEEN RANKED LOCATION MEANS *OF MALLARDS USING WOLF CREEK LAKE.*

Winter	Total Counted	Location Preference *
1983-1984	16,878	C E B D A
1984-1985	97,118	C B D E A
1985-1986	84,103	C E A B D
1986-1987	192,380	C E A B D
1987-1988	118,777	C E A B D
1988-1989	108,800	C E B A D
1989-1990	71,212	C E D A B
1990-1991	42,116	C E D A B
1991-1992	27,507	C E D A B
1992-1993	17,317	C A D B E
1993-1994	20,131	E D C A B
1994-1995	18,371	E D C B A
1995-1996	43,554	E C D A B

* Line underscores ranked (least to greatest) location means that were not significantly ($p > 0.05$) different.

TABLE 7. SIGNIFICANT DIFFERENCES BETWEEN RANKED LOCATION MEANS OF CANADA GEESE USING WOLF CREEK LAKE.

1983-1984	3,668	C D A E B
1984-1985	6,453	A C B D E
1985-1986	11,587	C A B E D
1986-1987	14,584	C B E D A
1987-1988	13,058	C D B A E
1988-1989	20,395	C E D B A
1989-1990	10,903	C D B E A
1990-1991	7,974	E D C A B
1991-1992	7,365	C D B E A
1992-1993	14,197	C D E B A
1993-1994	10,480	C D E B A
1994-1995	7,360	E C D B A
1995-1996	18,905	D C E B A

* Line underscores ranked (least to greatest) location means that were not significantly different (p > 0.05).

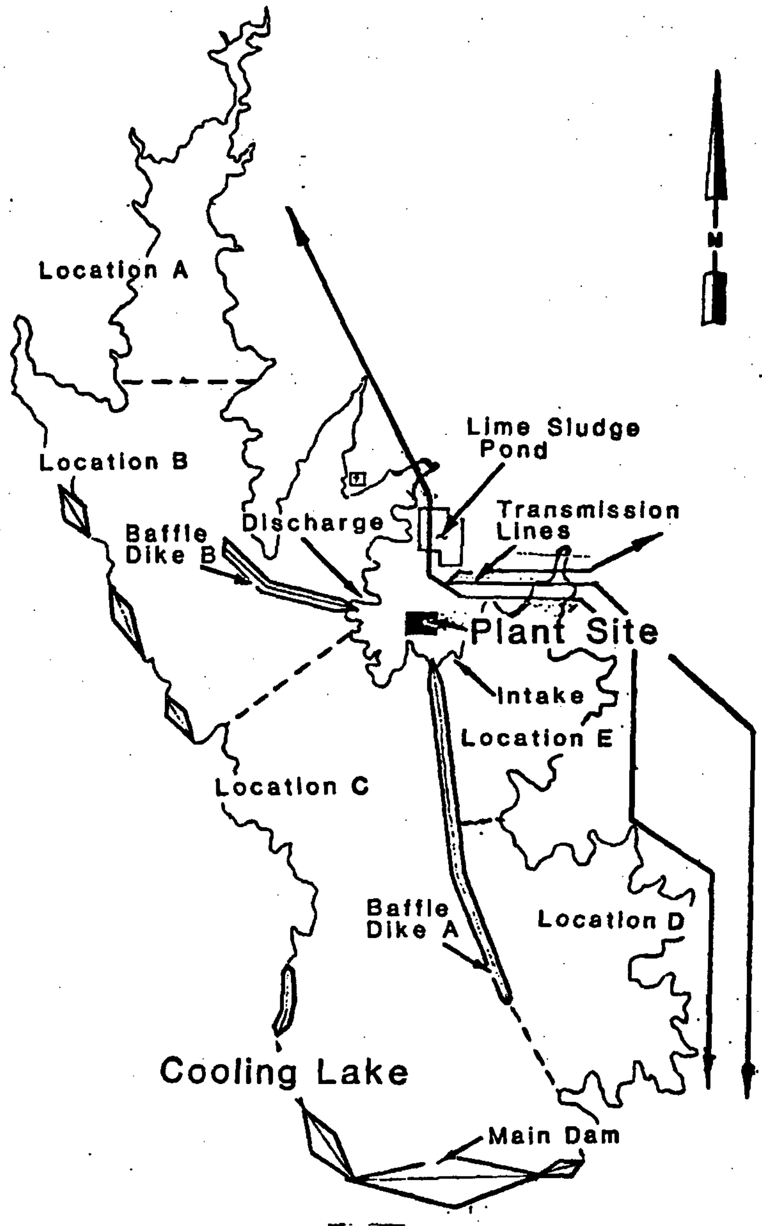


Figure 1. Wolf Creek Lake and associated structures.

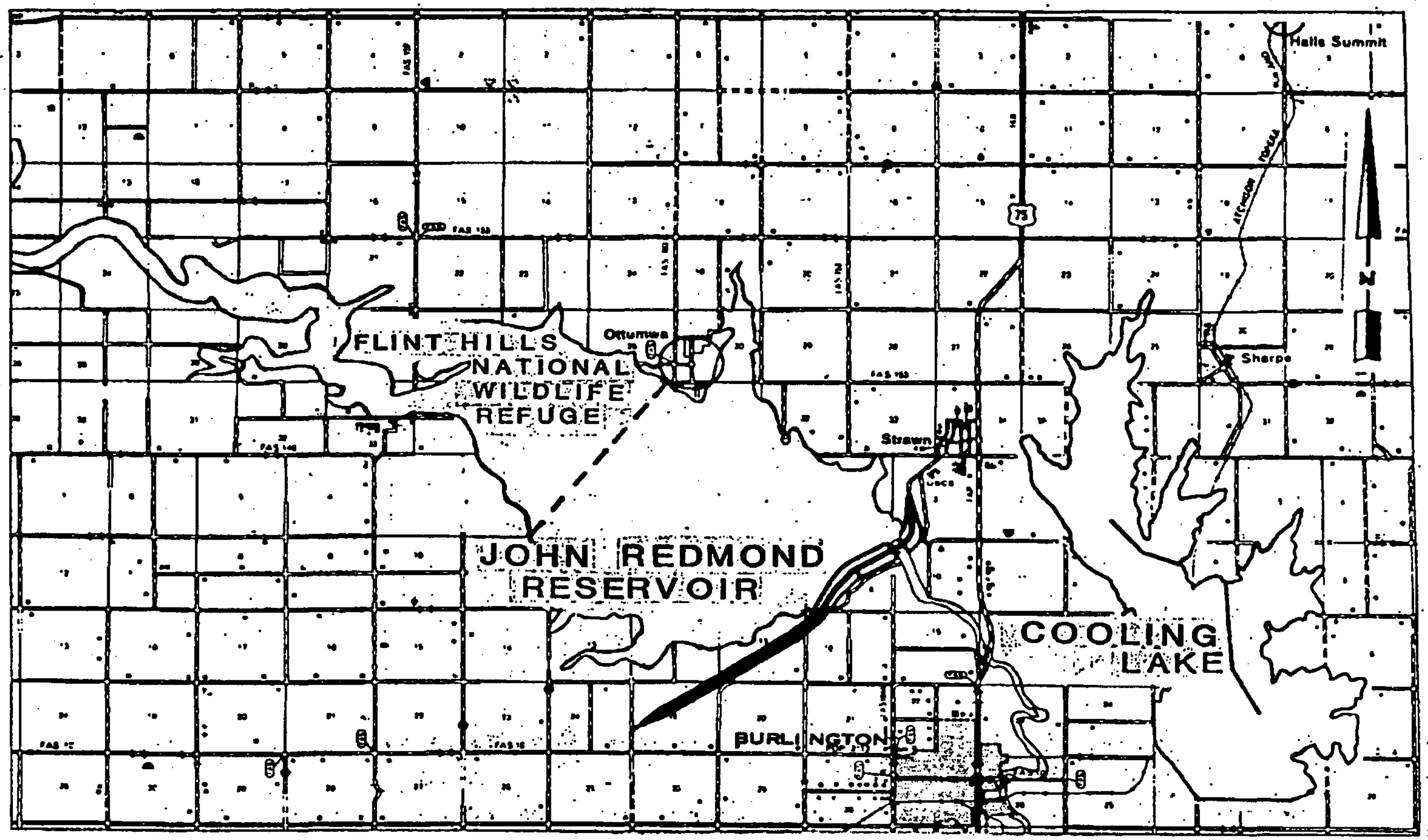


Figure 2. Wolf Creek Lake and John Redmond Reservoir, Coffey County, Kansas

[redacted]

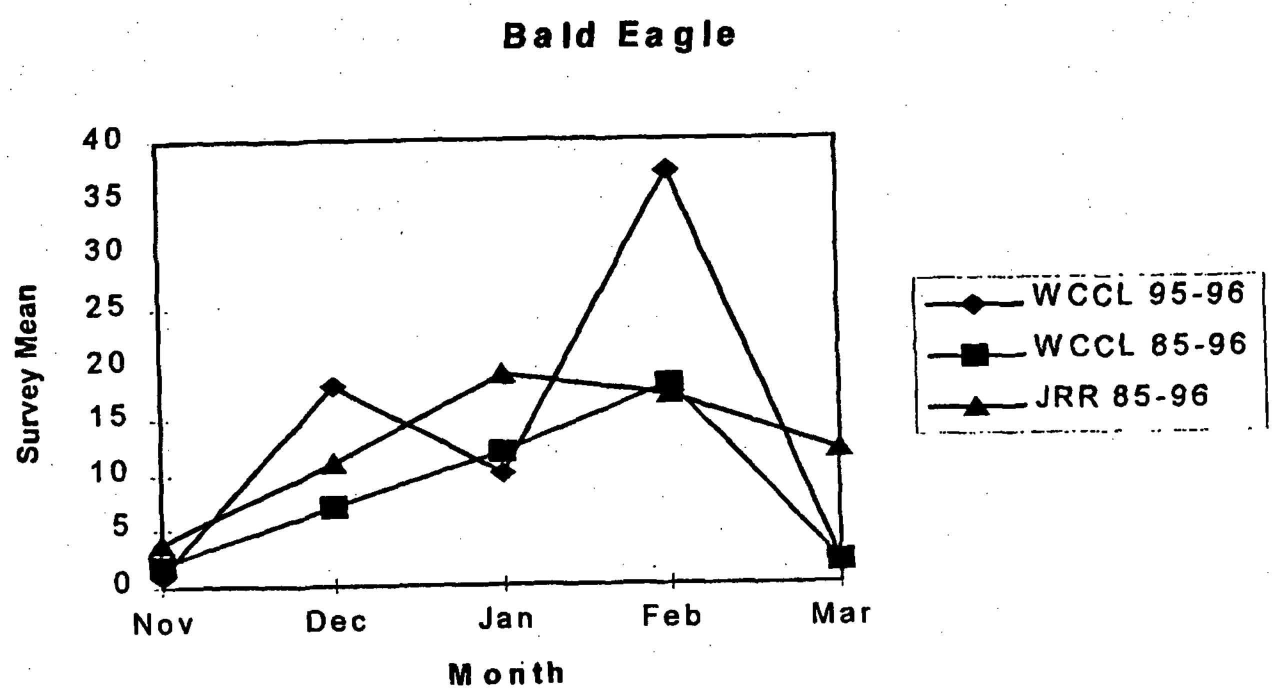


Figure 3. Annual bald eagle usage comparisons between Wolf Creek Lake and John Redmond Reservoir. Data includes December through March surveys.

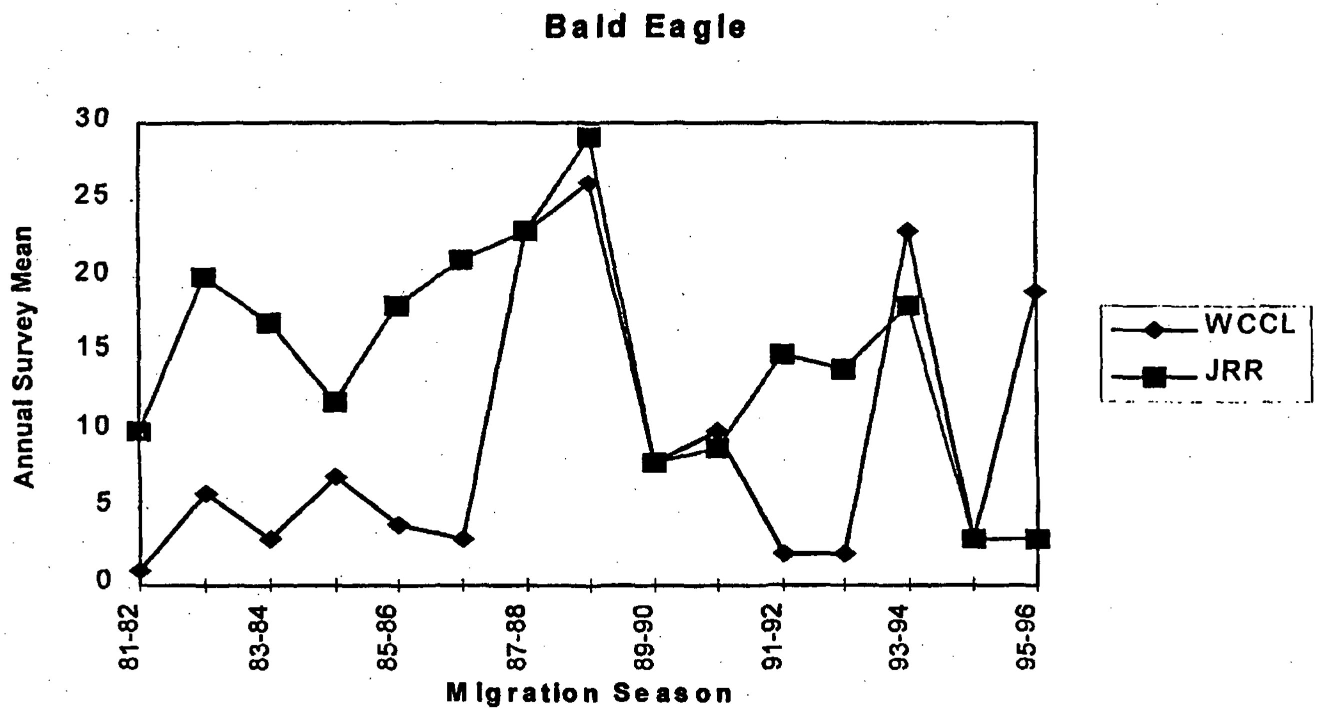


Figure 4. Monthly operational bald eagle usage of Wolf Creek Lake and John Redmond Reservoir.

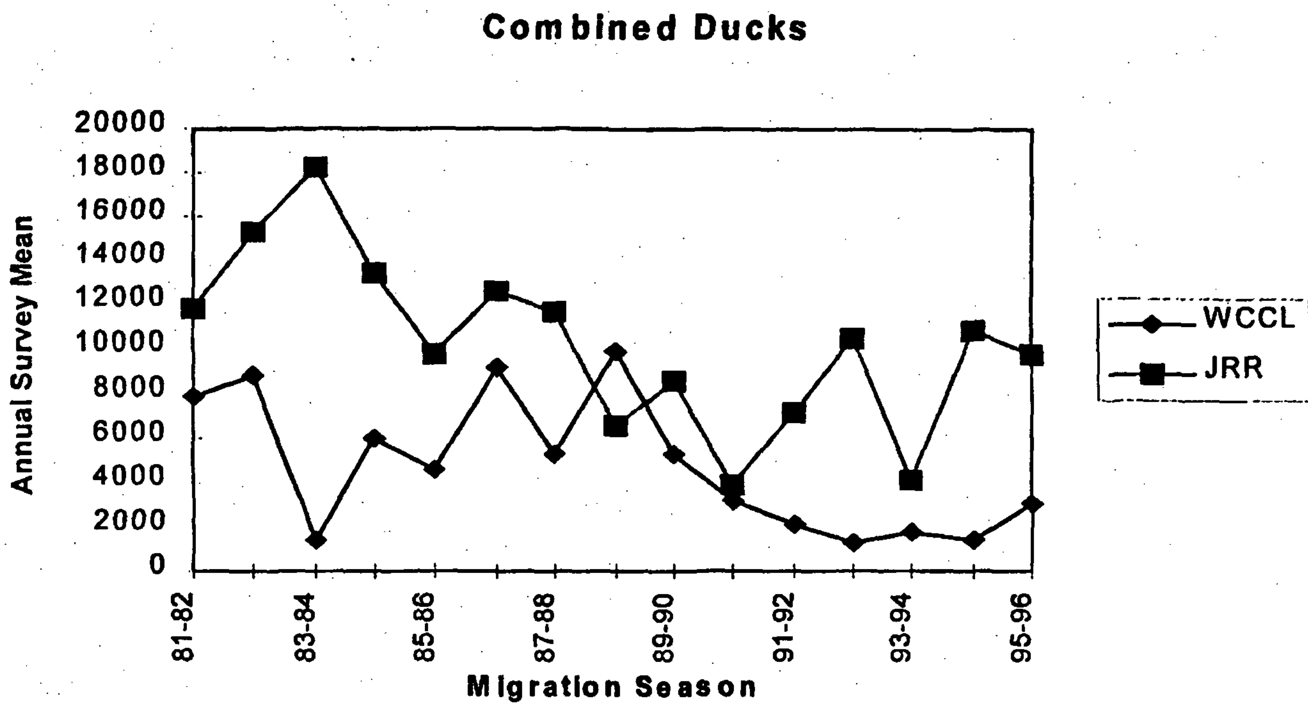


Figure 5. Annual combined duck usage comparisons between Wolf Creek Lake and John Redmond Reservoir. Data includes September through March surveys until after the 1987-1988 season when September surveys were excluded.

[redacted]

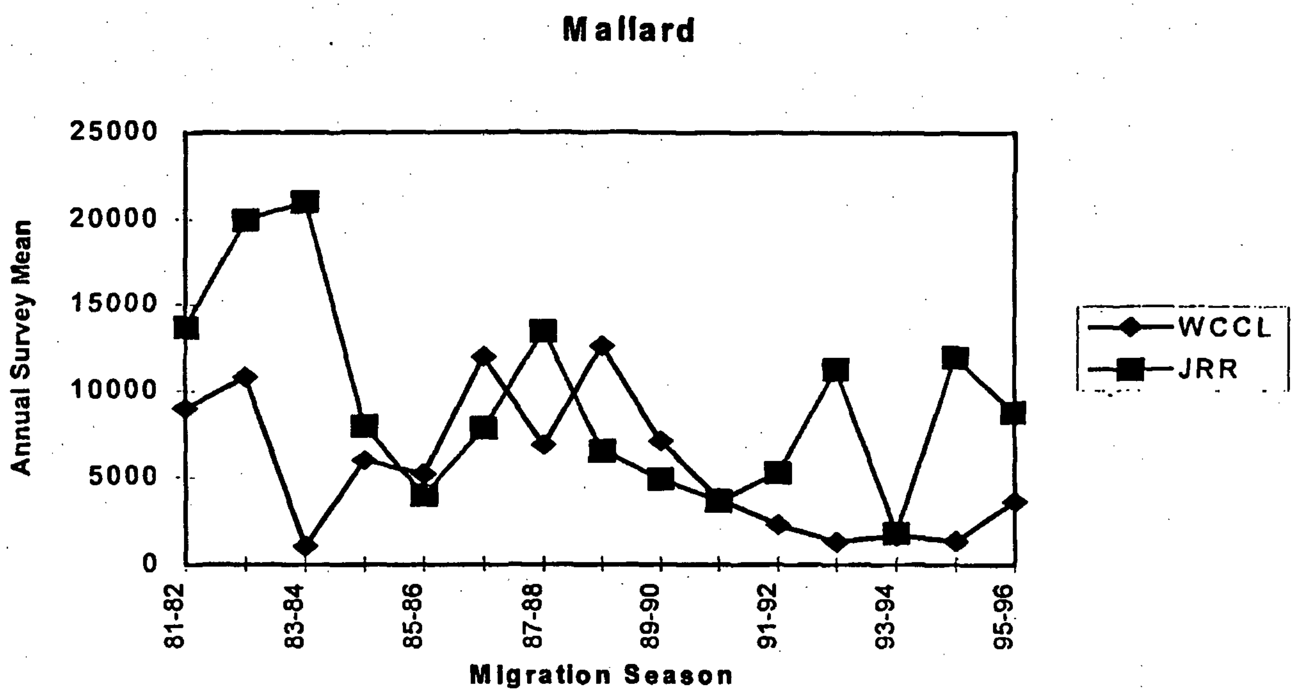


Figure 6. Annual mallard usage comparisons between Wolf Creek Lake and John Redmond Reservoir. Data includes November through February surveys.

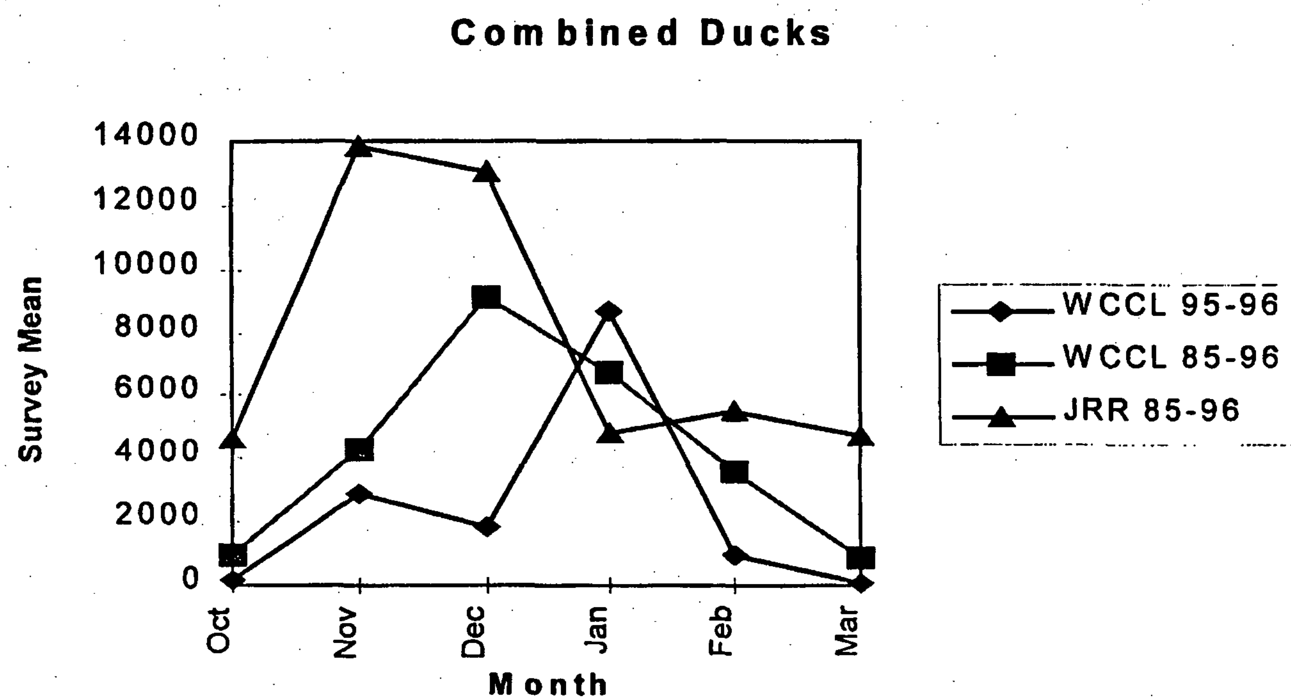


Figure 7. Monthly operational combined ducks usage of Wolf Creek Lake and John Redmond Reservoir.

[redacted]

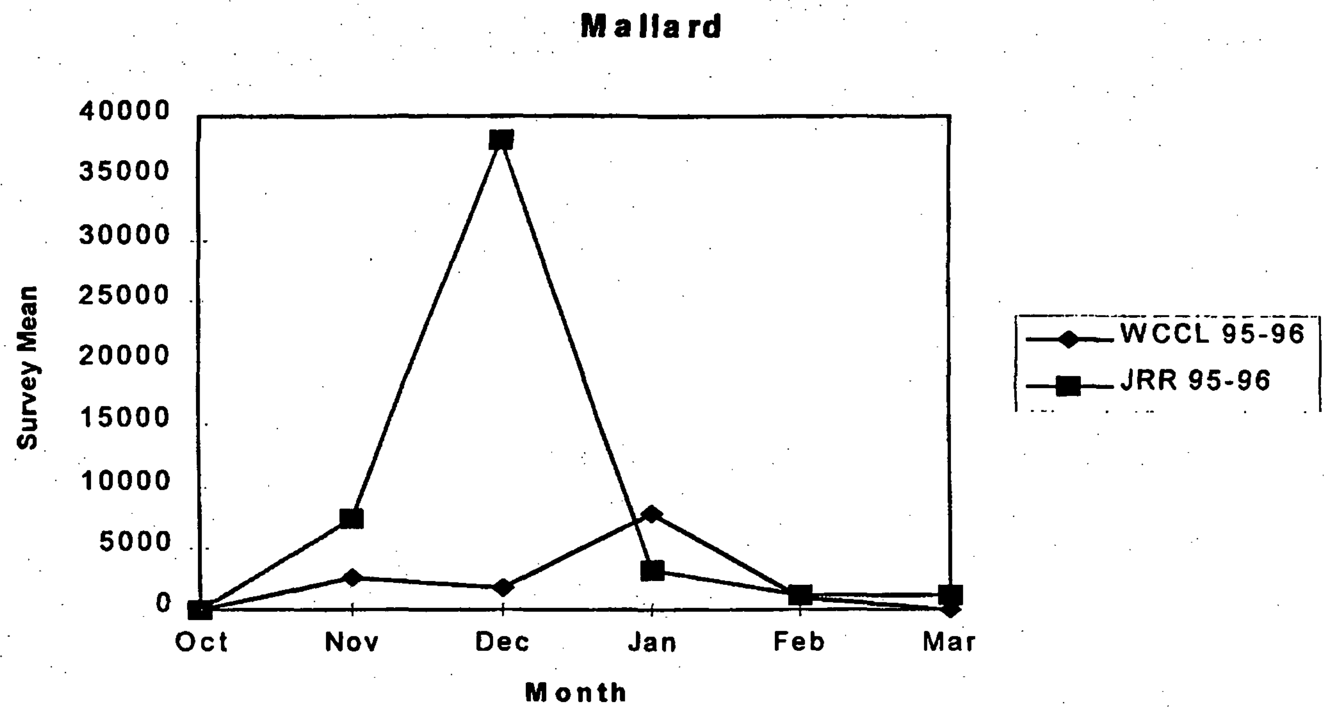


Figure 8. Monthly operational mallard usage of Wolf Creek Lake and John Redmond Reservoir.

[redacted]

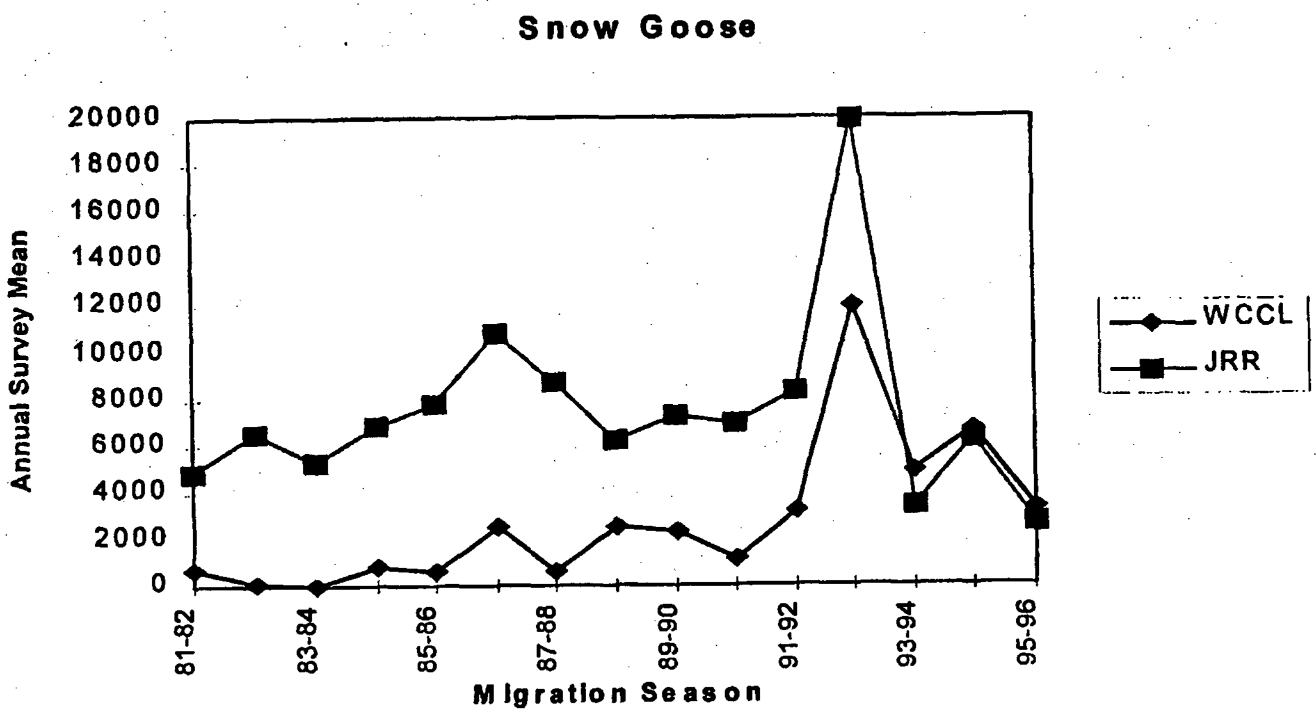


Figure 9. Annual snow goose usage comparisons between Wolf Creek Lake and John Redmond Reservoir.

[redacted]

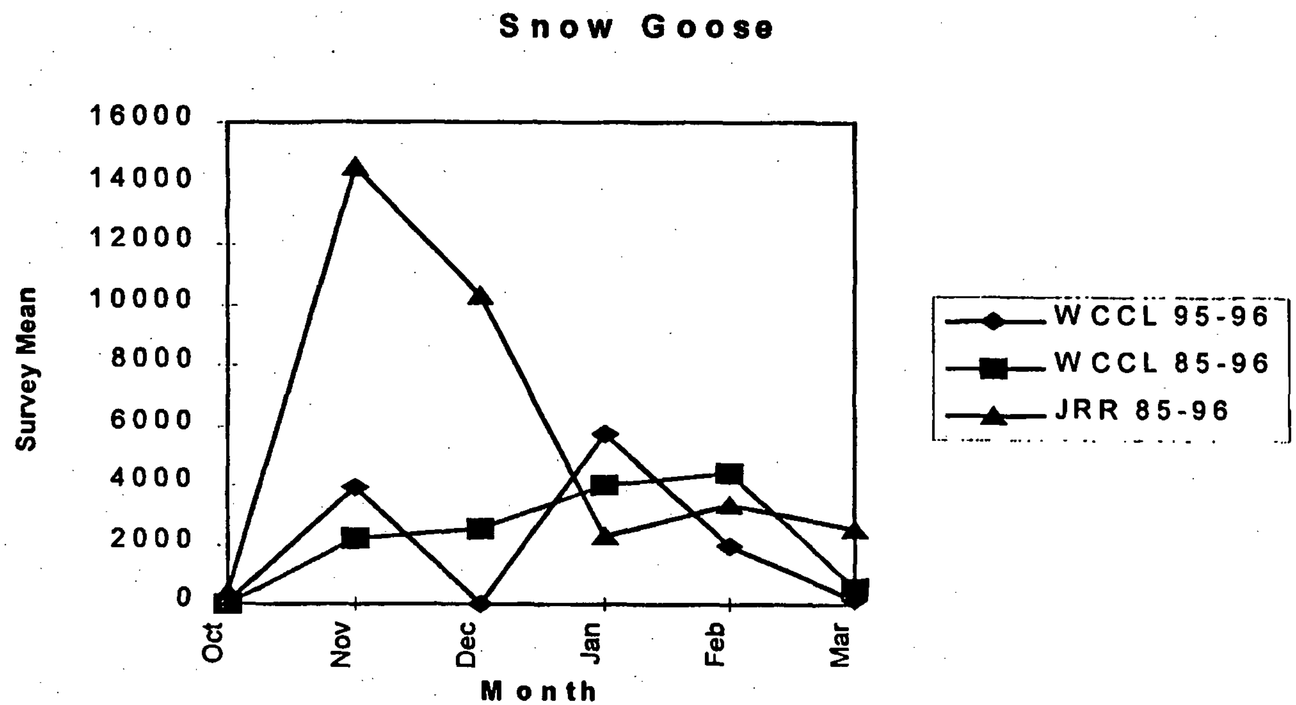


Figure 10. Monthly operational snow goose usage of Wolf Creek Lake and John Redmond Reservoir.

[redacted]

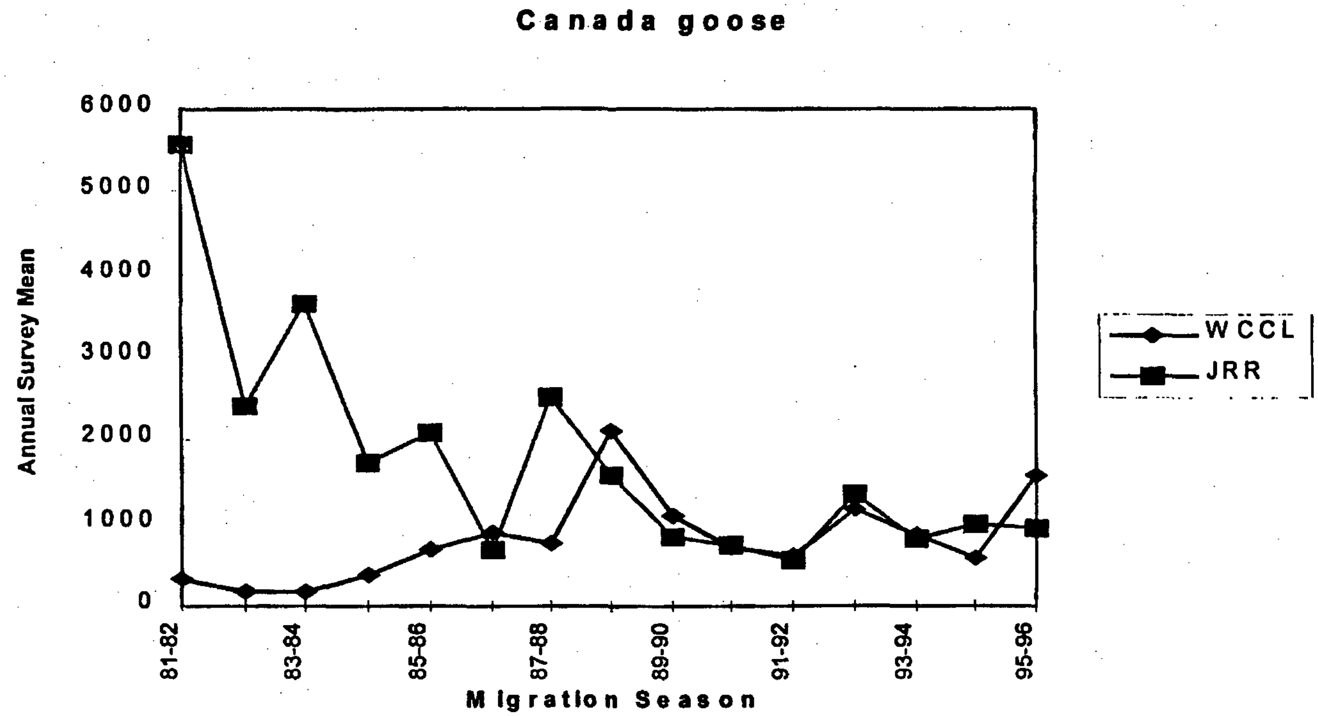


Figure 11: Annual Canada goose usage comparisons between Wolf Creek Lake and John Redmond Reservoir.

[redacted]

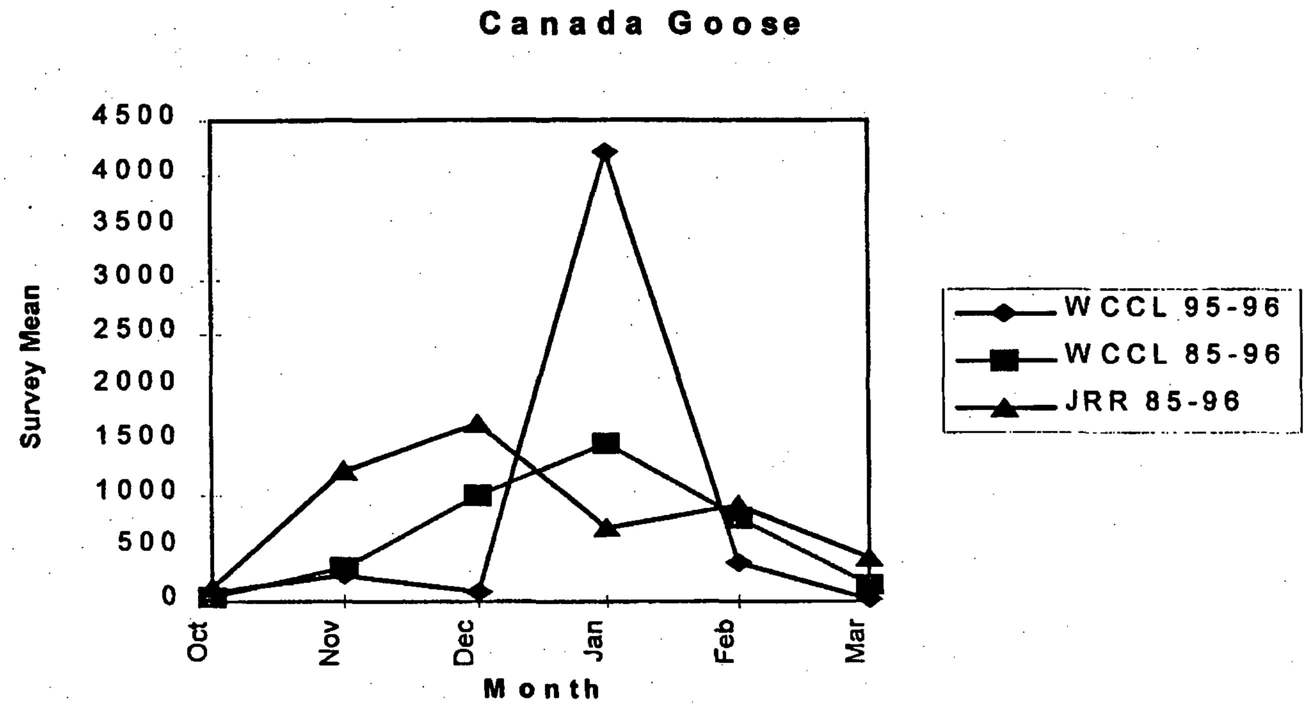


Figure 12. Monthly operational Canada goose usage of Wolf Creek Lake and John Redmond Reservoir.

[redacted]

Avian Protection Plan
Attachment

Review of Bird Collision Data on Transmission Facilities at

Wolf Creek Generating Station (WCGS)

With emphasis on the Lime Sludge Pond (LSP)

Background:

The Nuclear Regulatory Commission (NRC) in 1982 reviewed potential impacts to waterfowl due to collisions with electric transmission facilities adjacent to the cooling lake (Section 5.5.1.2, Final Environmental Statement related to the Operation of WCGS, NUREG 0878). The NRC recommended that a general survey program for waterfowl collision be completed to determine if mitigation was warranted. This recommendation was included in the Environmental Protection Plan, Appendix B to Facility Operating License NPF-42. This required a general survey program be accomplished to document significant waterfowl collision events and determine if mitigation was warranted.

Consequently, a collision survey was initiated in February, 1983, and continued through February, 1988. Surveys included dead bird searches of transmission lines crossing the cooling lake. All bird species were included, including bald eagles. These areas included the Firing Range Cove traversed by two 345 kV and one 69 kV line, and the Cemetery Cove, traversed by one 345 kV transmission line. These surveys occurred during the winter-spring migration seasons during each year.

The LSP is adjacent to the Cemetery Cove and was searched during each survey. Data was combined in annual reports with the Cemetery Cove through the 1985-86 migration survey season, but collisions around the LSP was available from the field data sheets. Table 1 shows the numbers and species of transmission mortalities found. Table two lists the live birds present immediately before each dead bird search. Records were kept for live bird usage beginning with November 1985 surveys. Comparing these tables demonstrates that no threatened or endangered birds were found to have collided with the associated transmission line. Unknown feathers were not from threatened or endangered birds. A few bald eagles were observed using the adjacent Cemetery Cove, but none were found during dead bird searches.

Tables 1 and 2 also demonstrate that species found during dead bird searches did not necessarily correspond to live species found using the area, indicating that collisions tended to be incidental, with no detrimental patterns present. To test this further, monthly totals of dead birds, pooled from the three search locations, were compared with the total waterfowl and waterbird numbers surveyed during the same months, assuming that the more birds in the area would mean higher collision mortality and greater impact from the transmission facilities. However, no relationship was found between collision frequency and bird usage of the cooling lake and LSP (Figure 1). Collision mortality was incidental to bird usage in the area, indicating that bird activity was not greatly impacted by the lines.

Since the transmission lines did not appear detrimental to general bird usage of the cooling lake, more localized usage data were analyzed. Beginning in November 1985, live bird usage in each search area was surveyed immediately prior to each dead bird search. This would show any adverse impacts at the LSP. The live bird data were compared to subsequent collisions found, again assuming that the greater the usage in the area, the greater the collision pattern would be. No relationships were found for any location, including the LSP (Figure 2). The more birds using the LSP did not increase transmission line collisions there.

A third comparison was made between the species diversity of dead birds found and the diversity of live birds surveyed in the search areas immediately prior to the searches. This was done assuming that the greater the number of species present would mean a greater number of species vulnerable to collision. There were no relationships found for all locations except the LSP (Figure 3). Approximately one third of the species using the LSP were consistently found during the dead bird searches. This suggests that of the birds using the LSP, more species were susceptible to collision not based on total numbers as shown above, but on the kinds of birds. Mallard was the primary species found at the LSP (Table 1).

In the 1987-1988 Annual Wildlife Monitoring Report, a review of the total collision results in relation to the total birds using the cooling lake was completed. Estimates of common biases were used to ensure worst case was evaluated. As shown in the report, total estimated collisions comprised a small percentage (0.2 to 0.5) of the total using the lake. This was very comparable to other collision impact assessments cited in the report, and well within published non-hunting mortality estimates. Consequently, no impacts were found to bird populations by the transmission facilities at WCGS.

To detect any changes in this assessment, bird usage surveys completed by the Kansas Department of Wildlife and Parks are reviewed annually. A summary of these reviews are provided in the Annual Environmental Operating Report provided to the NRC each year. No changes have been observed to date that would warrant any mitigative actions.

Table 1. Bird species, number of birds found during dead bird searches, and live birds using each search area immediately prior to each search for transmission facilities at Wolf Creek Generating Station.

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1983	February	European starling	1		3
		Unidentified duck sp.	1		
		Great blue heron	1		3
		Red-winged blackbird			3
		Brown-headed cowbird			1
	April	Blackbird sp	1		
		Great blue heron			3
		Unidentified duck sp			1
		Upland sandpiper			1
		Sandpiper sp	1		
		American coot		1	
		Red-winged blackbird		1	
		Ruddy duck		1	
	September	Unidentified feathers			2
		Blue-winged teal			1
		Mallard			1
	November	Unidentified feathers			5
		Gull sp.	1		
		Song sparrow			1
		Unidentified duck sp			1
		Red-winged blackbird			1
		Rusty blackbird			1
1984	February	Meadowlark			1
		Mallard			1
		American coot			1
		Unidentified duck sp.			2
		Red-winged blackbird			1
	April	Blue-winged teal			1
		Killdeer			1
		Greater prairie chicken			1
		American crow		1	
	September	Blue-winged teal			2
		Great blue heron			1
	November	Blue-winged teal			1
		Unidentified duck sp.			7
		Gadwall			2
		Unidentified feathers			1
		American coot			1

Table 1. (cont)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1985	February	Red-tailed hawk			1
		American crow			1
		American tree sparrow		1	
		Greater prairie chicken			1
		Unidentified duck sp.			1
	April	Great blue heron	1		2
		Eastern meadowlark			1
		Unidentified feathers		1	1
		Mallard		2	
		Brown thrasher			1
	September	Great blue heron			2
		American coot	1		1
		Ovenbird			
		Brown-headed cowbird		1	
		Red-winged blackbird			1
	November	American coot		1	2
		Ring-billed gull	1		
		Bufflehead	2		
		Unidentified duck sp.		1	
		Red-winged blackbird			2
		Unidentified feathers			2
		Mallard	1		
		Blue-winged teal	1		
	December	Double-crested cormorant		1	
		American coot		1	
		Mallard		1	
1986	January	Ring-billed gull		1	
		American coot		2	1
		Mallard	1	4	
		Pigeon		1	
		Red-winged blackbird			1
	February	Mallard	2	4	
		Unidentified feathers		1	1
		Bufflehead	1		
		American coot		1	1
		Red-winged blackbird			4
		Red-bellied woodpecker		1	
	April	Red-winged blackbird	1		
		Blue-wing teal			1

Table 1. (cont)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1986	April	Gadwall			1
		American coot		1	3
		Greater yellowlegs	1		
		Unidentified feathers			2
		Shorebird sp.			1
	October	Pied-billed grebe	1		
		White pelican			1
		Blue-winged teal	1		
	November	Mallard			2
		Ring-billed gull	1		
		Red-winged blackbird			1
	December	Mallard	2	1	
		Red-winged blackbird			1
1987	January	Mallard	2		
	February	Mallard	1	4	3
		Lesser scaup	1		
	April	White pelican		1	
		Yellow rail			1
		Lesser yellowlegs	1		
		Pectoral sandpiper	2		
		Red-winged blackbird	1		
	November	Double-crested cormorant			3
		Black-crowned night heron			1
		Mallard			2
		Unidentified duck sp.			1
		American coot		2	1
		Passerine sp.	1		
	December	Mallard			1
1988	January	Double-crested cormorant		1	
		Mallard		2	
		Red-winged blackbird			1
	February	Double-crested cormorant		1	
		Mallard			1
		Gadwall		1	
		Common crow	1		
		Unidentified feathers			1

Table 2. Monthly bird numbers surveyed using areas adjacent to transmission facilities immediately prior to dead bird searches at Wolf Creek Generating Station.

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1985	November	Hooded mergansers			15
		American coots		155	199
		Canada goose			40
		Mallards	25	124	161
		American wigeon		122	
		Bufflehead	2	2	3
		Green-winged teal		3	
	December	Ring-billed gull		1	
		Mallard		787	
		Bufflehead		6	
		American coot		99	
		American widgeon		55	
		Green-winged teal		25	
		Gadwall		14	
		Unidentified duck sp		21	
		Common merganser		7	
		Pintail		42	
		Bald eagle		2	
1986	January	Mallard	79	585	123
		Pintail		1	
		Bufflehead	9		
		American widgeon		8	
		Green-winged teal		13	
		Ring-billed gull		25	6
		Canada goose			18
		American crow		2	
		American coot		1	
	February	Mallard	226	304	31
		Bufflehead	93	15	3
		Pintail	10		1
		Goldeneye	2		
		Ring-billed gull		32	
		American widgeon		8	
		American coot	27	31	
		Green-winged teal	12	3	
		Killdeer	2		
		Common merganser	2		
		Canvasback			2
		Redhead duck			140
	April	Mallard	4	2	2
		Lesser scaup		6	

Table 2. (cont.)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
		American coot		156	142
		Blue-winged teal	8	2	9
		Double-crested cormorant		3	
		Killdeer	6		
		Shorebird sp.			12
		Greater yellowlegs		2	4
		Gadwall			1
	October	Blue-winged teal			58
		Great egret			1
		Great blue heron		2	3
		Osprey		1	
		American coot	2	1002	44
		Killdeer	12	8	
		Sandpiper sp.	20		
		Mallard	60	12	2
		Bufflehead	3		
		American widgeon		4	
	November	Goldeneye		6	
		Bufflehead	1	15	3
		American widgeon		250	
		American coot		150	
		Mallard	120	505	72
		Hooded merganser		2	
		Ring-billed gull		12	
		Gadwall		80	19
		Pied-billed grebe			3
		Green-winged teal		30	
		Canada goose			21
	December	Mallard	267	1239	259
		Buffledhead	26	12	2
		Great blue heron		2	
		American widgeon		12	
		Hooded merganser		2	
		Canada goose	9	42	6
		Green-winged teal		97	
		Goldeneye	9		
1987	January	Mallard	300	2145	90
		Hooded merganser		30	
		Canada goose	10	12	35
		Bufflehead	7		

Table 2. (cont.)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
	February	Mallard	891	835	1320
		Canada goose		15	382
		Green-winged teal			6
		American coot		5	
		Ring-necked duck	61		
		Bufflehead	84		
		Goldeneye	3		
		Redhead duck	69		
		Lesser scaup	14		
	April	Mallard	3	4	2
		Greater yellowlegs	16		
		Sandpiper sp.	46		
		American coot	1	11	247
		Bufflehead	33		
		Killdeer	8		
		Blue-winged teal	35	12	24
		Northern shoveler			11
		Gadwall			2
		Wilson's phalarope	2		
		Lesser yellowlegs	20		
		Pectoral sandpiper	16		
		Willet	2		
		Forster's tern		1	
	November	Mallard	150	167	110
		American coot	30	21	
		Canvasback	5		
		Bufflehead	9	2	
		Redhead duck	16		
	December	Mallard	15	1055	115
		Hooded merganser			3
		Great blue heron			1
		American coot		15	
		Canada goose		145	30
		Goldeneye		1	
		White-fronted goose		3	
1988	January	Bald eagle		14	
		Canada goose		305	6
		Mallard	90	895	35
		Great blue heron		4	

Table 2. (cont.)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
	February	Ring-billed gull		150	
		Mallard	10		30
		Bald eagle		2	
		Bufflehead	15		
		Canada goose			200
		Snow goose			30
		American coot			10

Figure 1. Dead birds found adjusted for common search biases compared with total bird usage of the cooling lake.

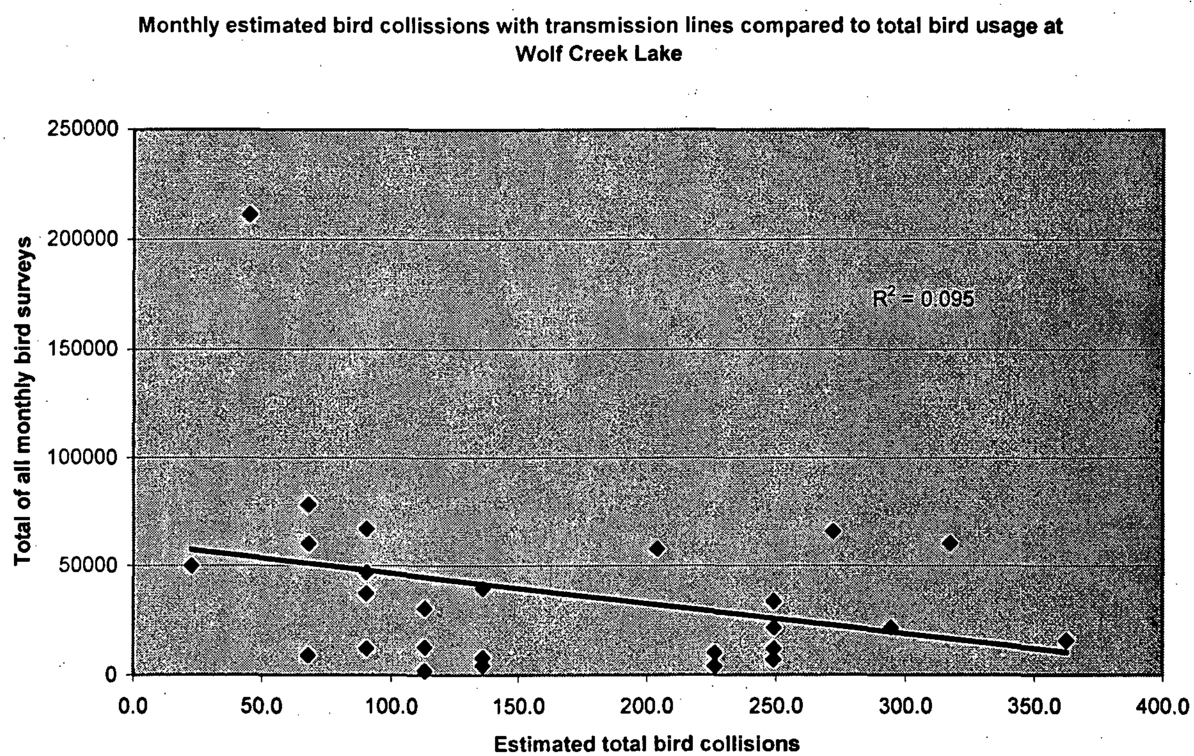
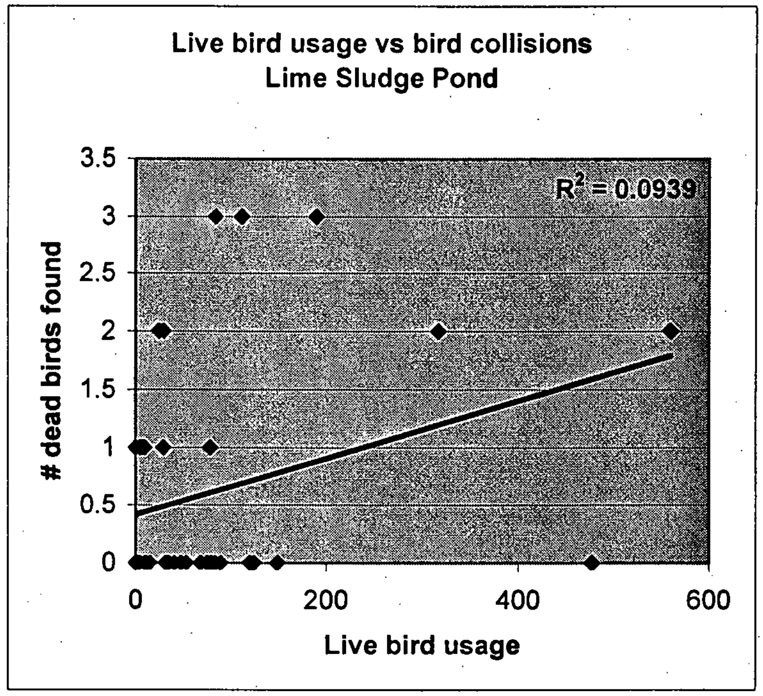


Figure 2. Live birds found in search areas immediately prior to dead bird searches. These totals do not reflect common search biases.



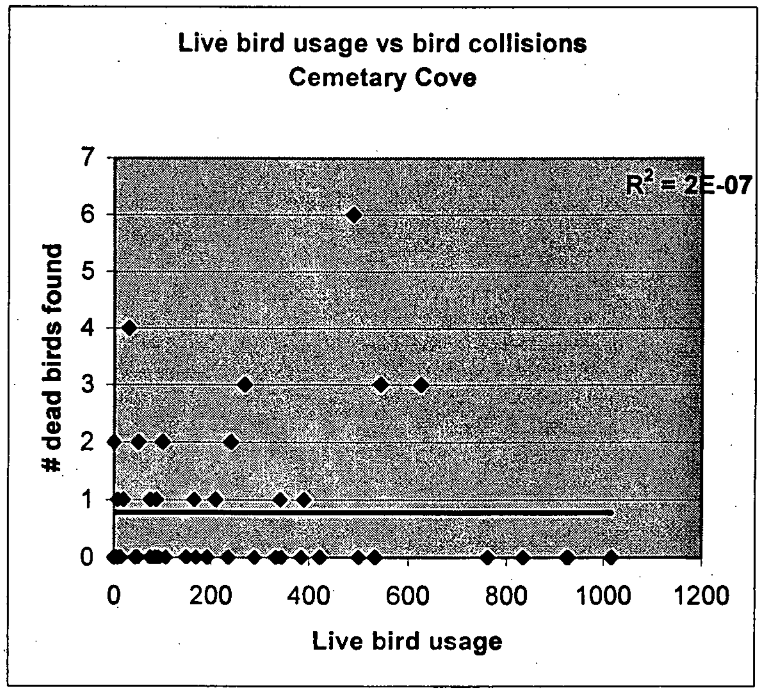
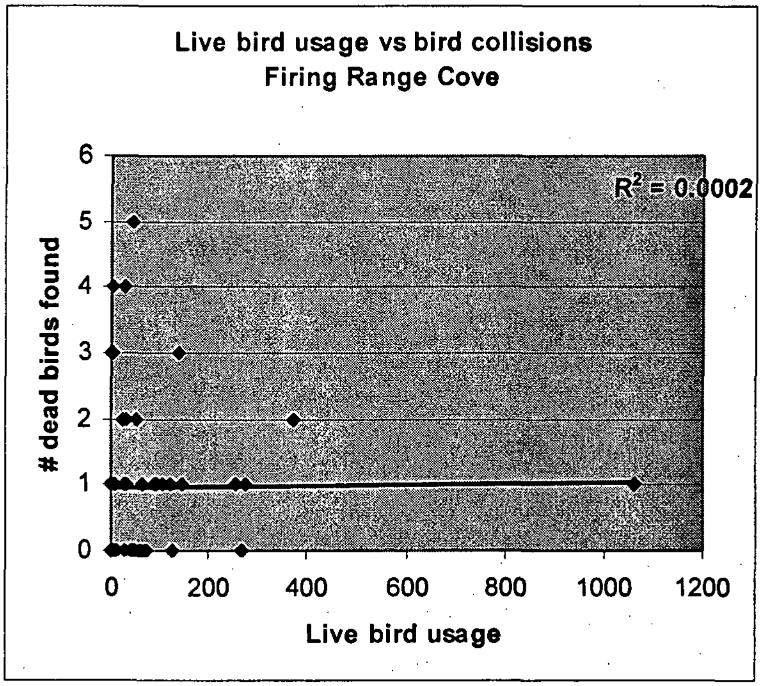


Figure 2. (cont).



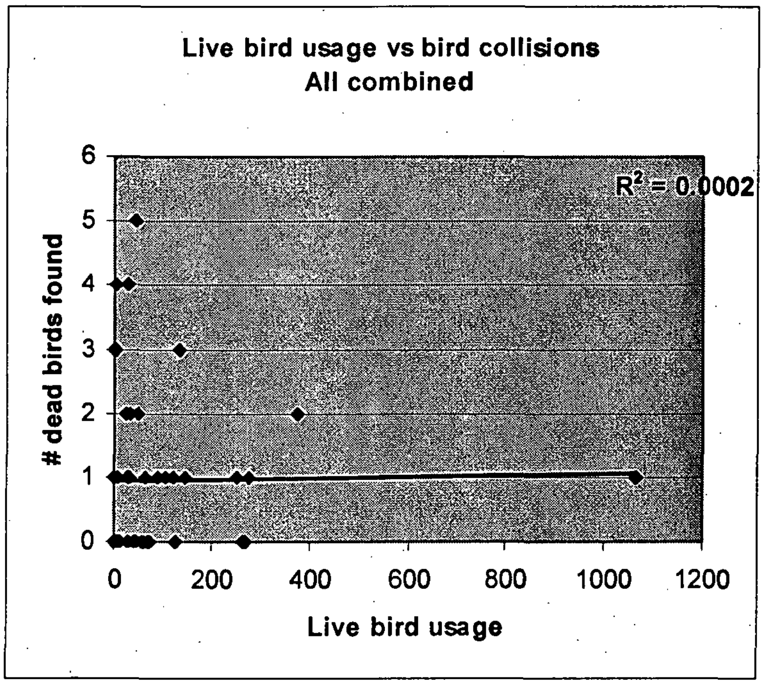
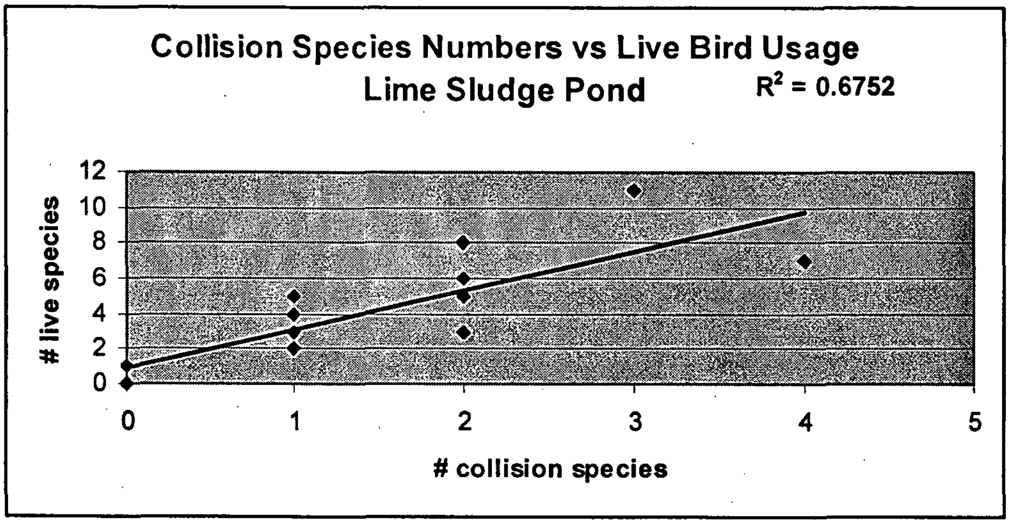
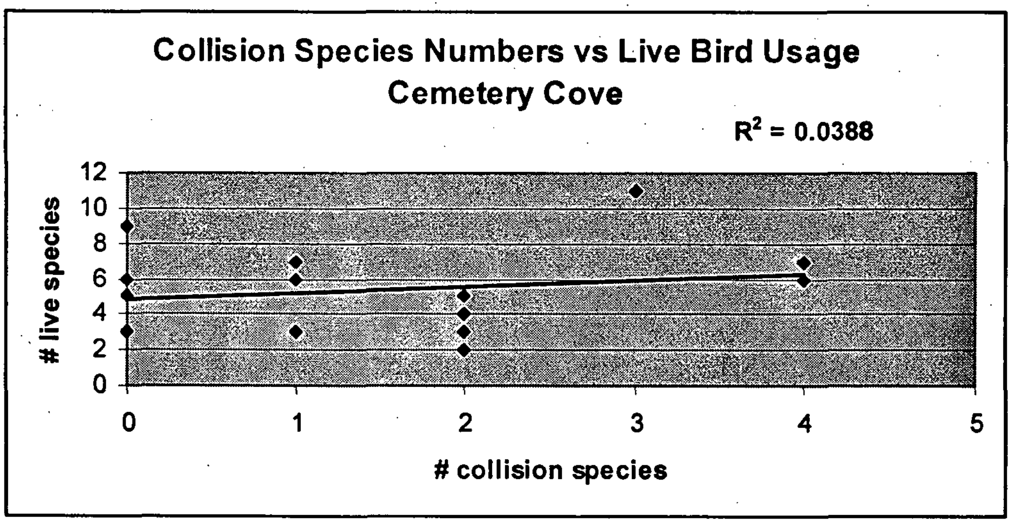
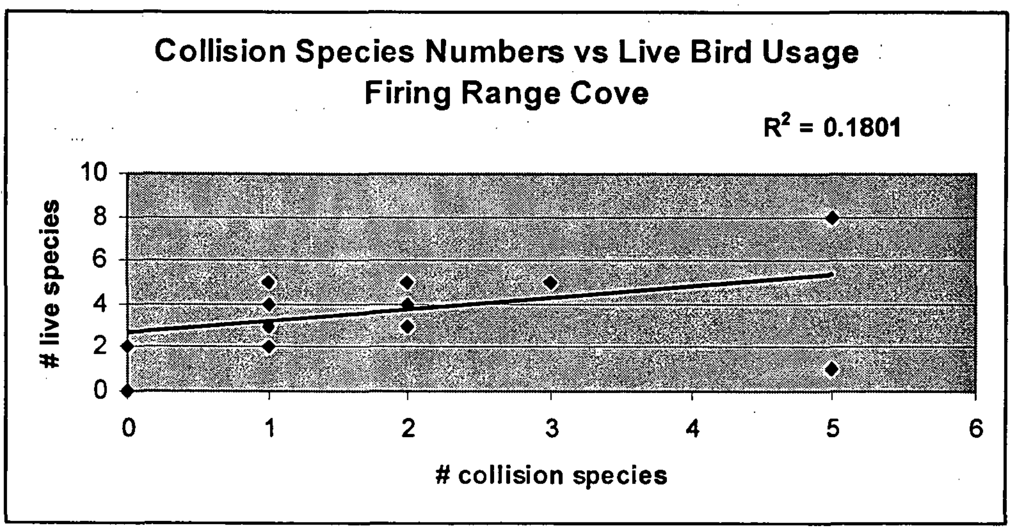


Figure 3. Species diversity of dead birds found compared to species diversity of live birds surveyed prior to searches.







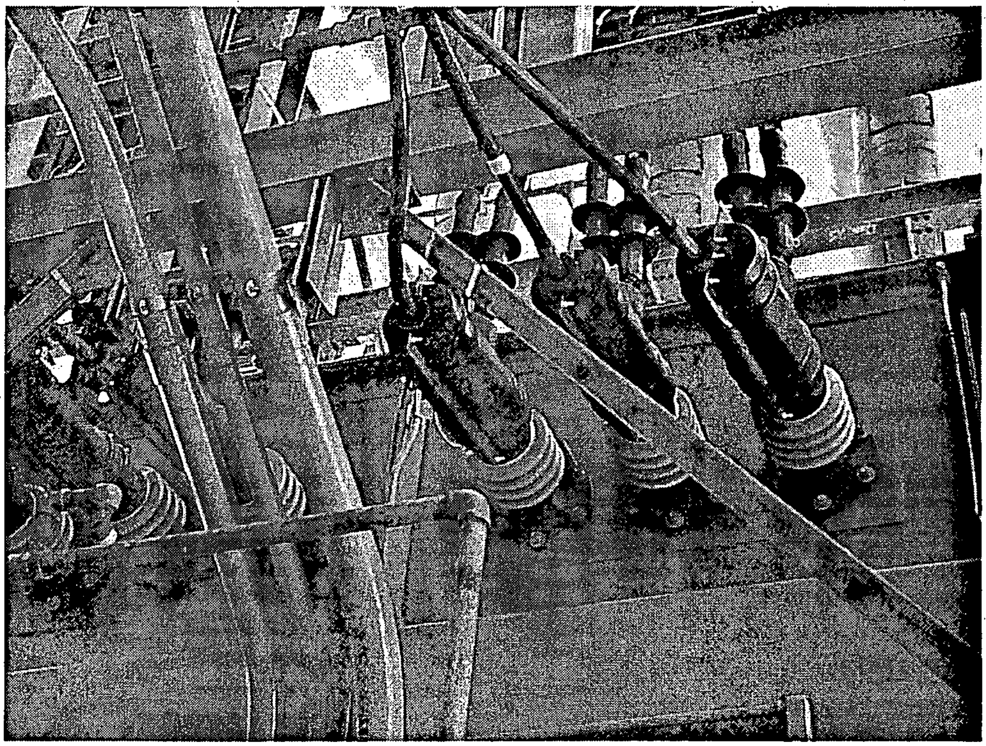


Figure 5. Typical bushing and conductor insulation present on WCGS transformers to prevent animal electrocutions.

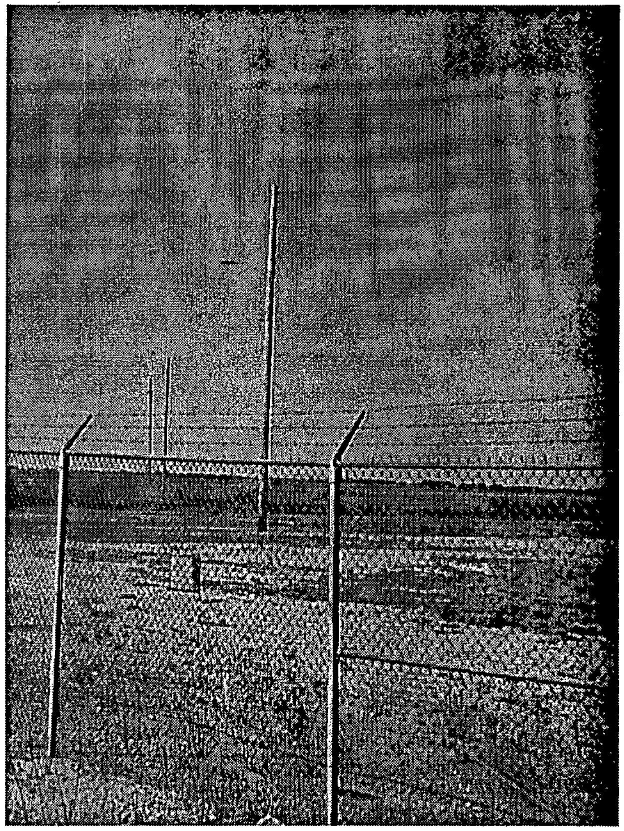


Figure 2. Poles where bald eagles have been observed roosting. These poles are considered safe due to well separated vertical conductors and pole tops available for perching.

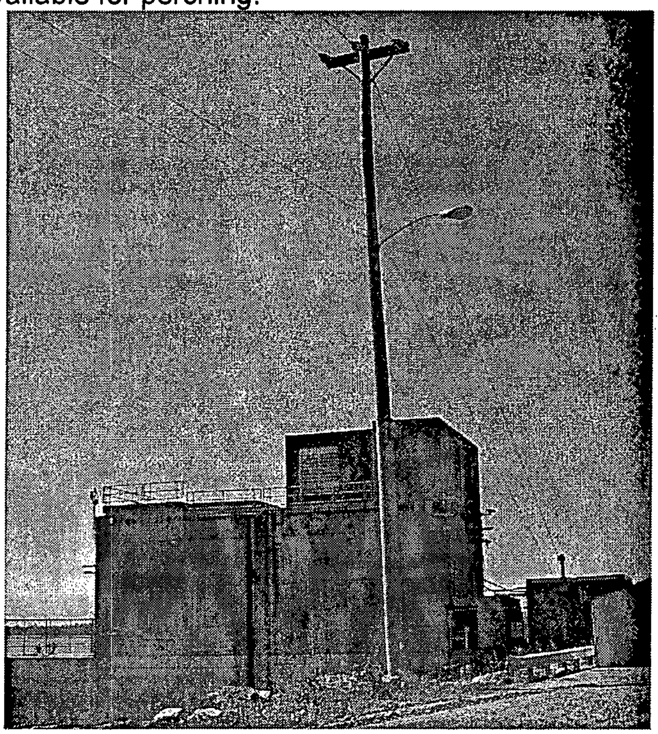


Figure 3 Pole 20 of the 13.8 kV distribution power loop where center phase conductor insulation is recommended to prevent potential bald eagle electrocution. Note close horizontal cross-arm configuration.

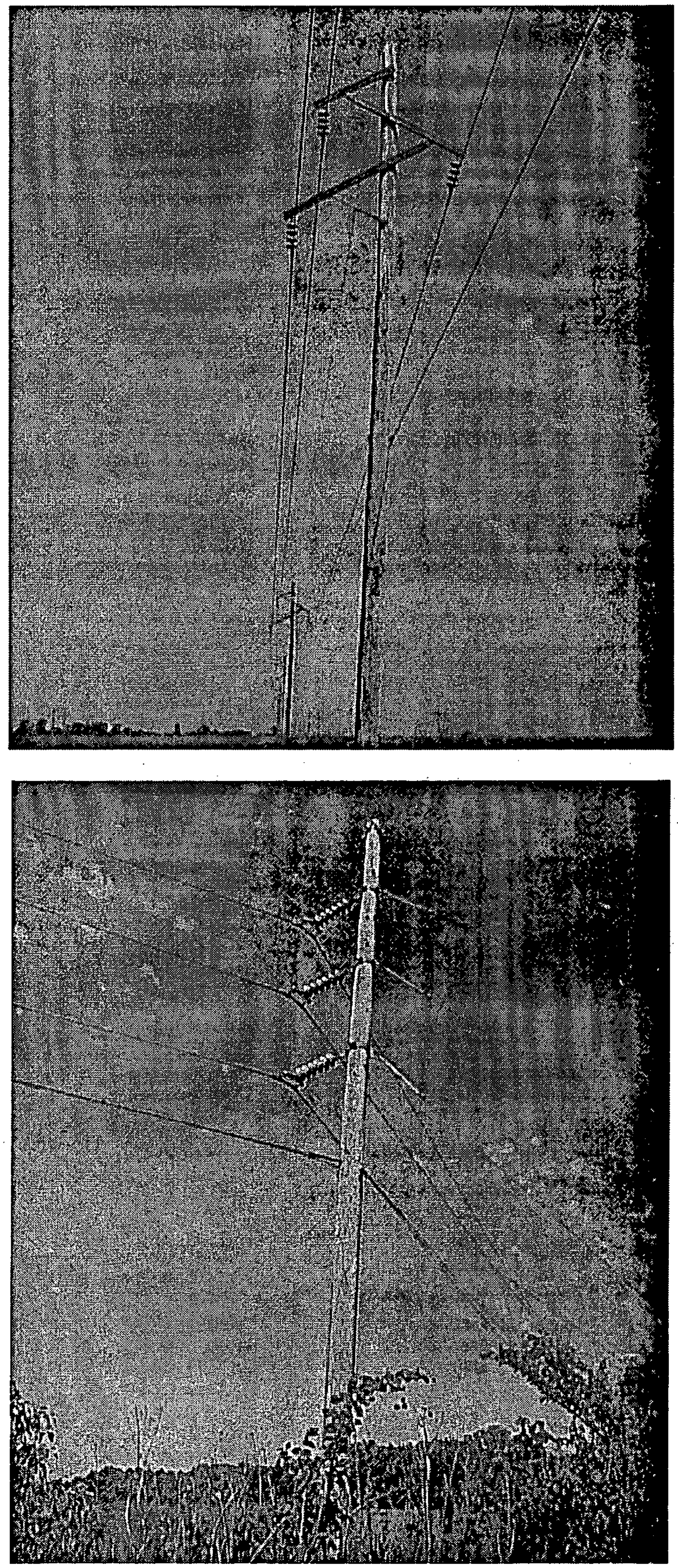


Figure 1. Typical poles of 69 kV WCGS tap of the Athens line showing eagle safe separated conductors and insulated guy hardware.

Table 1 (cont)

(1) Pole design features ranked from highest to lowest potential for electrocution hazards to bald eagles are as follows:

A. End pole three phase w/horizontal cross-arm, transformer and associated hardware.
B. Line pole three phase w/horizontal cross-arm, transformer, underground drops and associated hardware.
C. Corner/end pole three phase w/horizontal cross-arm
D. Line pole w/horizontal three phase cross-arm
E. Corner pole three phase w/vertical conductors, transformer and grounded guys.
F. Corner pole three phase w/vertical conductors and grounded guys.
G. End pole three phase w/vertical conductors, grounded guys and underground feed hardware.
H. End pole three phase w/vertical conductors and grounded guys.
I. Line pole three phase w/vertical conductors, transformer, and underground drop hardware.
J. Line pole three phase w/vertical conductors and transformer.
K. Line pole three phase w/vertical conductors and underground feed hardware.
L. Line pole three phase w/vertical conductors and switch hardware.
M. Corner/end pole three phase w/vertical conductors and non-grounded guys.
N. Line pole two phase w/horizontal cross-arm and two conductors.
O. Line pole three phase w/vertical conductors.

(2) Pole numbers correspond to poles numbered in the field, and to WCNOC drawing number 8025-E-1021, Rev 42.

Table 1. Susceptibility of bald eagles to electrocution on the 13.8 kV power distribution line at Wolf Creek Generating Station.

Bald Eagle Electrocution Potential	Eagle Use	Pole Design (1)	Pole number	Factors Related to Bald Eagle Safety: Less Safe ← Detriment: Horizontal Conductors	Grounded insulator hardware	Exposed transformer bushings	Grounded guy hardware	Non-insulated jumpers	Grounded switch/fuse hardware	Benefit → Safer: Behavior preventing contact	Transformer bushings covered	Insulated droppers	Ungrounded guy hardware	Separated vertical conductors	Insulator hardware not grounded	Ground conductor well separated	Pole top available for safe perch
Higher	Known roosts	N	46, 48											X	X	X	X
	Likely roosts next to lake habitat	C	20	X			X										X
		F	14, 17, 33, 35, 36, 38, 45, 49				X			X				X	X	X	X
		H	16, 25				X			X				X	X	X	X
		I	18, 26					X	X	X	X			X	X	X	X
		J	42					X		X	X			X	X	X	X
		K	15					X	X	X				X	X	X	X
		K	40						X	X		X		X	X	X	X
		O	19, 32, 34, 37, 41							X				X	X	X	X
	Not likely to be used as roost site	A	59B, 66	X			X		X		X	X			X	X	X
		B	59A	X					X		X	X			X	X	X
		C	55, 59	X			X								X	X	X
		D	54, 56, 57, 58, 61, 62, 63, 64, 65	X											X	X	X
		E	4				X	X	X	X	X			X	X	X	X
		G	1, 53				X	X	X	X				X	X	X	X
		I	3, 8, 30, 51				X	X	X	X	X			X	X	X	X
		J	11					X	X	X	X			X	X	X	X
		K	6, 27, 31, 39, 50					X	X	X				X	X	X	X
		L	5, 12, 28, 50A					X	X	X				X	X	X	X
		M	10							X			X	X	X	X	X
		N	61, 62, 63, 64, 65	X						X					X	X	X
Lowest		O	2, 7, 9, 13, 29, 43, 44, 52							X				X	X	X	X

5.3.2 Waterfowl Disease Contingency Plan

The heated condition of CCL may enhance the potential for development of waterfowl disease pathogens (NRC, 1982). This contingency plan is to provide guidance to mitigate or control such outbreaks on CCL, whether attributable to WCGS operation or not.

Initial investigation will be conducted by WCNOC biologists to determine the scope of the event. The USFWS and KDWP are the agencies responsible for such wildlife issues, and will be contacted for assessment and recommended actions if disease is suspected, or numerous carcasses are involved. WCNOC will assist these agencies as needed.

Immediate notification, following disease problem identification, will be completed by WCNOC at the numbers listed below until at least one is contacted:

1. US Fish and Wildlife Service
   Contaminant Specialist, Manhattan, (785) 539-3474
   Flinthills National Wildlife Refuge, Hartford, (620) 392-5553

2. Kansas Department of Wildlife and Parks
   District Wildlife Biologist, New Strawn, (620) 364-2522
   Natural Resource Officer, New Strawn, (620) 364-3418
   Region 5 Office, Chanute, (620) 431-0380
   Pratt Headquarters, Pratt, (620) 672-5911

6.0 LITERATURE CITED

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington, D.C.

Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. Edison Electric Institute and the Raptor Research Foundation. Washington, D.C.

APLIC and USFWS, 2005. Avian Power Plan (APP) Guidelines, a Joint Document Prepared By The Edison Electric Institute's Avian Power Line Interaction Committee (APLIC) and U. S. Fish and Wildlife Service (USFWS). April 2005.

NRC, 1982. Final Environmental Statement Related to the Operation of WCGS, Unit No. 1. NUREG 0878.

USFWS, 2003. Migratory Bird Permit Memorandum on Nest Destruction. MBPM-2, April 15, 2003.

mitigation was warranted. Consequently, transmission lines traversing the areas of high waterfowl and bald eagle usage were monitored and assessed for actual and potential collision problems beginning in 1983 and continued into 1985.

The research determined that collision mortality at WCGS was not considered significant for waterfowl. No bald eagle collisions were observed. See attached collision survey summary for more detail. Increased collisions, or waterfowl use changes indicating increased potential for collisions, will be assessed by WCNOC per NRC (1982). Mitigation needs will be addressed with Westar Energy's APP.

5.1.3 Chemical or Thermal Water Quality Affects to Fish Prey Base

The Kansas Department of Health and Environment (KDHE) regulates water quality discharges from WCGS with a National Pollutant Discharge Elimination System (NPDES) permit. All chemical additions are reviewed and approved by the KDHE prior to use. Periodic bioassays are also completed to demonstrate no impacts to aquatic biota, including fish. Adherence to this permit will ensure continued water quality, thus preclude any degradation to the bald eagle fish prey base.

There are no thermal discharge changes expected due to license extension. Currently, thermal effluents from WCGS concentrate fish and waterfowl during winter periods, thus increasing foraging opportunities for wintering bald eagles.

5.2 <u>Improvements for Avian Protection</u>

The assessment of potential avian impacts, particularly to bald eagles, has identified two areas where mitigation is recommended to prevent potential impacts in the future. These involve electrocution hazards at portions of the distribution power loop identified above. Modifications include:

1. Install insulation on the center conductor on pole 20 from the bushing approximately three feet (Figure 3) to eliminate potential for bald eagle electrocution.

2. Install perch deterrents and/or insulate center conductors on poles 54 through 59 (Figure 4). These modifications will reduce electrocution potential caused by the closely spaced horizontal conductors.

5.3 <u>Future Contingencies for Avian Protection</u>

5.3.1 Electrocution and Collision Events

Based on past experience, bird mortality due to electrocution or collision is not expected to increase in the future at WCGS. In the event electrocution or collision events increase, mortalities will be investigated, recorded and reported in accordance with the current USFWS salvage permit. Consultation with APLIC and USFWS will help determine any mitigation activities if such events become problematic. APLIC (1994 and 1996) guidelines will be followed when practical.

If electrocution or collision events involve Westar Energy or KEPCo lines, then the respective company will be notified, and remediation activities will be determined by applicable APP's. WCNOC will assist where needed.

beneficial for reducing electrocution potential offset many of the potential detrimental conditions (Table 1).

Protected Bird Interactions

Typically, electrocution threats to birds are greatly influenced by conductor spacing (APLIC 1996). In the vicinity of WCGS, the bald eagle has been the largest species likely to use utlility poles, and because of its large wingspan, would be able to bridge larger conductor spacings. Consequently, conductor configurations and distances judged safe for bald eagles would also be safe for smaller birds.

However, roosting behavior differences of various species may cause different susceptibilities. On the distribution power loop, various switches, breakers, and pole-mounted transformers may provide suitable roosts, and some species smaller than bald eagles, can and may prefer to get among the hardware, rather than on pole tops. Insulated bushings and jumpers on pole-mounted transformers, etc are present, thus reducing electrocution potential in such instances.

It was found that line spacing and configuration on pole numbers 54 through 59 (Figure 4) may pose potential electrocution threats to some birds, particularly red-tailed hawks, great-horned owls, and flocking blackbird species. Review of past reports for the USFWS salvage permit maintained for WCGS identified one great-horned owl electrocution since 1985. Electrocution of mixed blackbirds on portions of this line has been suspected as causing service outages on this line, but specific evidence has not been confirmed.

5.1.1.4 480 Volt Distribution Lines

Low voltage distribution lines do not typically pose electrocution hazards (APLIC 1996). At WCGS, such 480 volt lines provide electricity for lighting and outbuildings, and are typically mounted underneath the 13.8 kV power loop lines. Conductors are insulated preventing electrocutions. No modifications to these lines were considered necessary.

5.1.1.5 Transformers

There were no transformers at WCGS that were deemed as potential electrocution hazards to bald eagles. The pole mounted transformers associated with the 13.8 kV distribution power loop were evaluated with each pole (Table 1), and all had bushing insulators, thus eliminating electrocution potential for all birds. The larger 345 kV transformers require conductor separation beyond the reach of a bald eagles wingspan, thus all smaller species. Intermediate transformers associated with WCGS have covered conductors and bushings to prevent animal caused system outages and damage Figure 5). Some transformers in the switchyard are owned by Westar Energy, consequently are covered by their APP.

5.1.2 Collision Potential

The NRC in 1982 reviewed potential impacts to waterfowl due to collision with electric transmission facilities adjacent to the cooling lake (NRC 1982). The NRC recommended that a general survey program for waterfowl collisions be completed to determine if

5.1.1.2 69 kV Transmission Lines

There has been bird electrocutions observed associated with WCGS. The WCGS tap of the Athens line is owned and operated by Westar Energy thus is part of its APP. Due to the design of this line, this line will not be dangerous to bald eagles. Design includes well-separated conductors on typical line poles, and non-grounded hardware and guys making phase to ground electrocutions unlikely (Figure 1). Poles also have safe tops available for perching, which bald eagles prefer.

The WCGS to Sharpe line is owned and operated by the Lyon/Coffey County Rural Electric Cooperative, and is thus included in its policy for prevention of wildlife contacts. This line is not expected to pose electrocution hazards to birds, including bald eagles. Design benefits included sufficient conductor separation and non-grounded insulator hardware reducing phase-ground electrocution potential. Safe pole tops are also available for perching. The line is also not located in habitat frequented by bald eagles.

5.1.1.3 13.8 kV Distribution Power Loop

<u>Bald Eagle Interactions</u>

There has been no bald eagle electrocutions observed on the 13.8 kV Distribution Power Loop, sometimes called the "construction loop". This power loop surrounds the WCGS proper consisting of 64 poles spanning approximately 2.1 miles (reference WCNOC drawing 8025-E-1021). It distributes power to various buildings and facilities, and is maintained by WCNOC. It consists of numerous pole-mounted transformers, jumper leads to under ground services, cutoff fuses, switches, and corners. These types of electric setups are known to present electrocution hazards to birds (APLIC 1996). Electrocution hazards were considered for each pole, with emphasis on bald eagle susceptibility. Table 1 lists the benefits and detriments that each pole has, and prioritizes them as to their potential for eagle electrocutions.

For assessment of bald eagle electrocution potential, poles were prioritized from highest to lowest as; (1) known eagle roost poles, (2) likely roost poles, and (3) unlikely roost poles. As shown in Table 1, eagles have been known to roost on two poles, which were considered safe for bald eagles (Figure 2). No mitigation is recommended for these poles.

Of the likely roost poles identified in Table 1, only pole 20 was considered potentially dangerous to bald eagles (Figure 3). This pole has close conductors and a horizontal cross-arm configuration. The pole is also adjacent to water habitats, and may be an attractive roost site, especially for wintering bald eagles foraging around the lake. All remaining poles judged as likely roosts were not considered hazardous to bald eagles due to the multiple factors beneficial for preventing eagle electrocution as identified in Table 1.

The remainder of the distribution power loop poles were considered unlikely to be used by bald eagles, and thus were not judged to pose significant electrocution threats. These poles are distant from likely foraging habitat, are around high human activity, in parking lots, or along mowed lawn areas. In addition, factors judged

November 14, 2005 letter from M. J. LeValley, USFWS, to K. J. Moles, WCNOC). In addition bald eagles are large birds, and may be more susceptible to electrocution and collisions (APLIC 1994, 1996).

To ensure WCGS exists with minimal impact to birds, and to address license extension concerns, this APP includes three main phases; (1) assessment, (2) improvement, and (3) future contingency plans.

5.1 Assessment Phase for Avian Protection

The assessment of power lines and facilities presented below were completed by WCNOC biologists using APLIC (1994, 1996) guidelines. Biologists from two current APLIC member utilities, Great Plains Energy and Westar Energy assisted with this assessment. Applicable reports and literature were used to address collision and water quality concerns.

5.1.1 Electrocution Potential

All lines were inspected for electrocution hazards using criteria in APLIC (1996). There are four primary types of aerial power lines, in addition to transformers, associated with WCGS. They include:

1. 345 kilovolt (kV) transmission lines owned and operated by Westar Energy, including the LaCygne to Benton, and Wolf Creek to Rose Hill lines..
2. 69 kV transmission lines, including the WCGS tap of the Athens line (approximately four miles) owned and operated by Westar Energy, and the WCGS to Sharpe line (approximately 2.5 miles), owned and operated by Lyon-Coffey Electric Cooperative.
3. 13.8 kV distribution power loop operated by WCNOC.
4. 1000 volt or less (typically 480 volt) distribution lines operated by WCNOC.
5. Transformers at WCGS operated by WCNOC and Westar Energy.

5.1.1.1 345 kV Transmission Lines

There were no electrocution hazards to bald eagles and other birds identified at WCGS from the 345 kV transmission lines. The lines are owned, inspected, maintained, and operated by Westar Energy. As such, they are covered by Westar Energy's Avian Protection Plan (APP) which includes documentation and reporting to the USFWS of bird mortalities associated with the lines. The APP provides for retrofitting or modifying lines, poles, and equipment to bird safe standards where mortalities are known.

In general, the conductor separation required for the 345kV transmission lines are more than can be spanned by birds, including the bald eagle, thus eliminating electrocution potential. Insulator fouling by feces streaming, or nest construction may pose electrocution hazards (APLIC 1996). These types of bird interactions are inspected for and addressed by Westar Energy's routine inspections and APP.

birds may cause phase-ground or phase-phase shorts. This also protects birds from electrocution.

2. Cliff swallows commonly attempt to nest on plant buildings causing significant housekeeping and disease concerns associated with the mud nest colonies. Control activities include netting or sheeting to eliminate nesting sites prior to active nesting. In areas where this isn't feasible, nest starts are removed before eggs are laid, thus preventing establishment of a nesting colony. Active colonies exist at the CCL spillway and the causeway bridge providing nearby colonies for displaced birds, thus preventing take. Nest starts are not considered active (without eggs or young), thus no permitting is required (USFWS 2003). Active, or suspected active nests are allowed to stay unless significant hazards are involved. After evaluation by WCGS biologists, a permit from the USFWS will be obtained before nest removal in such instances.

3. Barn swallow nests tend to pose similar housekeeping concerns as Cliff swallows, except on a smaller scale. If nest site modification isn't feasible, then inactive nest start removal is completed. Suspected or actual active nests are allowed to stay unless significant hazards are involved. Such hazards may include safety concerns to personnel by adult birds protecting nests around ladders and stairs. WCGS biologists will evaluate on a case-by-case basis, and obtain specific USFWS permits before nest removal.

4. Miscellaneous bird interactions in the past have included high bird activity in security motion detection areas, usually by swallows and mixed blackbird species. Noise and distress calls have been used to discourage bird activity and help reduce this problem. Eastern kingbird nesting has periodically caused personnel safety concerns at the meteorological tower and plant buildings. When necessary, to remove such birds, specific permits from the USFWS are required.

5.0 POTENTIAL IMPACTS TO BIRDS

The potential impacts to protected bird species due to the presence and operation of WCGS include:

1. Electrocution with power-lines, poles and transformers

2. Collision on aerial lines

3. Chemical or thermal water quality impacts, particularly to the fish prey base of bald eagles

4. potential increase for waterfowl disease pathogens in the warm water discharge to CCL.

Impacts to bald eagles are emphasized in this APP because this species is currently listed as threatened, thus protected by the ESA, as well as the MBTA and BGEPA. Removal fro the threatened list is currently being considered by the USFWS. As a threatened species, it deserves greater attention during the WCGS operating license extension process. The extension is an federal action by the Nuclear Regulatory Commission (NRC), and as such will require USFWS and Kansas Department of Wildlife and Parks consultation. Potential impacts were identified by the USFWS during pre-submittal consultation with WCNOC (see attached

5. The Endangered Species Act (16 U.S.C. 1531-1544: ESA), prohibits the take of a listed species. Take is defined as "...to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct."

6. The Kansas Nongame and Endangered Species Conservation Act (K.S.A. 32-1009 to 32-1011) prohibits take and possession of state listed nongame, threatened or endangered species.

7. The USFWS Migratory Bird Permit MB715225, and current revisions, has been issued for migratory bird salvage and mortality investigation at WCGS. This permit does not provide for take.

8. The Kansas Department of Wildlife and Parks (KDWP) Scientific Collecting and Salvage Permit (currently SC-066-2006), and current renewals, is maintained for bird possession and mortality investigation at WCGS.

3.0 BIRD ENHANCEMENT ACTIVITIES

Offsetting potential adverse impacts to birds by WCGS, various enhancement activities have been completed at WCGS. The existence of the CCL has created excellent habitat for many bird species. In addition, WCNOC's land conservation and wildlife stewardship activities provide bird habitats. These include shallow water wetland development, native grassland and forb management, and maintenance of forested habitats.

WCNOC partnerships with wildlife agencies have also attempted to enhance regional bird diversity and habitat use. Ospreys were released in an attempt to promote a breeding population in Kansas. This was done in partnership with the KDWP from 1996 though 2000. Peregrine falcons were released in 2004 and 2005 in an ongoing attempt to promote nesting on plant facilities. This was completed with KDWP and USFWS permitting and support.

A pair of bald eagles have nested since 1994 in a tree inundated by the CCL. An area around the nest is buoyed off and human disturbance is prohibited within 300 yards of the nest site. WCNOC helps monitor this nest for the USFWS. Thermal effluents also provide foraging habitat for wintering bald eagles, which was not available prior to CCL.

Enhancements for nesting around WCGS and the lake include placement of eastern bluebird, wood duck, American kestrel, and Canada goose structures.

4.0 BIRD IMPACTS TO WCGS

Nuisance bird issues at WCGS involving protected species include perching/roosting, nesting attempts, and motion activity in security areas. Except for house sparrows, starlings and pigeons, lethal control methods are not considered for use at WCGS without specific permitting from the USFWS. Specific bird impacts to WCGS and preferred method for control are as follows:

1. Mixed blackbird flocks attracted to the lake typically roost on the construction power distribution loop in such numbers causing occasional electric service disruption to WGCS administration buildings. Common practice is to insulate potential areas where

Avian Protection Plan
at
Wolf Creek Generating Station

1.0 INTRODUCTION

It is the policy of Wolf Creek Nuclear Operating Corporation (WCNOC) to operate Wolf Creek Generating Station (WCGS) in a manner protecting environmental quality through implementation of an environmental protection program (Corporate Policy 5, Environmental Stewardship). This environmental policy includes actions beyond regulatory compliance, some of which are identified within this Avian Protection Plan (APP).

This APP addresses interactions with protected birds at WCGS. House sparrows, European starlings, and pigeons are not protected, are considered non-native pest species, and thus are not included within this APP. Addressed are current regulations and issues, WCGS bird enhancements activities, and nuisance situations and impacts to WCGS caused by protected species. However, the primary goal of this APP is to assess potential adverse impacts of WCGS to birds, identify improvements to minimize these impacts, and present contingency plans for potential future events.

This APP is site-specific for WCGS, which is a nuclear electric generating station in east-central Kansas. Associated with WCGS are transmission lines, distribution lines, transformers, buildings, and a cooling lake (Coffey County Lake, CCL). Potential impacts to WCGS from bird interactions include electric service disruption to plant facilities, interruption of plant operation, personnel safety and health, and cleanliness. Potential impacts to birds include electrocution, power line collision, prey base alterations, and disease pathogen presence.

2.0 REGULATORY BASIS

For WCGS, several regulatory concerns or permits are applicable to this APP and are as follows:

1. Appendix B to the Facility Operating License No. NPF-42, referencing the Final Environmental Statement, Operating License Stage (NUREG 0878), for WCGS, recommends a disease contingency plan for preventing or controlling a waterfowl disease episode. This APP includes a waterfowl disease contingency plan.

2. Potential impacts were identified by the U. S. Fish and Wildlife Service (USFWS) during pre-submittal consultation with WCNOC for WCGS license extension action (see attached November 14, 2005 letter from M. J. LeValley, USFWS, to K. J. Moles, WCNOC). This APP addresses potential bald eagle impacts.

3. The Migratory Bird Treaty Act (16 U.S.C. 703-712: MBTA) prohibits the taking, killing, possession, transportation and importation of migratory birds, their eggs, parts, and nests without USFWS permitting.

4. The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d: BGEPA) provides additional protection to bald and golden eagles above that in the MBTA.

Avian Protection Plan

at

Wolf Creek Generating Station

with emphasis of potential impacts to the Bald Eagle
from License Renewal at Wolf Creek Generating Station

Wolf Creek Nuclear Operating Corporation

August , 2006

IMAGED 04/26/2006

K01-017

62

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

April 26, 2006

RA 06-0065

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Docket No. 50-482: 2005 Annual Environmental Operating Report

Gentlemen:

Enclosed is the Annual Environmental Operating Report, which is being submitted pursuant to Wolf Creek Generating Station (WCGS) Facility Operating License NPF-42, Appendix B. This report covers the operation of WCGS for the period of January 1, 2005, through December 31, 2005.

No commitments are identified in this correspondence. If you have any questions concerning this matter, please contact me at (620) 364-4126, or Ms. Diane Hooper (620) 364-4041.

Sincerely,

Kevin J. Moles

Kevin J. Moles

KJM/rlt

Enclosure

cc: J. N. Donohew (NRC), w/e
W. B. Jones (NRC), w/e
B. S. Mallett (NRC), w/e
Senior Resident Inspector (NRC), w/e

WOLF CREEK GENERATING STATION

ANNUAL ENVIRONMENTAL OPERATING REPORT 2005

ENVIRONMENTAL MANAGEMENT ORGANIZATION

WOLF CREEK NUCLEAR OPERATING CORPORATION

P.O. BOX 411

BURLINGTON, KANSAS 66839

April 2006

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1.0 INTRODUCTION

The 2005 Annual Environmental Operating Report is being submitted in accordance with the objectives of the Environmental Protection Plan (EPP), Appendix B to the Facility Operating License NPF-42. The purpose of this report is to demonstrate that the Wolf Creek Generating Station (WCGS) operated during 2005 in a manner protective of the environment

2.0 ENVIRONMENTAL MONITORING

2.1 AQUATIC [EPP Section 2.1]

2.1.1 Impacts of Water Withdrawal on the Neosho River

The WCGS Final Environmental Statement/Operating License Stage (FES/OLS, Section 5.6), NUREG-0878, postulated that makeup water withdrawal of 41 cubic feet per second during drought conditions would extend the duration and severity of low-flow conditions below John Redmond Reservoir (JRR). This, in turn, was expected to reduce riffle habitat that would adversely affect the Neosho madtom, a federally listed threatened species.

Neosho River flows at Burlington were maintained during makeup withdrawal activities. Therefore, there were no adverse impacts to the Neosho River or Neosho madtom habitats attributable to WCGS water withdrawal during 2005. The owners of WCGS have contracted with the Kansas Water Resources Board to pump up to 9.672 billion gallons of water per calendar year to Coffey County Lake (CCL), formerly known as Wolf Creek Lake, from the tailwaters of the JRR. A total of 3.703 billion gallons, or 38 percent of the contracted allotment, was used for WCGS purposes during 2005. The makeup water for CCL was pumped from January 1 through January 12, May 1 through May 2, June 19 through June 27, and November 4 through December 31, 2005. Measurements at Burlington, Kansas, taken during 2005 by the United States Geological Survey, indicate that flows downstream of the WCGS withdrawal station in the Neosho River were not reduced by makeup pumping activities.

2.1.2 Oxidizing Biocide Discharges to Coffey County Lake

Circulating Water System (CWS) Discharge:

Biocide use at WCGS was predicted to cause periodic, appreciable mortality in a conservatively estimated 40 acres of the discharge area to CCL. However, these impacts were not expected to meaningfully affect the overall biological productivity of the lake (FES/OLS, Section 5.5.2.2). The postulated biocide levels expected to cause the impacts were from 0.68 to 1.08 mg/l of total residual chlorine at the CWS discharge (FES/OLS, Section 4.2.6.1). Three 30-minute doses per day of 411 pounds of chlorine per dose were projected to produce these concentrations.

Impacts from actual biocide use during 2005 were considered to be less than postulated in the FES/OLS. A sodium hypochlorite and sodium bromide formulation was used to control biological fouling in WCGS cooling water systems during 2005. Evaluations completed at WCGS demonstrated that the sodium hypochlorite and sodium bromide formulation would not have greater impacts to the cooling lake environment than those expected from the level of chlorine use identified in the FES/OLS. All changes were reviewed and approved by the Kansas Department of Health and Environment (KDHE) prior to implementation.

The WCGS National Pollutant Discharge Elimination System (NPDES, Number I-NE07-PO02) permit limits biocide discharges to levels lower than postulated in the FES/OLS. This permit was administered by the KDHE. The biocide level for the CWS was limited to a maximum of 0.2 mg/l, total residual oxidant (TRO), for a maximum of two hours per day. Compliance during 2005 was 100 percent. Actual oxidizing biocide dosages averaged approximately 27.6 pounds per day and the daily average TRO was 0.06 mg/l.

Essential Service Water System (ESWS) Discharge:

During 2005, a continuous diversion of approximately 17,000 gallons per minute of WCGS Service Water System flow to the ESWS was completed to provide microbiologically induced corrosion protection and sedimentation control. The KDHE established a 1.0 mg/l TRO limit for the SWS flow diversion through the ESWS. Actual measurements of TRO averaged <0.09 mg/l, and compliance with the NPDES limit in 2005 was 100 percent. No fish mortality or water quality changes attributable to ESWS biocide discharges were observed. Based on this information, permitted biocide discharge during 2005 did not have appreciable effects on the cooling lake environment.

2.1.3 Cold Shock

In the event of a rapid decline in plant power level during winter, fishes attracted to the WCGS heated discharge could experience mortality due to a quick reduction in body temperature (cold shock). In reference to licensing document evaluations, the WCGS EPP Section 2.1 (c) states, "Cold shock effects on fish due to reactor shutdowns could cause significant mortality to aquatic species in the cooling lake."

No adverse impacts due to cold shock mortality events occurred during 2005. There were two plant shutdowns during 2005. The first was from January 22 through February 4, and the second from April 9 through May 19, 2005. Both shutdowns, but primarily the first, were during cold periods when fish have generally been attracted to the warm water discharges, thus susceptible to cold-shock events. No fish mortality attributable to cold-shock effects were observed following these plant shutdowns.

2.1.4 Impingement and Entrainment

Impacts of entrainment and impingement of fish and aquatic organisms due WCGS cooling water pumping were projected to be significant, as indicated in the WCGS EPP, Section 2.1 (d). EPP Section 2.1 states that the NRC relies on the State of Kansas for determination of the need for monitoring entrainment and impingement impacts. Although the State of Kansas has not required WCGS to monitor entrainment and impingement impacts, periodic observations during 2005 indicated that fish impingement at the WCGS circulating water intake was negligible.

2.1.5 Impacts of Coffey County Lake Discharges to the Neosho River

The WCGS NPDES permit requires that CCL discharges be sampled on the first day of each discharge and weekly thereafter until the end of each respective discharge. Discharge limits were set for chlorides, and pH (NPDES Outfall 004). Lake discharges typically have occurred at the Blowdown Spillway and Service Spillway. During 2005, no discharges occurred at the Blowdown Spillway. There were no NPDES violations from discharges from the Service Spillway, and no detrimental effects have been identified to the Neosho River water quality in 2005.

2.2 TERRESTRIAL [EPP Section 2.2]

2.2.1 Control of Vegetation in the Exclusion Zone

The composition and structure of vegetation in the 453 hectare (1120 acre) exclusion zone were selectively controlled to be compatible with the function and security of station facilities. Most areas in the immediate vicinity of the power block have been planted and maintained in a lawn-type condition. Other areas within the exclusion area have been mowed for security and aesthetic purposes. There were no changes in overall vegetation management of the exclusion zone during 2005.

2.2.2 Vegetation Buffer Zone Surrounding Coffey County Lake.

To create a buffer zone of least 500 acres around CCL, as specified in EPP Section 2.2 (b), agricultural production activities were curtailed in 1980 within a border ranging from approximately 200-400 feet adjacent to the lake shoreline. This area is approximately 1440 acres. Previously grazed or hayed native grass areas were left undisturbed. Previously cultivated lands were allowed to advance through natural succession stages, or native grasses were established in these areas. Land management activities included controlled burning to enhance and/or maintain the designated buffer zone with a naturally occurring biotic community.

2.2.3 Herbicide Use for Maintenance of WCGS Structures

Herbicides were used on transmission line corridors, gravel areas, railroad easements, and various land areas associated with WCGS. Application rates followed label instructions. All herbicides used were registered by the Kansas Department of Agriculture when purchased. No environmental impacts from herbicide treatment of WCGS facilities were identified. A summary of herbicide application is provided below.

The Lacygne to Benton 345 kilovolt (KV) transmission line corridor on property associated with WCGS was sprayed to control undesirable brush and tree growth. Herbicides included Tordon 22K (EPA Reg. No. 62719-6), Escort (EPA Reg. No. 352-439), and Arsenal (EPA Reg. No. 241-346).

In areas where bare-ground control was desired, a herbicide mix of Karmex DF (EPA Reg. No 352-508) and Oust (EPA Reg. No. 352-401) was used. Roundup Ultra (EPA Reg. No 524-475), or comparable substitutes, was also used for

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problem weed areas. These herbicides were used on various gravel areas, including the switchyard, protected area boundary, meteorological tower, storage tank berms, railroad beds, and storage yards.

Nuisance tree and brush growth was controlled with Tordon 22 K, Tordon RTU (EPA Reg. No. 62719-31), Remedy (EPA Reg. No. 62719-70), Weed Pro 2,4-D (EPA Reg. No. 10107-31), and Roundup Ultra. Areas treated included the dam, spillways, railroad easements, and selected grassland areas around the cooling lake.

Four plants listed as noxious weeds by the Kansas Department of Agriculture were controlled on WCGS lands. These were serecia lespedeza, musk thistle, Johnson grass, and field bindweed. Serecia lespedeza was treated with Pasturegard (EPA Reg. No. 62719-477), Remedy, and Weed Pro 2, 4-D. Musk thistle was controlled with mechanical means. Johnson grass was controlled with Roundup Ultra while field bindweed was controlled through normal farming practices by the tenants of the agricultural leases.

2.2.4 Waterfowl Disease Contingency Plan and Monitoring

A waterfowl disease contingency plan was maintained to provide guidance for station biologists in the event of suspected or actual disease outbreaks. The contingency plan lists appropriate federal and state wildlife agency contacts to be made by WCNOC in the event of such problems. During routine environmental monitoring and surveillance activities taking place over this reporting period, no waterfowl mortality attributable to disease pathogens was identified.

2.2.5 Fog Monitoring Program [EPP Subsection 4.2.1]

Visibility monitoring was initiated in December, 1983, and continued through 1987. The purpose of this study was to evaluate the impact of waste heat dissipation from CCL on fog occurrence along U. S. 75 near New Strawn, Kansas. The program was required through one year of commercial operation that started in September, 1985. Upon conclusion of 1987 data collection, sufficient information was available to evaluate cooling lake fogging, and all commitments relevant to fog monitoring had been satisfied. The fog monitoring study concluded that operation of WCGS did not appreciably increase fogging incidents from that measured before operation.

During 2005, there were no reports of fogging incidents in the vicinity of nearby U. S. 75 from individuals or local agencies responsible for traffic safety. Periodic fogging caused by the cooling lake did occur during the winter months of 2005, but was restricted to the plant site. No mitigation actions or further monitoring were warranted.

2.2.6 Wildlife Monitoring Program [EPP Subsection 4.2.2]

A wildlife monitoring program was initiated in 1982 to monitor and assess waterfowl, waterbird, and bald eagle usage of CCL. This program included transmission-line collision surveys to assess collision mortality and determine potential mitigation needs. This wildlife monitoring program was to continue for at least two years following WCGS start-up (FES-OLS Section 5.5.1.2), which occurred during September, 1985. Upon completion of 1996 monitoring, sufficient data had been collected to determine waterfowl, waterbird, and bald eagle usage of CCL. Consequently, the scope of the wildlife monitoring program was reduced. The current program consists of reviewing CCL waterfowl and bald eagle survey data collected by the Kansas Department of Wildlife and Parks (KDWP). If review of the KDWP's data indicates usage has changed from that previously documented, then additional monitoring may be initiated, if warranted. This additional monitoring may include collision mortality monitoring.

Review of waterfowl and bald eagle monitoring data from the KDWP indicate that no significant usage changes occurred during 2005. No disease outbreaks or widespread crop depredation attributable to waterfowl use of CCL was observed in 2005. No changes to the wildlife monitoring program were warranted.

2.2.7 Land Management Program [EPP Subsection 4.2.3]

Land management activities on all company-owned lands except within the 453 hectare (1120 acre) WCGS exclusion area were designed to achieve balances between agricultural production and conservation values. An annual management plan addressed needs and accepted techniques for land maintenance, soil conservation, and wildlife management. These included the repair or construction of soil conservation structures, wetland areas, and permanent vegetative covers. An environmental education area was improved and maintained as part of the land management program. A summary of the year 2005 land management activities appears in Section 4.1 of this report. The land management program continued in 2005 to balance agriculture production and conservation values.

3.0 ENVIRONMENTAL PROTECTION PLAN REPORTING REQUIREMENTS

3.1 PLANT DESIGN OR OPERATION CHANGES [EPP Section 3.1]

Proposed plant design and operational changes which have the potential to affect the environment must receive an environmental evaluation prior to implementation. There were no changes in station design or operation nor were there tests or experiments that required a evaluation for the presence of an un-reviewed environmental question during 2005.

3.2 NON-ROUTINE ENVIRONMENTAL REPORTS

3.2.1 Submitted Non-routine Reports

There were no environmental reports involving significant non-routine impacts submitted to the NRC during 2005.

3.2.2 Unusual or Important Environmental Event Evaluations

No unusual or important environmental events reportable according to specifications in the EPP were identified during 2005.

3.3 ENVIRONMENTAL NONCOMPLIANCES [EPP Subsection 5.4.1]

Potential non-radiological environmental noncompliances or noteworthy events were documented and evaluated in accordance with WCNOC's Corrective Action Program, using Performance Improvement Requests (PIRs). A PIR is WCNOC's administrative

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process for corrective action and improvements. Events evaluated during 2005 included improvements to the refrigerant and chemical control programs. All the documented enhancement and reviews were determined not to be reportable pursuant to EPP criteria.

4.0 SUMMARY OF ENVIRONMENTAL INVESTIGATIONS AT WOLF CREEK GENERATING STATION

4.1 2005 LAND MANAGEMENT ACTIVITIES

The EPP requires a land management program that will implement conservation and wildlife management techniques to attempt to balance production and conservation values (EPP Section 4.2.3). The land management program at WCGS satisfied this requirement. Specific program objectives were to:

a. conserve or improve both agricultural and natural resources,
b. foster good relations with local agricultural and natural resource communities,
c. satisfy licensing requirements,
d. improve the appearance of the company's lands, and
e. enhance, for educational purposes, the natural resources of the Environmental Education Area (EEA).

These objectives were attained as explained below.

Grasslands at WCGS consisted of areas leased for grazing and hay production and other areas maintained for regulatory compliance, soil conservation, and wildlife. Areas adjacent to CCL, approximately 1500 acres, exceeded the 500 acre buffer zone of "naturally occurring biotic communities" referenced in the EPP. Approximately 1,930 acres of native rangeland were leased for grazing and haying in 2005. Leases specified rotation programs, season lengths, maximum grazing rates, and hay cutting dates.

Fire has always been an integral part of the prairie and was used to control woody brush invasion, control less desirable cool-season grasses or weeds, increase wildlife value, and to increase prairie vigor and production. Prescribed burning was completed on approximately 1997 acres during 2005.

Management of cropland reduced soil erosion, maintained rent income, and increased wildlife benefits. Conservation farming, terracing, and wildlife strip management continued to help achieve the objectives. A total of 1282 acres of cropland was leased in 2005. Consistent with past years, the cropland lease contracts specified that common conservation practices be followed. On fields with appropriate terraces to follow, contour farming was required. Double-cropping, i.e., producing two crops on the same acreage during the same season, was generally prohibited because this practice usually increases soil loss. Fall tillage of crop residues was prohibited except for certain instances, such as tillage necessary for fall planting of wheat, plowing of terraces and deep tillage practices to improve productivity.

Activities at the EEA were designed to improve wildlife habitat and increase the public's chances to view a greater variety of wildlife. Tree and shrub planting, wildlife food plots, controlled burning, and trail improvements were a few of the techniques employed. The EEA has drawn a large amount of attention and continues to be well suited for educational purposes.

4.2. 2005 ZEBRA MUSSEL MONITORING ACTIVITIES

Zebra mussels were not observed during 2005 monitoring of the Neosho River and CCL. Monitoring was completed to provide early detection of the presence of zebra mussel in the vicinity of WCGS. Efforts included substrate and shoreline searches of the Neosho River upstream of JRR and immediately downstream of JRR in the vicinity of the Makeup-water Screen House (MUSH), where water is pumped from the Neosho River to CCL. Settlement monitors were placed and substrate scrapes were conducted at plant structures on the Neosho River and CCL. Inspections of fishing boats were also continued through 2005.

Zebra mussels were discovered at El Dorado Lake on August 25, 2003, approximately 80 miles southwest of WCGS in the Walnut River drainage, which is immediately west of the Cottonwood/Neosho watershed. During 2005, the mussels expanded their range downstream to Oklahoma. None have been observed in the Neosho watershed in Kansas.

The Neosho River and CCL would be conducive for zebra mussel survival and growth based on water quality conditions present. Introduction to CCL will most likely be caused by WCGS pumping activities from the Neosho River. Boat inspections will likely prevent mussel introduction via recreational boats. Monitoring was designed to help ensure that zebra mussels would be detected as early as practical in the WCGS area.

4.3 2005 FISHERY MONITORING ACTIVITIES

Monitoring during 2005 demonstrated that the fishery in CCL remained in good condition with no adverse trends identified. Fish predation pressure on the gizzard shad population continued to prevent excessive shad impingement problems at the circulating water intake. Fishery monitoring activities as outlined in this report were designed to continue to measure long-term trends and help WCGS prepare for any short term changes, particularly for any changes in the potential for shad impingement events.

Public angling on the lake did not impact the fishery's function of supporting plant operations. The catch and release philosophy promoted when the lake was opened for the public has been compatible with gizzard shad control objectives. Monitoring data did warrant management activities to improve the fishery for public use. These recommendations to the KDWP were:

1. Increase of the creel limit for crappie greater than 14 inches from two to ten fish per day to increase angler use and increase harvest of older crappie.

2. Increase the catfish creel limit from five to ten fish per day to be consistent with statewide creel limits. Catfish are not considered a significant predator of gizzard shad.

3. Decrease the wiper length limit from 24 to 21 inches to increase harvest of older fish.

SCHEDULE OF WORK TO BE DONE
(For Herbicide Based Right-of-Way Line Clearance)
(Attachment 1)

Contractor shall furnish all labor, tools, equipment, materials, expenses, transportation, and supervision to perform transmission line clearance through the application of herbicide and/or mechanical hand cutting. Clearing shall be done to the full width of the right-of-way on the transmission line segments specified in Exhibit A, Schedule of Units. All trees and brush (e.g. plum species) regardless of size with trunks inside the right-of-way shall be treated in accordance with the specifications of this contract. Side pruning branches from a tree whose trunk is outside of the right-of-way is not included in the basic contract. Line clearance work performed outside the parameters of the Contract shall be approved by the Company prior to the work being performed and shall be paid in addition to the lump sum bid. Contractor shall provide a time and equipment rate schedule with the lump sum bid.

All woody vegetation greater than 12 feet in height shall be hand-cut flat, leaving a stump 2 inches in height or less. With the prior written approval of the property owner, Contractor may windrow the hand-cut material at the edges of the right-of-way or leave the material where it is cut down. Contractor shall treat each stump that is hand-cut with an approved herbicide containing a brightly colored dye (visible for at least one week after application) to prevent re-sprouting of the cut stumps. All cut stumps shall be treated within 6 hours after being cut.

All woody vegetation less than or equal to 12 feet in height on the right-of-way shall be treated with an approved herbicide or hand-cut, as required. Contractor shall spray all trees, brush and vines within the rights-of-way utilizing high volume foliar, low volume foliar, low volume basal, or cut stump treatments unless the Company authorizes other procedures. When foliar spraying, there shall be a 10 foot setback from intermittent streams, and all rivers, reservoirs, impounded and natural lakes, all wells including drainage wells, abandoned wells and sink holes. Vegetation located within this setback shall be basal treated or hand-cut with the stumps treated with an approved herbicide. Trees located on and 10 foot back from edge of steep banks of streams, creeks, and rivers shall be hand cut and treated with an approved herbicide and leave the small growth species (e.g. plums and dogwood) to prevent possible bank erosion. With the prior written approval of the property owner, Contractor may windrow the hand-cut material at the edges of the right-of-way or leave the material where it is cut down, provided that all such material is kept clear of existing paths, trails, driveways or field roads. Contractor shall perform work so that a clear strip is maintained down the right-of-way to facilitate future line maintenance work. Contractor shall treat each stump that is hand-cut with an approved herbicide containing a brightly colored dye (visible for at least one week after application) to prevent re-sprouting of the cut stumps. All cut stumps shall be treated within 6 hours after being cut. Contractor shall be required to obtain a vegetation control level of at least 95% based on target woody vegetation stem count the full width of the right-of-way within each span (structure to structure). This includes complete control of the woody vegetation. Each line will be inspected by Company a minimum of 30 days after completion of the work to judge 95% target vegetation kill effectiveness. Any line section on which spraying is completed after August 27 will be inspected by Company after the trees leaf out the following spring to judge 95% target vegetation kill effectiveness. The contract balance retained by Company will be released upon the satisfactory results of said inspections.

The Contractor shall employ supervisory and field personnel who are knowledgeable and experienced and thoroughly trained in right-of-way vegetation management techniques and safety precautions. Contractor shall follow all Company safety rules applicable to line clearance work. If Contractor's safety rules are more restrictive than the comparable Company safety rules, Contractor's safety rules shall govern. All Contractor employees shall perform the work in accordance with all applicable federal, state and local regulations, and all work shall be done in accordance with regulations listed in OSHA 29 CFR 1910.269 and with the latest revision of ANSI Z-133.1. Contractor shall follow the Kansas Department of Transportation (KDOT) requirements, including work permits when performing line clearance work on state and interstate highway rights-of-way. Company representative will provide copy of Company standing permit for working on KDOT rights-of-way. The Contractor shall meet the criteria established by the Environmental Protection Agency for the certification of pesticide applicators as set forth in Part 171 of Title 40 of the Code of Federal Regulations. Before beginning work, Contractor shall provide Company a copy of the applicator license for each employee required to be so licensed.

The Company shall approve all herbicides used on Company rights-of-way before the contract is awarded. The Contractor shall follow all manufacturers' label instructions for the herbicides used. No excess materials or containers shall be left or disposed on Company property or rights-of-way.

The Contractor shall notify in writing all property owners along each line right-of-way. This notification letter shall describe the work to be performed and shall include the Contractor's name, contact person name and telephone number so that the property owner can contact Contractor with any questions or concerns related to the proposed work. If any property owner refuses to allow the Contractor to perform the appropriate line clearance work in accordance with these specifications and any specific exceptions noted by Contractor in the bid documents, Contractor shall promptly contact the Company representative to work out options available to clear the right-of-way to the satisfaction of all parties. This notification of Company representative shall not relieve Contractor of the obligation to make a good faith effort to meet with the landowner to resolve any issues that make the landowner unwilling to allow the work to be completed in accordance with these specifications. All exceptions to the contract shall be provided with the structure number and/or legal description of the property, including estimated cost for each location. Generalized exceptions will not be accepted. Work done to satisfy a landowner concern that does not conform to these specifications shall be approved in advance by Company representative. Said work shall be paid on an hourly rate basis and the value of the deleted work included in Contractor's lump sum bid shall be deducted from this contract.

The Contractor shall check that all work has been performed pursuant to these contract specifications before moving from each transmission line segment and shall notify Company representative of the date that work on each line segment begins and is completed. The Contractor shall also immediately notify the Company of any incidents involving electric interruptions, electrical contacts by employees, employee accidents or injuries (non-electrical), damage to Company or private property, and herbicide or oil spills. The Contractor shall be completely responsible for all damage claims or other incidents arising from runoff, drift, or contacts outside of the rights-of-way.

Contractor shall send the white copy of the Westar Energy Weekly Contract Crew Forestry/Time Report to the Company representative within 10 days of the workweek completed. Contractor shall report total removal units and man-hours, total trim units and man-hours, equipment hours, total acreage cleared and the total amount of herbicide product applied for each line cleared. Contractor shall fill in all information (including telephone numbers) requested on the Field Information Sheet and shall mark through and correct any such information which is found to be incorrect.

Company hereby permits Contractor access to public and private easements utilized by the Company for transmission of electricity as necessary to perform line clearance work. Contractor shall make all necessary arrangements with property owners for access route to transmission rights-of-way during performance of work. Company assumes no responsibility for damage resulting from Contractor gaining access to work locations.

Prior to work being awarded on this Contract, Contractor shall furnish a proposed schedule for completion of each line segment awarded. This schedule shall include a list of the number of personnel and equipment Contractor proposes to use to perform the work being awarded.

Company will furnish a route map for each line listed in Exhibit A, Schedule of Units. The plan and profile maps for each line listed in Exhibit A, Schedule of Units may be viewed at the Westar Energy office on the 3rd Floor, 818 Kansas Avenue, Topeka, Kansas.

SCHEDULE OF WORK TO BE DONE
(For Mechanical Mowing and Side Pruning)
(Attachment 1)

Contractor shall furnish all labor, tools, equipment, materials, expenses, transportation, and supervision to perform transmission line clearance through mechanical methods and/or manual hand cutting and side pruning. All trees and brush (e.g. plum species) regardless of size with trunks inside the right-of-way shall be cleared in accordance with the specifications of this contract. Clearing shall be done to the full width of the right-of-way from the ground to the sky utilizing proper arboricultural practices, where practical, to direct tree growth away from the transmission line segments specified in Exhibit A, Schedule of Units. All potential danger or hazard trees outside of rights-of-way shall be evaluated and marked for possible removal according to International Society of Arboriculture's "A Handbook of Hazard Tree Evaluation for Utility Arborists" dated June 1993. The Contractor shall promptly contact the Company for appropriate action when a potential danger tree is identified. Removal of danger trees and line clearance work performed outside the parameters of the Contract shall be approved by the Company prior to the work being performed and shall be paid in addition to the lump sum bid. Contractor shall provide a time and equipment rate schedule with the lump sum bid.

Contractor shall clear the right-of-way using mechanical mowing and side pruning methods so that only small sized mulched debris (smaller than a baseball bat) is left on the right-of-way floor. All mowed stubs shall be 3 inches or less in height. Trees around steel towers shall be hand cut and the stumps treated inside the tower footprint and extending at least two feet outside the perimeter of the tower legs. All trees and brush that are hand cut inside and around the perimeter of the tower legs shall be removed from the tower footprint and mowed to specifications. All trees with a diameter greater than the mechanical ax can efficiently mow shall be hand cut flat, leaving a stump 2 inches in height or less. Contractor shall treat each stump that is hand cut with an approved herbicide containing a brightly colored die (visible for at least one week after application) to prevent re-sprouting of the cut stumps. All stumps shall be treated within 6 hours after being cut. Contractor shall dispose of all trees, limbs, brush, and debris to the satisfaction of all parties concerned, including the Company's representative. With the prior written approval of the property owner, Contractor may windrow the hand-cut or mowed material at the edges of the right-of-way, provided that all such material is kept clear of existing paths, trails, driveways or field roads. Contractor shall perform work so that a clear strip is maintained down the right-of-way to facilitate future line maintenance work.

The Contractor shall employ supervisory and field personnel who are knowledgeable and experienced and thoroughly trained in right-of-way vegetation management techniques and safety precautions. Contractor shall follow all Company safety rules applicable to line clearance work. If Contractor's safety rules are more restrictive than the comparable Company safety rules, Contractor's safety rules shall govern. All Contractor employees shall perform the work in accordance with all applicable federal, state and local regulations, and all work shall be done in accordance with regulations listed in provide copy of OSHA 29 CFR 1910.269 and with the latest revision of ANSI Z-133.1. Contractor shall follow the Kansas Department of

Transportation (KDOT) requirements, including work permits when performing line clearance work on state and interstate highway rights-of-way. Company representative will Company standing permit for working on KDOT rights-of-way. The Contractor shall meet the criteria established by the Environmental Protection Agency for the certification of pesticide applicators as set forth in Part 171 of Title 40 of the Code of Federal Regulations. Before beginning work, Contractor shall provide Company a copy of the applicator license for each employee required to be so licensed.

The Company shall approve all herbicides used on Company rights-of-way before the contract is awarded. The Contractor shall follow all manufacturers' label instructions for the herbicides used. No excess materials or containers shall be left or disposed on Company property or rights-of-way.

The Contractor shall notify in writing all property owners along each line right-of-way. This notification letter shall describe the work to be performed and shall include the Contractor's name, contact person name and telephone number so that the property owner can contact Contractor with any questions or concerns related to the proposed work. If any property owner refuses to allow the Contractor to perform the appropriate line clearance work in accordance with these specifications and any specific exceptions noted by Contractor in the bid documents, Contractor shall promptly contact the Company representative to work out options available to clear the right-of-way to the satisfaction of all parties. This notification of Company representative shall not relieve Contractor of the obligation to make a good faith effort to meet with the landowner to resolve any issues that make the landowner unwilling to allow the work to be completed in accordance with these specifications. All exceptions to the contract shall be provided with the structure number and/or legal description of the property, including estimated cost for each location. Generalized exceptions will not be accepted. Work done to satisfy a landowner concern that does not conform to these specifications shall be approved in advance by Company representative. Said work shall be paid on an hourly rate basis and the value of the deleted work included in Contractor's lump sum bid shall be deducted from this contract.

The Contractor shall check that all work has been performed pursuant to the contract specifications before moving from each transmission line segment and shall notify Company representative of the date that work on each line segment begins and is completed. The Contractor shall also immediately notify the Company of any incidents involving electric interruptions, electrical contacts by employees, employee accidents or injuries (non-electrical), damage to Company or private property, and herbicide or oil spills.

Contractor shall send the white copy of the Westar Energy Weekly Contract Crew Forestry/Time Report to the Company representative within 10 days of the workweek completed. Contractor shall report total removal units and man-hours, total trim units and man-hours, equipment hours, total acreage cleared and the total amount of herbicide product applied for each line cleared. Contractor shall fill in all information (including telephone numbers) requested on the Field Information Sheet and shall mark through and correct any such information which is found to be incorrect.

Company hereby permits Contractor access to public and private easements utilized by the Company for transmission of electricity as necessary to perform line clearance work. Contractor shall make all necessary arrangements with property owners for access route to transmission rights-of-way during performance of work. Company assumes no responsibility for damage resulting from Contractor gaining access to work locations.

Prior to work being awarded on this Contract, Contractor shall furnish a proposed schedule for completion of each line segment awarded. This schedule shall include a list of the number of personnel and equipment Contractor proposes to use to perform the work being awarded.

Company will furnish a route map for each line listed in Exhibit A, Schedule of Units. The plan and profile maps for each line listed in Exhibit A, Schedule of Units may be viewed at the Westar Energy office on the 3rd Floor, 818 Kansas Avenue, Topeka, Kansas.

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MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 5/10/05
Product Code: 38322
MSDS: 004788

GARLON* 4 HERBICIDE

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Garlon* 4 Herbicide

COMPANY IDENTIFICATION:
Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Triclopyr ((3,5,6-trichloro-2-pyridinyl)oxy) acetic acid, butoxy ethyl ester	CAS# 064700-56-7	61.6%
Balance, total, including:		38.4%
Kerosene	CAS# 008008-20-6	

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW
Amber liquid. Combustible. Kerosene-like odor. May cause eye and skin irritation. Toxic to aquatic organisms.
EMERGENCY PHONE NUMBER: 800-992-5994

4. FIRST AID:

EYES: Flush eyes thoroughly with water for several minutes. Remove contact lenses after initial 1-2 minutes and continue flushing for several minutes. If affects occur, consult a physician, preferably an ophthalmologist.

SKIN: Wash skin with plenty of water.

INGESTION: Do not induce vomiting. Call a physician and/or transport to emergency facility immediately.

INHALATION: Move to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

NOTE TO PHYSICIAN: The decision of whether to induce vomiting or not should be made by a physician. If lavage is performed, suggest endotracheal and/or esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIRE FIGHTING MEASURES:

FLASH POINT: 147°F (64°C)
METHOD USED: TCC

FLAMMABLE LIMITS
LFL: Not determined
UFL: Not determined

EXTINGUISHING MEDIA: Water fog, foam, CO_2, and dry chemical.

FIRE & EXPLOSION HAZARDS: Combustible. Toxic, irritating vapors may be produced if product is involved in fire.

FIRE-FIGHTING EQUIPMENT: Use positive pressure self-contained breathing apparatus and full protective clothing.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS/LEAKS: Keep out of streams and domestic water supplies. Absorb small spills in inert material such as sand. For large spills, dike the area and contact Dow AgroSciences at 800-992-5994.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Keep out of reach of children. Do not use near heat or open flame. Harmful if swallowed, inhaled, or absorbed through skin. Avoid contact with eyes, skin and clothing. Avoid breathing mists and vapors. Avoid contamination of food. Store above 28°F or agitate before use. Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. For handling relative to end-use of this product, read the product label for further information concerning the use of personal protective equipment (PPE) under the Worker Protection Standard of 1993. Store in the original container.

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where a potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINE(S):
3,5,6-Trichloro-2-pyridinyloxyacetic acid, Dowanol EB ester: Dow AgroSciences Industrial Hygiene Guide is 2 mg/M^3 as acid equivalent, Skin.
Kerosene: Dow AgroSciences Industrial Hygiene Guide is 10 mg/M^3.

A "skin" notation following the exposure guideline refers to the potential for dermal absorption of the material. It is intended to alert the reader that inhalation may not be the only route of exposure and that measures to minimize dermal exposures should be considered.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guidelines. When respiratory protection is required for certain operations, use a NIOSH approved air-purifying respirator.

SKIN PROTECTION: Use protective clothing chemically resistant to this material. Selection of specific items such as faceshield, gloves, boots, apron, or full body suit will depend on operation. Remove contaminated clothing immediately, wash skin area with soap and water, and launder clothing before reuse or dispose of properly.

EYE/FACE PROTECTION: Use safety glasses.

APPLICATORS AND ALL OTHER HANDLERS: Refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT: >302°F (150°C) initial
VAPOR PRESSURE: 0.1 mm @ 37.8°C (kerosene)
VAPOR DENSITY: >1
SOLUBILITY IN WATER: Emulsifies
SPECIFIC GRAVITY: 1.08
APPEARANCE: Amber liquid
ODOR: Kerosene-like

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Combustible. Avoid sources of ignition if temperature is near or above flash point. Stable under normal storage conditions.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Acid, base, and oxidizing material.

HAZARDOUS DECOMPOSITION PRODUCTS: Nitrogen oxides, hydrogen chloride, and phosgene may result under fire conditions.

HAZARDOUS POLYMERIZATION: Not known to occur.

11. TOXICOLOGICAL INFORMATION:

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects, which could occur if this material is not handled in the recommended manner.

EYE: May cause slight temporary eye irritation. Corneal injury is unlikely.

SKIN: Prolonged or repeated contact may cause skin irritation. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals. With the dilute mix, no allergic skin reaction is expected. Prolonged skin contact is unlikely to result in absorption of harmful amounts. Repeated skin contact may result in absorption of harmful amounts. The LD_{50} for skin absorption is >2000 mg/kg (rabbits) and >5000 mg/kg (rats).

INGESTION: Low toxicity if swallowed. The oral LD_{50} for rats is 1581 mg/kg (males) and 1338 mg/kg (females). Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Aspiration into the lungs may occur during ingestion or vomiting, causing lung damage or even death due to chemical pneumonia.

INHALATION: Excessive exposure may cause irritation to upper respiratory tract (nose and throat). Kerosene may cause central nervous system effects.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Triclopyr BEE, in animals, effects have been reported on the following organs: blood, kidney, and liver.

CANCER INFORMATION: Triclopyr BEE did not cause cancer in laboratory animals. In a lifetime animal dermal carcinogenicity study, an increased incidence of skin tumors was observed when kerosene was applied at doses that also produced skin irritation. This response was similar to that produced in skin by other types of chronic chemical/physical irritation. No increase in tumors was observed when non-irritating dilutions of kerosene were applied at equivalent doses, indicating that kerosene is unlikely to cause skin cancer in the absence of long-term continued skin irritation. In long-term animal studies with ethylene glycol butyl ether, small but statistically significant increases in tumors were observed in mice but not rats. The effects are not believed to be relevant to humans. If the material is handled in accordance with proper industrial handling, exposures should not pose a carcinogenic risk to man.

TERATOLOGY (BIRTH DEFECTS): For triclopyr BEE, birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother.

REPRODUCTIVE EFFECTS: Triclopyr BEE, in laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

MUTAGENICITY: For triclopyr BEE, in-vitro and animal mutagenicity studies were negative.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL FATE:

MOVEMENT & PARTITIONING:
Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5).
Measured log octanol/water partition coefficient (Log Pow) is 4.09.
Log air/water partition coefficient (Log Kaw) is -4.0.

DEGRADATION & PERSISTENCE:
Biodegradation under aerobic static laboratory conditions is moderate (BOD20 or BOD28/ThOD between 10 and 40%).

ECOTOXICOLOGY:
Material is highly toxic to aquatic organisms on an acute basis (LC_{50}/EC_{50} is between 0.1 and 1 mg/L in most sensitive species).

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities. This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. If the material as supplied becomes a waste, follow all applicable regional, national and local laws and regulations.

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MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

GARLON* 4 HERBICIDE

Effective Date: 5/10/05
Product Code: 38322
MSDS: 004788

14. TRANSPORT INFORMATION:

U.S. DEPARTMENT OF TRANSPORTATION INFORMATION

FOR ALL NON-BULK PACKAGES SHIPPED BY AIR, LAND OR WATER:
This material is not regulated for transport.

FOR BULK PACKAGES SHIPPED BY LAND:
COMBUSTIBLE LIQUID, N.O.S. (CONTAINS KEROSENE)/COMBUSTIBLE LIQUID/NA1993/PGIII

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

U.S. REGULATIONS

SARA 313 INFORMATION: To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A fire hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
Kerosene	008008-20-6	PA1 NJ3

NJ3=New Jersey Workplace Hazardous Substance (present at greater than or equal to 1.0%).
PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

Health	2
Flammability	2
Reactivity	1

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): To the best of our knowledge, this product contains no chemical subject to reporting under CERCLA.

16. OTHER INFORMATION:

MSDS STATUS: Revised Sections: 3, 11, 13
Reference: DR-0196-5102
Replaces MSDS dated: 2/22/02
Document Code: D03-102-003
Replaces Document Code: D03-102-002

The Information Herein Is Given In Good Faith, But No Warranty, Express or Implied, Is Made. Consult Dow AgroSciences for Further Information.

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Specimen Label

Dow AgroSciences

Garlon® 4

Specialty Herbicide

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For the control of woody plants and annual and perennial broadleaf weeds in non-crop areas, including industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, fence rows, non-irrigation ditch banks, forests and in the establishment and maintenance of wildlife openings. Use on these sites may include application to grazed areas.

Active Ingredient:	
triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid, butoxyethyl ester	61.6%
Inert Ingredients	38.4%
Total	100.0%

Contains petroleum distillates
Acid equivalent: triclopyr - 44.3% - 4 lb/gal

EPA Reg. No. 62719-40

Keep Out of Reach of Children

CAUTION PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Causes Moderate Eye Irritation • Harmful If Swallowed • Prolonged Or Frequently Repeated Skin Contact May Cause Allergic Reactions In Some Individuals

Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco.

Personal Protective Equipment (PPE)

WPS Uses: Applicators and other handlers who handle this pesticide for any use covered by the Worker Protection Standard (40 CFR Part 170) – for this product, forestry sites -- must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks

Non-WPS Uses: Applicators and other handlers who handle this pesticide for any use NOT covered by the Worker Protection Standard (40 CFR Part 170) – for this product, non-forestry sites -- must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables are given, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the WPS (40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the WPS.

First Aid

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
If swallowed: Immediately call a poison control center or doctor. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give **any** liquid to the person. Do not give anything by mouth to an unconscious person.

Note to Physician: This product may pose an aspiration pneumonia hazard. Contains petroleum distillates.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

Environmental Hazards

This pesticide is toxic to fish. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Physical or Chemical Hazards

Combustible. Do not use or store the product near heat or open flame.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies elsewhere on this label. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Agricultural Use Requirements

The requirements in this box apply to forestry uses.

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Chemical-resistant gloves
- Shoes plus socks
- Protective eyewear

Non-Agricultural Use Requirements

The requirements in this box apply to all use sites on this label except for forestry uses.

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for Agricultural Pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Entry Restrictions for Non-WPS Uses: For applications to non-cropland areas, do not allow entry into areas until sprays have dried.

Storage and Disposal

Do not contaminate water, food, or feed by storage and disposal. Open dumping is prohibited.
Pesticide Storage: Store above 28°F or agitate before use.
Pesticide Disposal: Wastes resulting from the use of this product (that cannot be used according to label instructions) may be disposed of on site or at an approved waste disposal facility.
Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

General Information

Use Garlon® 4 specialty herbicide for the control of woody plants and annual and perennial broadleaf weeds in non-crop areas, including industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides and railroads, fence rows, non-irrigation ditch banks; forests and in the establishment and maintenance of wildlife openings. Use on these sites may include application to grazed areas.

General Use Precautions and Restrictions

In Arizona: The state of Arizona has not approved Garlon 4 for use on plants grown for commercial production; specifically forests grown for commercial timber production, or on designated grazing areas.

When applying this product in tank mix combination, follow all applicable use directions, precautions, and limitations on each manufacturer's label.

Chemigation: Do not apply this product through any type of irrigation system.

Do not apply Garlon 4 directly to, or otherwise permit it to come into direct contact with, grapes, tobacco, vegetable crops, flowers, or other desirable broadleaf plants. Do not permit spray mists containing Garlon 4 to drift onto such plants.

It is permissible to treat non-irrigation ditch banks, seasonally dry wetlands (such as flood plains, deltas, marshes, swamps, or bogs) and transitional areas between upland and lowland sites where surface water is not present except in isolated pockets due to uneven or unlevel conditions. Do not apply to open water (such as lakes, reservoirs, rivers, streams, creeks, salt water bays, or estuaries).

Do not apply on ditches currently being used to transport irrigation water. Do not apply where runoff or irrigation water may flow onto agricultural land as injury to crops may result.

Do not apply this product using mist blowers unless a drift control additive, high viscosity inverting system, or equivalent is used to control spray drift.

Sprays applied directly to Christmas trees may result in conifer injury. When treating unwanted vegetation in Christmas tree plantations, care should be taken to direct sprays away from conifers.

Garlon 4 is formulated as a low volatile ester. However, the combination of spray contact with impervious surfaces, such as roads and rocks, and increasing ambient air temperatures, may result in an increase in the volatility potential for this herbicide, increasing a risk for off-target injury to sensitive crops such as grapes and tomatoes.

- Apply no more than 1/2 gallon of Garlon 4 (2 lb ae of triclopyr) per acre per growing season on range and pasture sites, including rights-of-way, fence rows or any area where grazing or harvesting is allowed.
- On forestry sites, Garlon 4 may be used at rates up to 6 quarts (6 lb ae of triclopyr) per acre per year.
- Garlon 4 may be used at rates up to 8 quarts (8 lb ae of triclopyr) per acre per year on non-crop areas including industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides and railroads, fence rows, non-irrigation ditch banks.

Grazing and Haying Restrictions
Except for lactating dairy animals, there are no grazing restrictions following application of this product.

- **Grazing Lactating Dairy Animals:** Do not allow lactating dairy animals to graze treated areas until the next growing season following application of this product.
- Do not harvest hay for 14 days after application.
- Grazed areas of non-cropland and forestry sites may be spot treated if they comprise no more than 10% of the total grazable area.

Slaughter Restrictions: During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter.

Avoiding Injurious Spray Drift

Make applications only when there is little or no hazard from spray drift. Small quantities of spray, which may not be visible, may seriously injure susceptible plants. Do not spray when wind is blowing toward susceptible crops or ornamental plants that are near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray.

Aerial Application (Helicopter Only): For aerial application on rights-of-way or other areas near susceptible crops, apply through a Microfoil[1] or Thru-Valve boom[1], or use an agriculturally labeled drift control additive. Other drift reducing systems or thickened sprays prepared by using high viscosity inverting systems may be used if they are made as drift-free as mixtures containing agriculturally labeled thickening agents or applications made with the Microfoil or Thru Valve boom. Do not use a thickening agent with the Microfoil or Thru Valve booms, or other systems that cannot accommodate thick sprays. Spray only when the wind velocity is low (follow state regulations). Avoid application during air inversions. If a spray thickening agent is used, follow all use recommendations and precautions on the product label.

[1] Reference within this label to a particular piece of equipment produced by or available form other parties is provided without consideration for use by the reader at its discretion and subject to the reader's independent circumstances, evaluation, and expertise. Such reference by Dow AgroSciences is not intended as an endorsement of such equipment, shall not constitute a warranty (express or implied) of such equipment, and is not intended to imply that other equipment is not available and equally suitable. Any discussion of methods of use of such equipment does not imply that the reader should use the equipment other than is advised in directions available from the equipment's manufacturer. The reader is responsible for exercising its own judgment and expertise, or consulting with sources other than Dow AgroSciences, in selecting and determining how to use its equipment.

Spray Drift Management

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications:

1. The distance of the outer most operating nozzles on the boom must not exceed 3/4 the length of the rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.

Where states have more stringent regulations, they should be observed.

The applicator should be familiar with and take into account the information covered in the following Aerial Drift Reduction Advisory. [This information is advisory in nature and does not supersede mandatory label requirements.]

Aerial Drift Reduction Advisory

Information on Droplet Size: The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see Wind, Temperature and Humidity, and Temperature Inversions).

Controlling Droplet Size:

- **Volume** - Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- **Pressure** - Do not exceed the nozzle manufacturer's recommended pressures. For many nozzle types lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of Nozzles** - Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle Orientation** - Orienting nozzles so that the spray is released parallel to the airstream produced larger droplets than other orientations and is the recommended practice. Significant deflection from horizontal will reduce droplet size and increase drift potential.
- **Nozzle Type** - Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift.

Boom Length: For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.

Application Height: Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

Swath Adjustment: When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller drops, etc.).

Wind: Drift potential is lowest between wind speeds of 2 to 10 mph. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 mph due to variable wind direction and high inversion potential. **Note:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

Temperature and Humidity: When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions: Applications should not occur during a local, low level temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of the smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas: The pesticide should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Ground Equipment: To aid in reducing spray drift, Garlon 4 should be used in thickened (high viscosity) spray mixtures using an agriculturally labeled drift control additive, high viscosity invert system, or equivalent as directed by the manufacturer. When using a spray thickening or inverting additive, follow all use directions and precautions on the product label. With ground equipment, spray drift can be reduced by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by keeping the operating spray pressures at the lower end of the manufacturer's recommended pressures for the specific nozzle type used (low pressure nozzles are available from spray equipment manufacturers); and by spraying when wind velocity is low. Do not apply with nozzles that produce a fine droplet spray. Select nozzles and pressures which provide adequate plant coverage, but minimize the production of fine spray particles.

High Volume Leaf-Stem Treatment: To minimize spray drift, keep sprays no higher than brush tops and keep spray pressures low enough to provide coarse spray droplets. An agriculturally labeled thickening agent may be used to reduce drift.

Plants Controlled by Garlon 4

Woody Plant Species

alder	dogwood	poplar
arrowwood	Douglas-fir	salmonberry
ash	elderberry	salt-bush (*Braccharis* spp.)
aspen	elm	salt-cedar†
bear clover (bearmat)	gallberry	sassafras
beech	gorse	scotch broom
birch	hazel	sumac
blackberry	hickory	sweetbay magnolia
blackgum	hornbeam	sweetgum
boxelder†	kudzu††	sycamore
Brazilian pepper	locust	tanoak
buckthorn	madrone	thimbleberry
cascara	maples	tree-of-heaven (*Ailanthus*)†
Ceanothus	mulberry	tulip poplar
cherry	oaks	wax myrtle
chinquapin	persimmon	wild rose
choke cherry	pine	willow
cottonwood	poison ivy	winged elm
Crataegus (hawthorn)	poison oak	

†For best control, use either a basal bark or cut stump treatment.
††For complete control, re-treatment may be necessary.

Tank Mixing: As a low volume foliage spray, up to 12 quarts of Garlon 4 may be applied in tank mix combination with labeled rates of Tordon K or Tordon 101 Mixture in 10 to 100 gallons of finished spray. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Broadcast Applications With Ground Equipment

Apply using equipment that will assure thorough and uniform coverage of the spray volumes applied. See Table 1 for relationship between mixing rate, spray volume and maximum application rate.

Woody Plant Control

Foliage Treatment: Use 4 to 8 quarts of Garlon 4 in enough water to make 5 gallons or more of total spray per acre, or 1 1/2 to 3 quarts of Garlon 4 may be combined with labeled rates of 2,4-D low volatile ester, Tordon 101 Mixture, or Tordon K in sufficient water to make 5 gallons or more of total spray per acre. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Broadleaf Weed Control

Use Garlon 4 at rates of 1 to 4 quarts in a total volume of 5 gallons or more per acre as a water spray mixture. Apply anytime weeds are actively growing. Garlon 4 at 0.25 to 3 quarts may be tank mixed with labeled rates of 2,4-D amine or low volatile ester, Tordon K, or Tordon 101 Mixture to improve the spectrum of activity. For thickened (high viscosity) spray mixtures, Garlon 4 can be mixed with diesel oil or other inverting agent. When using an inverting agent, read and follow the use directions and precautions on the product label. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Aerial Application (Helicopter Only)

Aerial sprays should be applied using suitable drift control. (See General Use Precautions and Restrictions.)

Foliage Treatment (Utility and Pipeline Rights-of-Way)

Use 4 to 8 quarts of Garlon 4 alone, or 3 to 4 quarts of Garlon 4 in a tank mix combination with labeled rates of 2,4-D low volatile ester, Tordon 101 Mixture or Tordon K and apply in a total spray volume of 10 to 30 gallons per acre. Use the higher rates and volumes when plants are dense or under drought conditions. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Basal Bark and Dormant Brush Treatments

Mixing Directions

To control susceptible woody plants in rights-of-way other non-crop areas, and forests, use Garlon 4 in oil or oil-water mixtures prepared and applied as described below. Prepare oil-based mixtures using either diesel fuel, No. 1 or No. 2 fuel oil, kerosene or a commercially available basal oil. Substitute other oils or diluents only as recommended by the oil or diluent's manufacturer. When preparing an oil mixture, read and follow the use directions and precautions on the manufacturer's product label. See Table 1 for relationship between mixing rate, spray volume and maximum application rate.

Note: All basal bark and dormant brush treatment methods may be used to treat susceptible woody species on range and permanent pasture land provided that no more than 2 quarts of Garlon 4 are applied per acre. Large plants or species requiring higher rates of Garlon 4 may not be completely controlled.

Oil Mixture Sprays

Add Garlon 4 to the required amount of oil in the spray tank or mixing tank and mix thoroughly. If the mixture stands over 4 hours, reagitation is required.

Oil Mixtures of Garlon 4 and Tordon K: Tordon K and Garlon 4 may be used in tank mix combination for basal bark treatment of woody plants. These herbicides are incompatible and will not form a stable mixture when mixed together directly in oil. Make a stable tank mixture for basal bark application by first combining each product with a compatibility agent prior to final mixing in the desired ratio. (See product bulletin for mixing instructions.) Tordon K is not registered for use in the states of California and Florida.

Oil-Water Mixture Sprays

Prepare a premix of oil, surfactant and Garlon 4 in a separate container. Do not allow any water or mixtures containing water to get into the premix or Garlon 4 since a thick "invert" (water in oil) emulsion may form that will be difficult to break. Such an emulsion may also be formed if the premix or Garlon 4 is put into the mixing tank before the addition of water. Fill the spray tank about one-half full with water, then slowly add the premix with continuous agitation and complete filling the tank with water. Continue moderate agitation.

Basal Bark Treatment

To control susceptible woody plants with stems less than 6 inches in basal diameter, mix 1 to 5 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with knapsack sprayer or power spraying equipment using low pressure (20 to 40 psi). Spray the basal parts of brush and tree trunks to a height of 12 to 15 inches from the ground, thoroughly wetting the indicated area. Spray until runoff at the ground line is noticeable. Old or rough bark requires more spray than smooth young bark. Apply anytime, including the winter months, except when snow or water prevent spraying to the ground line.

Low Volume Basal Bark Treatment

To control susceptible woody plants with stems less than 6 inches in basal diameter, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using low pressure and a solid cone or flat fan nozzle. Spray the basal parts of brush and tree trunks in a manner which thoroughly wets the lower stems, including the root collar area, but not to the point of runoff. Herbicide concentration should vary with size and susceptibility of species treated. Apply anytime, including the winter months, except when snow or water prevent spraying to the ground line or when stem surfaces are saturated with water. See Table 1 for relationship between mixing rate, spray volume and maximum application rate. **Note:** The addition of a soil active herbicide to a basal bark mixture with Garlon 4 may result in damage to surrounding non-target vegetation. Care should be taken to assess the areas in which these soil active herbicides are used in combination with Garlon 4 in basal bark applications.

Garlon 4 Plus Tordon K In Oil Tank Mix: Garlon 4 and Tordon K may be used in tank mix combination as a low volume basal bark treatment to improve control of certain woody species such as ash, elm, maple, poplar, aspen, hackberry, oak, oceanspray, birch, hickory, pine, tanoak, cherry, locust, sassafras, and multiflora rose. (See product bulletin for mixing instructions.) Tordon K is not registered for use in the states of California and Florida.

Streamline Basal Bark Treatment (Southern States)

To control or suppress susceptible woody plants for conifer release, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using equipment which provides a directed straight stream spray. Apply sufficient spray to one side of stems less than 3 inches in basal diameter to form a treated zone that is 6 inches in height. When the optimum amount of spray mixture is applied, the treated zone should widen to encircle the stem within approximately 30 minutes. Treat both sides of stems which are 3 to 4 inches in basal diameter. Direct the spray at bark that is approximately 12 to 24 inches above ground. Pines (loblolly, slash, shortleaf, and Virginia) up to 2 inches in diameter breast height (dbh) can be controlled by directing the spray at a point approximately 4 feet above ground. Vary spray mixture concentration with size and susceptibility of the species being treated. Best results are achieved when applications are made to young vigorously growing stems which have not developed the thicker bark characteristic of slower growing, understory trees in older stands. This technique is not recommended for scrub and live oak species, including blackjack, turkey, post, live, bluejack and laurel oaks, or bigleaf maple. Apply from approximately 6 weeks prior to hardwood leaf expansion in the spring until approximately 2 months after leaf expansion is completed. Do not apply when snow or water prevent spraying at the desired height above ground level.

Low Volume Stem Bark Band Treatment (North Central and Lake States)

To control susceptible woody plants with stems less than 6 inches in basal diameter, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using low pressure and a solid cone or flat fan nozzle. Apply the spray in a 6- to 10-inch wide band that completely encircles the stem. Spray in a manner that completely wets the bark, but not to the point of runoff. The treatment band may be positioned at any height up to the first major branch. For best results, apply the band as low as possible. Spray mixture concentration should vary with size and susceptibility of species to be treated. Applications may be made anytime, including winter months.

Thinline Basal Bark Treatment

To control susceptible woody plants with stems less than 6 inches in diameter, apply Garlon 4, either undiluted or mixed at 50 to 75% v/v with oil, in a thin stream to all sides of the lower stems. The stream should be directed horizontally to apply a narrow band of Garlon 4 around each stem or clump. Use a minimum of 2 to 15 milliliters of Garlon 4 or oil mixture with Garlon 4 to treat single stems and from 25 to 100 milliliters to treat clumps of stems. Use an applicator metered or calibrated to deliver the small amounts required.

Dormant Stem Treatment

Dormant stem treatments control susceptible woody plants and vines with stems less than 2 inches in diameter. Plants with stems greater than 2 inches in diameter may not be controlled and resprouting may occur. This treatment method is best suited for sites with dense, small diameter brush. Dormant stem treatments of Garlon 4 can also be used as a chemical side-trim for controlling lateral branches of larger trees that encroach onto roadside, utility, or other rights-of-way.

Mix 4 to 8 quarts of Garlon 4 in 2 to 3 gallons of crop oil concentrate or other recommended oil and add this mixture in enough water to make 100 gallons of spray solution. Use continuous adequate agitation. Apply with Radiarc, OC or equivalent nozzles, or handgun using 70 to 100 gallons of spray per acre to ensure uniform coverage of stems. Garlon 4 may be mixed with 4 quarts of Weedone 170 herbicide to improve the control of black cherry and broaden the spectrum of herbicidal activity. In western states, apply anytime after woody plants are dormant. In other areas apply anytime within 10 weeks of budbreak, generally February through April. Do not apply to wet or saturated bark as poor control may result.

Cut Stump Treatment

To control resprouting, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using low pressures and a solid cone or flat fan nozzle. Spray the root collar area, sides of the stump, and the outer portion of the cut surface, including the cambium, until thoroughly wet, but not to the point of runoff. Spray mixture concentration should vary with the size and susceptibility of species treated. Apply anytime, including in winter months, except when snow or water prevent spraying to the ground line.

Cut Stump Treatment in Western States

To control resprouting of salt cedar and other *Tamarix* species, bigleaf maple, tanoak, Oregon myrtle, and other susceptible species, apply undiluted Garlon 4 to wet the cambium and adjacent wood around the entire circumference of the cut stump. Treatments may be applied throughout the year; however, control may be reduced with treatment during periods of moisture stress as in late summer. Use an applicator which can be calibrated to deliver the small amounts of material required.

Forest Management Applications

For broadcast applications, apply 1 to 6 quarts of Garlon 4 per acre in a total spray volume of 5 to 25 gallons per acre by air or 10 to 100 gallons per acre by ground. Use spray volumes sufficient to provide thorough coverage of treated foliage. Nozzles or additives that produce larger droplets of spray may require higher spray volumes to provide adequate coverage.

Forest Site Preparation (Not for Conifer Release)

Southern States including Alabama, Arkansas, Delaware, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia: To control susceptible woody plants and broadleaf weeds, apply Garlon 4 at a rate of 4 to 6 quarts per acre. To broaden the spectrum of woody plants and broadleaf weeds controlled, apply 2 to 4 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Tordon 101 Mixture or Tordon K. Tordon 101 Mixture and Tordon K are not registered for use in the state of Florida. Where grass control is also desired, Garlon 4 alone or in tank mix combination with Tordon K or Tordon 101 Mixture may be applied with labeled rates of other herbicides registered for grass control in forests. Use of tank mix products must be in accordance with the most restrictive of label limitations and precautions. Do not exceed labeled application rates. Garlon 4 cannot be tank mixed with any product containing a label prohibition against such mixing.

Western, Northeastern, North Central, and Lake States (States not Listed Above as Southern States): To control susceptible woody plants and broadleaf weeds, apply Garlon 4 at a rate of 3 to 6 quarts per acre. To broaden the spectrum of woody plants and broadleaf weeds controlled, apply 1.5 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Tordon 101 Mixture, Tordon K, or 2,4-D low volatile ester. Tordon 101 Mixture and Tordon K are not registered for use in the state of California. Where grass control is also desired, Garlon 4 alone or in tank mix combination with Tordon 101 Mixture or Tordon K may be applied with labeled rates of other herbicides registered for grass control in forests. When applying tank mixes, follow applicable use directions and precautions on each product label.

Southern Coastal Flatwoods: To control susceptible broadleaf weeds and woody species such as gallberry and wax-myrtle, and for partial control of saw-palmetto, apply 2 to 4 quarts of Garlon 4 per acre. To broaden the spectrum of species controlled to include fetterbush, staggerbush, titi, and grasses, apply 2 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Arsenal Applicator's Concentrate herbicide. Where control of gallberry, wax-myrtle, broadleaf weeds, and grasses is desired, apply 2 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Accord Concentrate or Accord SP herbicide.

These treatments may be broadcast during site preparation of flat planted or bedded sites or, on bedded sites, applied in bands over the top of beds. For best results, apply in late summer or fall. Efficacy may not be satisfactory when applications are made in early season prior to August. **Note:** Do not apply after planting pines.

Note: Conifers planted sooner than 1 month after treatment with Garlon 4 at less than 4 quarts per acre or sooner than 2 months after treatment at 4 to 6 quarts per acre may be injured. When tank mixtures of herbicides are used for forest site preparation, labels for all products in the mixture should be consulted and the longest recommended waiting period before planting observed.

Directed Spray Applications for Conifer Release

To release conifers from competing hardwoods and brush such as red maple, sugar maple, striped maple, sweetgum, red and white oaks, ash, hickory, alder, birch, aspen, pin cherry, *Ceanothus* spp., blackberry, chinquapin, and poison oak, mix 4 to 20 quarts of Garlon 4 in enough water to make 100 gallons of spray mixture. This spray mixture should be directed onto foliage of competitive hardwoods using knapsack or backpack sprayers with flat fan nozzles or equivalent any time after the hardwoods and brush have reached full leaf size, but before autumn coloration. The majority of treated hardwoods and brush should be less than 6 feet in height to ensure adequate spray coverage. Care should be taken to direct spray away from contact with conifer foliage, particularly foliage of desirable pines. See Table 1 for relationship between mixing rate, spray volume and maximum application rate.

Note: Spray may cause temporary damage and growth suppression where contact with conifers occurs; however, injured conifers should recover and grow normally. Over-the-top spray applications can kill pines.

Broadcast Applications for Mid-Rotation Understory Brush Control in Southern Coastal Flatwoods Pine Stands (Ground Equipment Only)

For control of susceptible species such as gallberry and wax-myrtle and broadleaf weeds, apply 2 to 4 quarts of Garlon 4 per acre. To broaden the spectrum of woody plants controlled to include fetterbush, staggerbush, and titi, apply 2 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Arsenal Applicator's Concentrate. Saw-palmetto will be partially controlled by use of Garlon 4 at 4 quarts per acre or by mixtures of Garlon 4 at 2 to 3 quarts per acre in tank mix combination with either Arsenal Applicator's Concentrate or Escort herbicide. These mixtures should be broadcast applied over target understory brush species, **but to prevent injury to pines, make applications underneath the foliage of pines.** Apply sprays in 30 gallons or more per acre of total volume. For best results, apply in late summer or fall. Efficacy may not be satisfactory when applications are made in early season prior to August.

Broadcast Applications for Conifer Release in the Pacific Northwest and California

Dormant Conifers Before Bud Swell (Excluding Pines): To control or suppress deciduous hardwoods such as vine maple, bigleaf maple, alder, scotch broom, or willow **before leaf-out**, or evergreen hardwoods such as madrone, chinquapin, and *Ceanothus* spp., use Garlon 4 at 1 to 2 quarts per acre. Use diesel or fuel oil as a diluent, or use water plus 1 to 2 gallons per acre of diesel oil or a suitable surfactant or oil substitute at manufacturer's recommended rates.

Conifer Plantations (Excluding Pines) After Hardwoods Begin Growth and Before Conifer Bud Break ("Early Foliar" Hardwood Stage): Use Garlon 4 at 1 to 1.5 quarts alone or with 2,4-D low volatile ester herbicide in water carrier to provide no more than 3 lb ae per acre from both products. After conifer bud break, these sprays may cause more serious injury to the crop trees. Use of a surfactant may cause unacceptable injury to conifers especially after bud break.

Conifer Plantations (Excluding Pines) After Conifers Harden Off in Late Summer and While Hardwoods are Still Actively Growing: Use Garlon 4 at rates of 1 to 1.5 quarts per acre alone or with 2,4-D low volatile ester to provide no more than 3 lb ae per acre from both products. Treat as soon after conifer bud hardening as possible so that hardwoods and brush are actively growing. Use of oil, oil substitute, or surfactant may cause unacceptable injury to the conifers.

Broadcast Applications for Conifer Release in the Eastern United States

To release spruce, fir, red pine, and white pine from competing hardwoods such as red maple, sugar maple, striped maple, alder, birch (white, yellow, and grey), aspen, ash, pin cherry, and *Rubus* spp. and perennial and annual broadleaf weeds, use Garlon 4 at rates of 1.5 to 3 quarts per acre alone or with 2,4-D amine or low volatile ester to provide no more than 4 lb ae per acre from both products. Apply in late summer or early fall after conifers have formed their overwintering buds and hardwoods are in full leaf and prior to autumn coloration.

Broadcast Applications for Conifer Release in the Lake States Region

To release spruce, fir, and red pine from competing hardwoods such as aspen, birch, maple, cherry, willow, oak, hazel, and *Rubus* spp. and perennial and annual broadleaf weeds, use Garlon 4 at rates of 1.5 to 3 quarts per acre. Apply in late summer or early fall after conifers have formed their overwintering buds and hardwoods are in full leaf and prior to autumn coloration.

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Loes Number: 010-00085

EPA-Accepted 01/12/06

Revisions:

1. Revised grazing and haying restrictions.
2. Added spray drift management guidance.

67. Any available studies or other information about the issues raised in the letter from the U.S. Fish and Wildlife Service (November 14, 2005) regarding terrestrial threatened andendangered species. For example: -- Any assessments of the transmission lines for conformity with “Suggested Practices for Raptor Protection on Power Lines” (Raptor Research Foundation 1996)? Please provide any such assessments and details of transmission line construction relevant to raptor protection. Also provide a copy of “Suggested Practices,” if available. Any special ROW maintenance procedures used to reduce the potential for impacts to Mead’s milkweed or animals with federal or state listing status.

• Clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Please claarify whether or not the referenced agricultural production areas are within the "Site Boundary" as shown on Figure 2-3. Identify any areas fenced to restrict human access and any areas fenced that may restrict wildlife access.

• Additional data on the avian collision studies that were ceased in 1986. Section 2.4 of the ER (WCGS, 1980) states that sufficient data had been collected by 1986. Provide any documentation of regulatory involvement and concurrence in this determination of sufficiency.

• Details on the power transmission system, including information on the design of the towers, the number and configuration of the lines on the towers within each right-of-way (ROW).

• Details regarding the maintenance procedures used in the transmission line ROWs, including mechanical, chemical, and biological control methods for vegetation management.

• More detailed maps/aerial photos of the transmission line ROWs showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains, and the location of the Sharpe Generating Station.

• Please provide information on the locations of transmission line ROWs crossings with parks, wildlife refuges, or wildlife management areas, or any major lakes (in addition to CCL), ponds, or streams? If so, please provide information on these crossings and their locations.

• Any available studies or other information about the issues raised in the letter from the U.S. Fish and Wildlife Service (November 14, 2005) regarding terrestrial threatened and endangered species.
For example:

-- Any assessments of the transmission lines for conformity with "Suggested Practices for Raptor Protection on Power Lines" (Raptor Research Foundation 1996)? Please provide any such assessments and details of transmission line construction relevant to raptor protection. Also provide a copy of "Suggested Practices," if available.

-- Any special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status.

• Any available maps and aerial photographs of the WCGS plant site and the area within and adjoining the larger site boundary (which encompasses CCL) showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains.

• Any available information identifying natural communities and dominant species of plants and animals that utilize terrestrial habitats of the site and the transmission line ROWs, as well as semiaquatic species such as waterfowl that use Lime Sludge Pond and CCL.

Terrestrial Ecology

Audit Needs request #85

> "Please provide any available studies or other information about the issues raised in the letter from the U. S. Fish and Wildlife Service (No. 14, 2005) regarding terrestrial threatened and endangered species. For example:
>
> Have there been any assessments of the transmission lines for conformity with "Suggested Practices for Raptor Protection on Power Lines" (Raptor Research Foundation 1996)? Please provide any such assessments and details of transmission line construction relevant to raptor protection. Is a copy of "Suggested Practices" available?
>
> Are there any special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status?"

Raptor protection:

The transmission lines, distribution lines, transformers, and associated hardware at Wolf Creek Generating Station (WCGS) have been assessed. An Avian Protection Plan (APP), with emphasis on potential impacts to the Bald eagle has been completed as a result, and documents this assessment (see attached APP). This APP addresses electrocution, collision, chemical impacts, and disease pathogen concerns.

Copies of applicable APP's for Westar Energy and Lyon-Coffey Rural Electric are also attached. These documents cover bird interactions on transmission lines associated with WCGS that are maintained by these utilities.

A copy of "Suggested Practices for Raptor Protection on Power Lines" (Raptor Research Foundation 1996) is attached for reference.

Right-of-way (ROW) Maintenance:

There are no special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status. Any listed birds are included in applicable APP's.

Avian Protection Plan

at

Wolf Creek Generating Station

with emphasis of potential impacts to the Bald Eagle
from License Renewal at Wolf Creek Generating Station

Wolf Creek Nuclear Operating Corporation

August 2006

Prepared by:

	Dan Haines	2/15/07 **Date**
Supervisor Regulatory Support Approval:	**Robert Hammond**	2/15/07 **Date**
Manager Regulatory Affairs Approval:	**Kevin J. Moles**	02/15/07 **Date**

at
Wolf Creek Generating Station

1.0 INTRODUCTION

It is the policy of Wolf Creek Nuclear Operating Corporation (WCNOC) to operate Wolf Creek Generating Station (WCGS) in a manner protecting environmental quality through implementation of an environmental protection program (Corporate Policy 5, Environmental Stewardship). This environmental policy includes actions beyond regulatory compliance, some of which are identified within this Avian Protection Plan (APP).

This APP addresses interactions with protected birds at WCGS. House sparrows, European starlings, and pigeons are not protected, are considered non-native pest species, and thus are not included within this APP. Addressed are current regulations and issues, WCGS bird enhancements activities, and nuisance situations and impacts to WCGS caused by protected species. However, the primary goal of this APP is to assess potential adverse impacts of WCGS to birds, identify improvements to minimize these impacts, and present contingency plans for potential future events.

This APP is site-specific for WCGS, which is a nuclear electric generating station in east-central Kansas. Associated with WCGS are transmission lines, distribution lines, transformers, buildings, and a cooling lake (Coffey County Lake, CCL). Potential impacts to WCGS from bird interactions include electric service disruption to plant facilities, interruption of plant operation, personnel safety and health, and cleanliness. Potential impacts to birds include electrocution, power line collision, prey base alterations, and disease pathogen presence.

2.0 REGULATORY BASIS

For WCGS, several regulatory concerns or permits are applicable to this APP and are as follows:

1. Appendix B to the Facility Operating License No. NPF-42, referencing the Final Environmental Statement, Operating License Stage (NUREG 0878), for WCGS, recommends a disease contingency plan for preventing or controlling a waterfowl disease episode. This APP includes a waterfowl disease contingency plan.

2. Potential impacts were identified by the U. S. Fish and Wildlife Service (USFWS) during pre-submittal consultation with WCNOC for WCGS license extension action (see attached November 14, 2005 letter from M. J. LeValley, USFWS, to K. J. Moles, WCNOC). This APP addresses potential bald eagle impacts.

3. The Migratory Bird Treaty Act (16 U.S.C. 703-712: MBTA) prohibits the taking, killing, possession, transportation and importation of migratory birds, their eggs, parts, and nests without USFWS permitting.

4. The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d: BGEPA) provides additional protection to bald and golden eagles above that in the MBTA.

5. The Endangered Species Act (16 U.S.C. 1531-1544: ESA), prohibits the take of a listed species. Take is defined as "...to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct."

6. The Kansas Nongame and Endangered Species Conservation Act (K.S.A. 32-1009 to 32-1011) prohibits take and possession of state listed nongame, threatened or endangered species.

7. The USFWS Migratory Bird Permit MB715225, and current revisions, has been issued for migratory bird salvage and mortality investigation at WCGS. This permit does not provide for take.

8. The Kansas Department of Wildlife and Parks (KDWP) Scientific Collecting and Salvage Permit (currently SC-066-2006), and current renewals, is maintained for bird possession and mortality investigation at WCGS.

3.0 BIRD ENHANCEMENT ACTIVITIES

Offsetting potential adverse impacts to birds by WCGS, various enhancement activities have been completed at WCGS. The existence of the CCL has created excellent habitat for many bird species. In addition, WCNOC's land conservation and wildlife stewardship activities provide bird habitats. These include shallow water wetland development, native grassland and forb management, and maintenance of forested habitats.

WCNOC partnerships with wildlife agencies have also attempted to enhance regional bird diversity and habitat use. Ospreys were released in an attempt to promote a breeding population in Kansas. This was done in partnership with the KDWP from 1996 though 2000. Peregrine falcons were released in 2004 and 2005 in an ongoing attempt to promote nesting on plant facilities. This was completed with KDWP and USFWS permitting and support.

A pair of bald eagles have nested since 1994 in a tree inundated by the CCL. An area around the nest is buoyed off and human disturbance is prohibited within 300 yards of the nest site. WCNOC helps monitor this nest for the USFWS. Thermal effluents also provide foraging habitat for wintering bald eagles, which was not available prior to CCL.

Enhancements for nesting around WCGS and the lake include placement of eastern bluebird, wood duck, American kestrel, and Canada goose structures.

4.0 BIRD IMPACTS TO WCGS

Nuisance bird issues at WCGS involving protected species include perching/roosting, nesting attempts, and motion activity in security areas. Except for house sparrows, starlings and pigeons, lethal control methods are not considered for use at WCGS without specific permitting from the USFWS. Specific bird impacts to WCGS and preferred method for control are as follows:

1. Mixed blackbird flocks attracted to the lake typically roost on the construction power distribution loop in such numbers causing occasional electric service disruption to WGCS administration buildings. Common practice is to insulate potential areas where

birds may cause phase-ground or phase-phase shorts. This also protects birds from electrocution.

2. Cliff swallows commonly attempt to nest on plant buildings causing significant housekeeping and disease concerns associated with the mud nest colonies. Control activities include netting or sheeting to eliminate nesting sites prior to active nesting. In areas where this isn't feasible, nest starts are removed before eggs are laid, thus preventing establishment of a nesting colony. Active colonies exist at the CCL spillway and the causeway bridge providing nearby colonies for displaced birds, thus preventing take. Nest starts are not considered active (without eggs or young), thus no permitting is required (USFWS 2003). Active, or suspected active nests are allowed to stay unless significant hazards are involved. After evaluation by WCGS biologists, a permit from the USFWS will be obtained before nest removal in such instances.

3. Barn swallow nests tend to pose similar housekeeping concerns as Cliff swallows, except on a smaller scale. If nest site modification isn't feasible, then inactive nest start removal is completed. Suspected or actual active nests are allowed to stay unless significant hazards are involved. Such hazards may include safety concerns to personnel by adult birds protecting nests around ladders and stairs. WCGS biologists will evaluate on a case-by-case basis, and obtain specific USFWS permits before nest removal.

4. Miscellaneous bird interactions in the past have included high bird activity in security motion detection areas, usually by swallows and mixed blackbird species. Noise and distress calls have been used to discourage bird activity and help reduce this problem. Eastern kingbird nesting has periodically caused personnel safety concerns at the meteorological tower and plant buildings. When necessary, to remove such birds, specific permits from the USFWS are required.

5.0 POTENTIAL IMPACTS TO BIRDS

The potential impacts to protected bird species due to the presence and operation of WCGS include:

1. Electrocution with power-lines, poles and transformers

2. Collision on aerial lines

3. Chemical or thermal water quality impacts, particularly to the fish prey base of bald eagles

4. potential increase for waterfowl disease pathogens in the warm water discharge to CCL.

Impacts to bald eagles are emphasized in this APP because this species is currently listed as threatened, thus protected by the ESA, as well as the MBTA and BGEPA. Removal fro the threatened list is currently being considered by the USFWS. As a threatened species, it deserves greater attention during the WCGS operating license extension process. The extension is an federal action by the Nuclear Regulatory Commission (NRC), and as such will require USFWS and Kansas Department of Wildlife and Parks consultation. Potential impacts were identified by the USFWS during pre-submittal consultation with WCNOC (see attached

November 14, 2005 letter from M. J. LeValley, USFWS, to K. J. Moles, WCNOC). In addition bald eagles are large birds, and may be more susceptible to electrocution and collisions (APLIC 1994, 1996).

To ensure WCGS exists with minimal impact to birds, and to address license extension concerns, this APP includes three main phases; (1) assessment, (2) improvement, and (3) future contingency plans.

5.1 Assessment Phase for Avian Protection

The assessment of power lines and facilities presented below were completed by WCNOC biologists using APLIC (1994, 1996) guidelines. Biologists from two current APLIC member utilities, Great Plains Energy and Westar Energy assisted with this assessment. Applicable reports and literature were used to address collision and water quality concerns.

5.1.1 Electrocution Potential

All lines were inspected for electrocution hazards using criteria in APLIC (1996). There are four primary types of aerial power lines, in addition to transformers, associated with WCGS. They include:

1. 345 kilovolt (kV) transmission lines owned and operated by Westar Energy, including the LaCygne to Benton, and Wolf Creek to Rose Hill lines..
2. 69 kV transmission lines, including the WCGS tap of the Athens line (approximately four miles) owned and operated by Westar Energy, and the WCGS to Sharpe line (approximately 2.5 miles), owned and operated by Lyon-Coffey Electric Cooperative.
3. 13.8 kV distribution power loop operated by WCNOC.
4. 1000 volt or less (typically 480 volt) distribution lines operated by WCNOC.
5. Transformers at WCGS operated by WCNOC and Westar Energy.

5.1.1.1 345 kV Transmission Lines

There were no electrocution hazards to bald eagles and other birds identified at WCGS from the 345 kV transmission lines. The lines are owned, inspected, maintained, and operated by Westar Energy. As such, they are covered by Westar Energy's Avian Protection Plan (APP) which includes documentation and reporting to the USFWS of bird mortalities associated with the lines. The APP provides for retrofitting or modifying lines, poles, and equipment to bird safe standards where mortalities are known.

In general, the conductor separation required for the 345kV transmission lines are more than can be spanned by birds, including the bald eagle, thus eliminating electrocution potential. Insulator fouling by feces streaming, or nest construction may pose electrocution hazards (APLIC 1996). These types of bird interactions are inspected for and addressed by Westar Energy's routine inspections and APP.

5.1.1.2 69 kV Transmission Lines

There has been bird electrocutions observed associated with WCGS. The WCGS tap of the Athens line is owned and operated by Westar Energy thus is part of its APP. Due to the design of this line, this line will not be dangerous to bald eagles. Design includes well-separated conductors on typical line poles, and non-grounded hardware and guys making phase to ground electrocutions unlikely (Figure 1). Poles also have safe tops available for perching, which bald eagles prefer.

The WCGS to Sharpe line is owned and operated by the Lyon/Coffey County Rural Electric Cooperative, and is thus included in its policy for prevention of wildlife contacts. This line is not expected to pose electrocution hazards to birds, including bald eagles. Design benefits included sufficient conductor separation and non-grounded insulator hardware reducing phase-ground electrocution potential. Safe pole tops are also available for perching. The line is also not located in habitat frequented by bald eagles.

5.1.1.3 13.8 kV Distribution Power Loop

Bald Eagle Interactions

There has been no bald eagle electrocutions observed on the 13.8 kV Distribution Power Loop, sometimes called the "construction loop". This power loop surrounds the WCGS proper consisting of 64 poles spanning approximately 2.1 miles (reference WCNOC drawing 8025-E-1021). It distributes power to various buildings and facilities, and is maintained by WCNOC. It consists of numerous pole-mounted transformers, jumper leads to under ground services, cutoff fuses, switches, and corners. These types of electric setups are known to present electrocution hazards to birds (APLIC 1996). Electrocution hazards were considered for each pole, with emphasis on bald eagle susceptibility. Table 1 lists the benefits and detriments that each pole has, and prioritizes them as to their potential for eagle electrocutions.

For assessment of bald eagle electrocution potential, poles were prioritized from highest to lowest as; (1) known eagle roost poles, (2) likely roost poles, and (3) unlikely roost poles. As shown in Table 1, eagles have been known to roost on two poles, which were considered safe for bald eagles (Figure 2). No mitigation is recommended for these poles.

Of the likely roost poles identified in Table 1, only pole 20 was considered potentially dangerous to bald eagles (Figure 3). This pole has close conductors and a horizontal cross-arm configuration. The pole is also adjacent to water habitats, and may be an attractive roost site, especially for wintering bald eagles foraging around the lake. All remaining poles judged as likely roosts were not considered hazardous to bald eagles due to the multiple factors beneficial for preventing eagle electrocution as identified in Table 1.

The remainder of the distribution power loop poles were considered unlikely to be used by bald eagles, and thus were not judged to pose significant electrocution threats. These poles are distant from likely foraging habitat, are around high human activity, in parking lots, or along mowed lawn areas. In addition, factors judged beneficial for reducing electrocution potential offset many of the potential detrimental conditions (Table 1).

Protected Bird Interactions

Typically, electrocution threats to birds are greatly influenced by conductor spacing (APLIC 1996). In the vicinity of WCGS, the bald eagle has been the largest species likely to use utility poles, and because of its large wingspan, would be able to bridge larger conductor spacings. Consequently, conductor configurations and distances judged safe for bald eagles would also be safe for smaller birds.

However, roosting behavior differences of various species may cause different susceptibilities. On the distribution power loop, various switches, breakers, and pole-mounted transformers may provide suitable roosts, and some species smaller than bald eagles, can and may prefer to get among the hardware, rather than on pole tops. Insulated bushings and jumpers on pole-mounted transformers, etc are present, thus reducing electrocution potential in such instances.

It was found that line spacing and configuration on pole numbers 54 through 59 (Figure 4) may pose potential electrocution threats to some birds, particularly red-tailed hawks, great-horned owls, and flocking blackbird species. Review of past reports for the USFWS salvage permit maintained for WCGS identified one great-horned owl electrocution since 1985. Electrocution of mixed blackbirds on portions of this line has been suspected as causing service outages on this line, but specific evidence has not been confirmed.

5.1.1.4 480 Volt Distribution Lines

Low voltage distribution lines do not typically pose electrocution hazards (APLIC 1996). At WCGS, such 480-volt lines provide electricity for lighting and outbuildings, and are typically mounted underneath the 13.8 kV power loop lines. Conductors are insulated preventing electrocutions. No modifications to these lines were considered necessary.

5.1.1.5 Transformers

There were no transformers at WCGS that were deemed as potential electrocution hazards to bald eagles. The pole mounted transformers associated with the 13.8 kV distribution power loop were evaluated with each pole (Table 1), and all had bushing insulators, thus eliminating electrocution potential for all birds. The larger 345 kV transformers require conductor separation beyond the reach of a bald eagles wingspan, thus all smaller species. Intermediate transformers associated with WCGS have covered conductors and bushings to prevent animal caused system outages and damage Figure 5). Some transformers in the switchyard are owned by Westar Energy, consequently are covered by their APP.

5.1.2 Collision Potential

The NRC in 1982 reviewed potential impacts to waterfowl due to collision with electric transmission facilities adjacent to the cooling lake (NRC 1982). The NRC recommended that a general survey program for waterfowl collisions be completed to determine if mitigation was warranted. Consequently, transmission lines traversing the areas of high waterfowl and bald eagle usage were monitored and assessed for actual and potential collision problems beginning in 1983 and continued into 1988.

The research determined that collision mortality at WCGS was not considered significant for waterfowl. No bald eagle collisions were observed. See attached collision survey summary for more detail. Increased collisions, or waterfowl use changes indicating increased potential for collisions, will be assessed by WCNOC per NRC (1982). Mitigation needs will be addressed with Westar Energy's APP.

5.1.3 Chemical or Thermal Water Quality Affects to Fish Prey Base

The Kansas Department of Health and Environment (KDHE) regulates water quality discharges from WCGS with a National Pollutant Discharge Elimination System (NPDES) permit. All chemical additions are reviewed and approved by the KDHE prior to use. Periodic bioassays are also completed to demonstrate no impacts to aquatic biota, including fish. Adherence to this permit will ensure continued water quality, thus preclude any degradation to the bald eagle fish prey base.

There are no thermal discharge changes expected due to license extension. Currently, thermal effluents from WCGS concentrate fish and waterfowl during winter periods, thus increasing foraging opportunities for wintering bald eagles.

5.2 Improvements for Avian Protection

The assessment of potential avian impacts, particularly to bald eagles, has identified two areas where mitigation is recommended to prevent potential impacts in the future. These involve electrocution hazards at portions of the distribution power loop identified above. Modifications include:

1. Install insulation on the center conductor on pole 20 from the bushing approximately three feet (Figure 3) to eliminate potential for bald eagle electrocution.

2. Install perch deterrents and/or insulate center conductors on poles 54 through 59 (Figure 4). These modifications will reduce electrocution potential caused by the closely spaced horizontal conductors.

5.3 Future Contingencies for Avian Protection

5.3.1 Electrocution and Collision Events

Based on past experience, bird mortality due to electrocution or collision is not expected to increase in the future at WCGS. In the event electrocution or collision events increase, mortalities will be investigated, recorded and reported in accordance with the current USFWS salvage permit. Consultation with APLIC and USFWS will help determine any mitigation activities if such events become problematic. APLIC (1994 and 1996) guidelines will be followed when practical.

If electrocution or collision events involve Westar Energy or KEPCo lines, then the respective company will be notified, and remediation activities will be determined by applicable APP's. WCNOC will assist where needed.

If electrocution or collision events involve Westar Energy or KEPCo lines, then the respective company will be notified, and remediation activities will be determined by applicable APP's. WCNOC will assist where needed.

5.3.2 Waterfowl Disease Contingency Plan

The heated condition of CCL may enhance the potential for development of waterfowl disease pathogens (NRC, 1982). This contingency plan is to provide guidance to mitigate or control such outbreaks on CCL, whether attributable to WCGS operation or not.

Initial investigation will be conducted by WCNOC biologists to determine the scope of the event. The USFWS and KDWP are the agencies responsible for such wildlife issues, and will be contacted for assessment and recommended actions if disease is suspected, or numerous carcasses are involved. WCNOC will assist these agencies as needed.

Immediate notification, following disease problem identification, will be completed by WCNOC at the numbers listed below until at least one is contacted:

1. US Fish and Wildlife Service
   Contaminant Specialist, Manhattan, (785) 539-3474
   Flinthills National Wildlife Refuge, Hartford, (620) 392-5553

2. Kansas Department of Wildlife and Parks
   District Wildlife Biologist, New Strawn, (620) 364-2522
   Natural Resource Officer, New Strawn, (620) 364-3418
   Region 5 Office, Chanute, (620) 431-0380
   Pratt Headquarters, Pratt, (620) 672-5911

6.0 LITERATURE CITED

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APLIC and USFWS, 2005. Avian Protection Plan (APP) Guidelines, a Joint Document Prepared By The Edison Electric Institute's Avian Power Line Interaction Committee (APLIC) and U. S. Fish and Wildlife Service (USFWS). April 2005.

NRC, 1982. Final Environmental Statement Related to the Operation of WCGS, Unit No. 1. NUREG 0878.

USFWS, 2003. Migratory Bird Permit Memorandum on Nest Destruction. MBPM-2, April 15, 2003.

Table 1. Susceptibility of bald eagles to electrocution on the 13.8 kV power distribution line at Wolf Creek Generating Station.

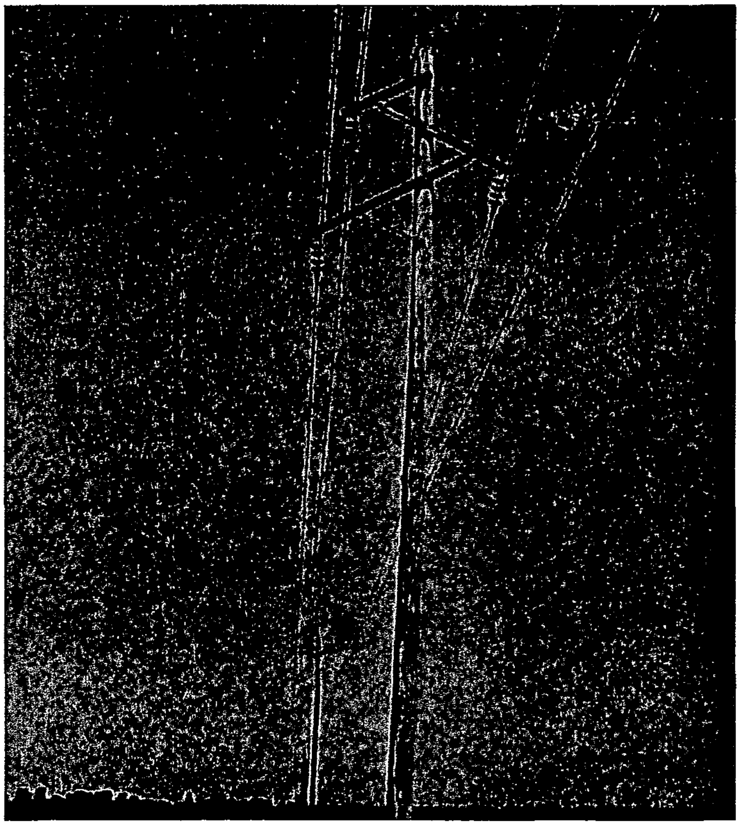
Bald Eagle Electrocution Potential	Eagle Use	Pole Design (1)	Pole number	Horizontal Conductors	Grounded insulator hardware	Exposed transformer bushings	Grounded guy hardware	Non-insulated jumpers	Grounded switch/fuse hardware	Behavior preventing contact	Transformer bushings covered	Insulated droppers	Ungrounded guy hardware	Separated vertical conductors	Insulator hardware not grounded	Ground conductor well separated	Pole top available for safe perch
				Factors Related to Bald Eagle Safety													
				Less Safe ← Detriment						Benefit → **Safer**							
Higher	Known roosts	N	46, 48											X	X	X	X
	Likely roosts next to lake habitat	C	20	X			X										X
		F	14, 17, 33, 35, 36, 38, 45, 49				X			X				X	X	X	X
		H	16, 25				X			X				X	X	X	X
		I	18, 26					X	X	X	X			X	X	X	X
		J	42					X		X	X			X	X	X	X
		K	15					X	X	X				X	X	X	X
		K	40						X	X		X		X	X	X	X
		O	19, 32, 34, 37, 41							X				X	X	X	X
	Not likely to be used as roost site	A	59B, 66	X			X		X		X	X			X	X	X
		B	59A	X					X		X	X			X	X	X
		C	55, 59	X			X								X	X	X
		D	54, 56, 57, 58, 61, 62, 63, 64, 65	X											X	X	X
		E	4				X	X	X	X	X			X	X	X	X
		G	1, 53				X	X	X	X				X	X	X	X
		I	3, 8, 30, 51				X	X	X	X	X			X	X	X	X
		J	11					X	X	X	X			X	X	X	X
		K	6, 27, 31, 39, 50					X	X	X				X	X	X	X
		L	5, 12, 28, 50A					X	X	X				X	X	X	X
		M	10							X			X	X	X	X	X
		N	61, 62, 63, 64, 65	X						X					X	X	X
Lowest		O	2, 7, 9, 13, 29, 43, 44, 52							X				X	X	X	X

Table 1 (cont)

(1) Pole design features ranked from highest to lowest potential for electrocution hazards to bald eagles are as follows:

A. End pole three phase w/horizontal cross-arm, transformer and associated hardware.
B. Line pole three-phase w/horizontal cross-arm, transformer, underground drops and associated hardware.
C. Corner/end pole three phase w/horizontal cross-arm
D. Line pole w/horizontal three phase cross-arm
E. Corner pole three phase w/vertical conductors, transformer and grounded guys.
F. Corner pole three phase w/vertical conductors and grounded guys.
G. End pole three phase w/vertical conductors, grounded guys and underground feed hardware.
H. End pole three phase w/vertical conductors and grounded guys.
I. Line pole three phase w/vertical conductors, transformer, and underground drop hardware.
J. Line pole three phase w/vertical conductors and transformer.
K. Line pole three phase w/vertical conductors and underground feed hardware.
L. Line pole three phase w/vertical conductors and switch hardware.
M. Corner/end pole three phase w/vertical conductors and non-grounded guys.
N. Line pole two-phase w/horizontal cross-arm and two conductors.
O. Line pole three phase w/vertical conductors.

(2) Pole numbers correspond to poles numbered in the field, and to WCNOC drawing number 8025-E-1021, Rev 42.



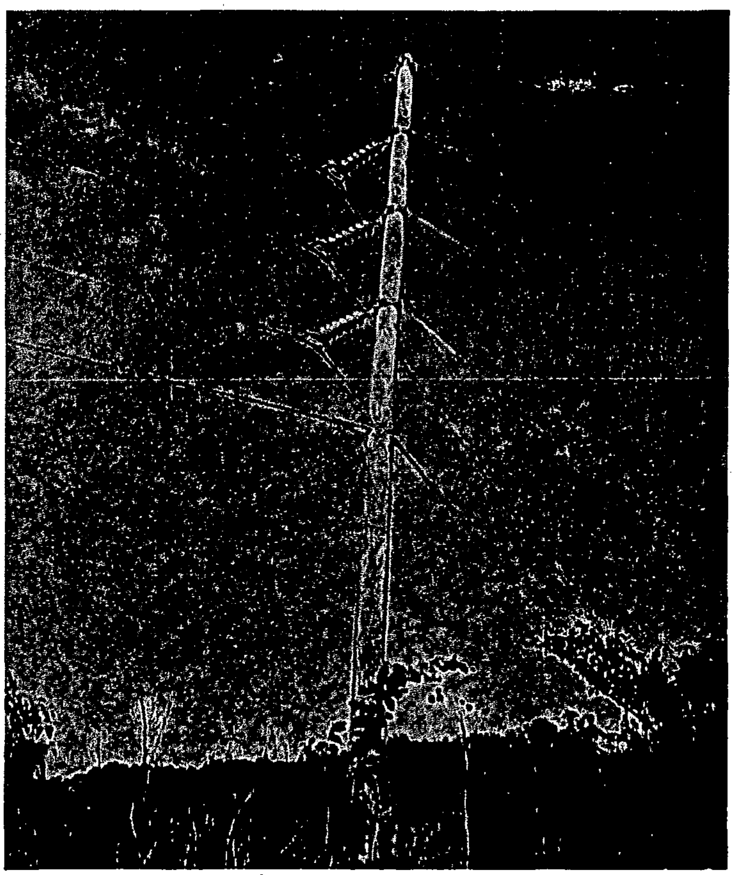


Figure 1. Typical poles of 69 kV WCGS tap of the Athens line showing eagle safe separated conductors and insulated guy hardware.

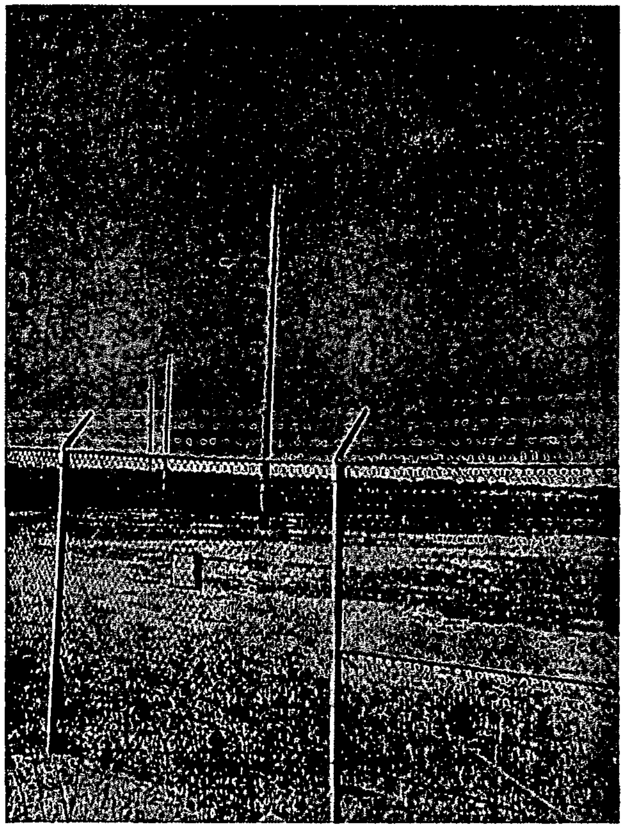


Figure 2. Poles where bald eagles have been observed roosting. These poles are considered safe due to well separated vertical conductors and pole tops available for perching.

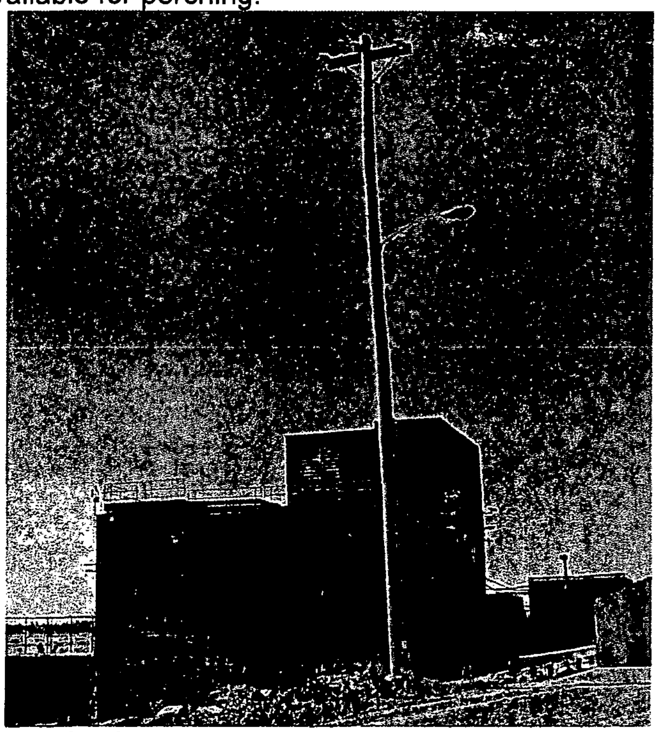


Figure 3 Pole 20 of the 13.8 kV distribution power loop where center phase conductor insulation is recommended to prevent potential bald eagle electrocution. Note close horizontal cross-arm configuration.

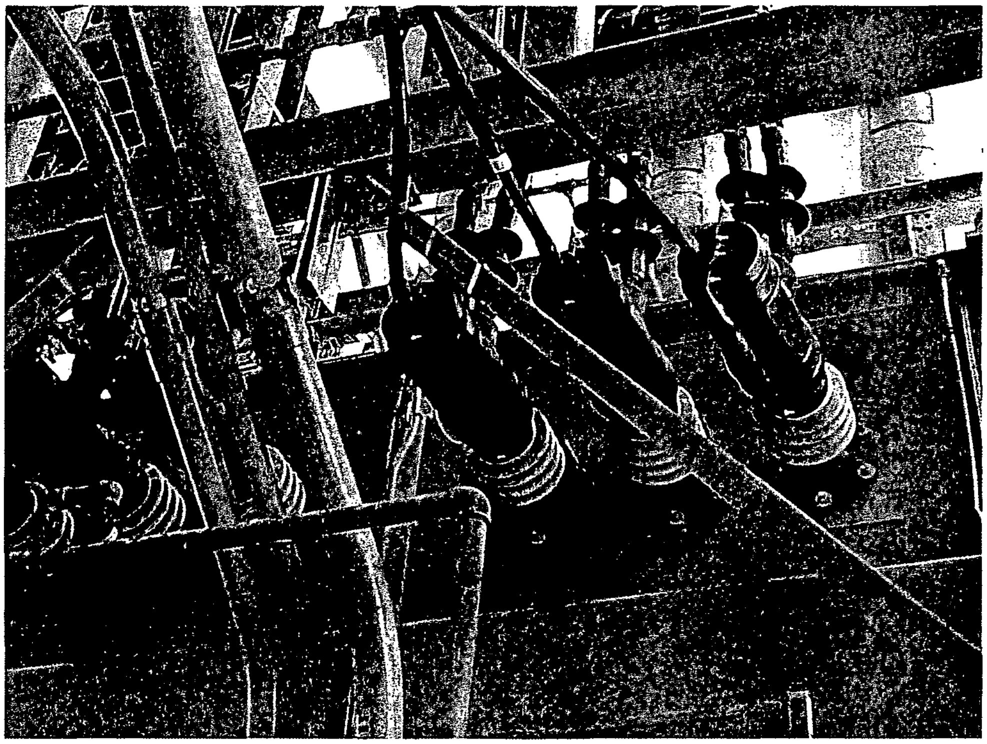


Figure 5. Typical bushing and conductor insulation present on WCGS transformers to prevent animal electrocutions.

Avian Protection Plan
Attachment

Review of Bird Collision Data on Transmission Facilities at

Wolf Creek Generating Station (WCGS)

With emphasis on the Lime Sludge Pond (LSP)

Background:

The Nuclear Regulatory Commission (NRC) in 1982 reviewed potential impacts to waterfowl due to collisions with electric transmission facilities adjacent to the cooling lake (Section 5.5.1.2, Final Environmental Statement related to the Operation of WCGS, NUREG 0878). The NRC recommended that a general survey program for waterfowl collision be completed to determine if mitigation was warranted. This recommendation was included in the Environmental Protection Plan, Appendix B to Facility Operating License NPF-42. This required a general survey program be accomplished to document significant waterfowl collision events and determine if mitigation was warranted.

Consequently, a collision survey was initiated in February, 1983, and continued through February, 1988. Surveys included dead bird searches of transmission lines crossing the cooling lake. All bird species were included, including bald eagles. These areas included the Firing Range Cove traversed by two 345 kV and one 69 kV line, and the Cemetery Cove, traversed by one 345 kV transmission line. These surveys occurred during the winter-spring migration seasons during each year.

The LSP is adjacent to the Cemetery Cove and was searched during each survey. Data was combined in annual reports with the Cemetery Cove through the 1985-86 migration survey season, but collisions around the LSP was available from the field data sheets. Table 1 shows the numbers and species of transmission mortalities found. Table two lists the live birds present immediately before each dead bird search. Records were kept for live bird usage beginning with November 1985 surveys. Comparing these tables demonstrates that no threatened or endangered birds were found to have collided with the associated transmission line. Unknown feathers were not from threatened or endangered birds. A few bald eagles were observed using the adjacent Cemetery Cove, but none were found during dead bird searches.

Tables 1 and 2 also demonstrate that species found during dead bird searches did not necessarily correspond to live species found using the area, indicating that collisions tended to be incidental, with no detrimental patterns present. To test this further, monthly totals of dead birds, pooled from the three search locations, were compared with the total waterfowl and waterbird numbers surveyed during the same months, assuming that the more birds in the area would mean higher collision mortality and greater impact from the transmission facilities. However, no relationship was found between collision frequency and bird usage of the cooling lake and LSP (Figure 1). Collision mortality was incidental to bird usage in the area, indicating that bird activity was not greatly impacted by the lines.

Since the transmission lines did not appear detrimental to general bird usage of the cooling lake, more localized usage data were analyzed. Beginning in November 1985, live bird usage in each search area was surveyed immediately prior to each dead bird search. This would show any adverse impacts at the LSP. The live bird data were compared to subsequent collisions found, again assuming that the greater the usage in the area, the greater the collision pattern would be. No relationships were found for any location, including the LSP (Figure 2). The more birds using the LSP did not increase transmission line collisions there.

A third comparison was made between the species diversity of dead birds found and the diversity of live birds surveyed in the search areas immediately prior to the searches. This was done assuming that the greater the number of species present would mean a greater number of species vulnerable to collision. There were no relationships found for all locations except the LSP (Figure 3). Approximately one third of the species using the LSP were consistently found during the dead bird searches. This suggests that of the birds using the LSP, more species were susceptible to collision not based on total numbers as shown above, but on the kinds of birds. Mallard was the primary species found at the LSP (Table 1).

In the 1987-1988 Annual Wildlife Monitoring Report, a review of the total collision results in relation to the total birds using the cooling lake was completed. Estimates of common biases were used to ensure worst case was evaluated. As shown in the report, total estimated collisions comprised a small percentage (0.2 to 0.5) of the total using the lake. This was very comparable to other collision impact assessments cited in the report, and well within published non-hunting mortality estimates. Consequently, no impacts were found to bird populations by the transmission facilities at WCGS.

To detect any changes in this assessment, bird usage surveys completed by the Kansas Department of Wildlife and Parks are reviewed annually. A summary of these reviews are provided in the Annual Environmental Operating Report provided to the NRC each year. No changes have been observed to date that would warrant any mitigative actions.

Table 1. Bird species, number of birds found during dead bird searches, and live birds using each search area immediately prior to each search for transmission facilities at Wolf Creek Generating Station.

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1983	February	European starling	1		3
		Unidentified duck sp.	1		
		Great blue heron	1		3
		Red-winged blackbird			3
		Brown-headed cowbird			1
	April	Blackbird sp	1		
		Great blue heron			3
		Unidentified duck sp			1
		Upland sandpiper			1
		Sandpiper sp	1		
		American coot		1	
		Red-winged blackbird		1	
		Ruddy duck		1	
	September	Unidentified feathers			2
		Blue-winged teal			1
		Mallard			1
	November	Unidentified feathers			5
		Gull sp.	1		
		Song sparrow			1
		Unidentified duck sp			1
		Red-winged blackbird			1
		Rusty blackbird			1
1984	February	Meadowlark			1
		Mallard			1
		American coot			1
		Unidentified duck sp.			2
		Red-winged blackbird			1
	April	Blue-winged teal			1
		Killdeer			1
		Greater prairie chicken			1
		American crow		1	
	September	Blue-winged teal			2
		Great blue heron			1
	November	Blue-winged teal			1
		Unidentified duck sp.			7
		Gadwall			2
		Unidentified feathers			1
		American coot			1

Table 1. (cont)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1985	February	Red-tailed hawk			1
		American crow			1
		American tree sparrow		1	
		Greater prairie chicken			1
		Unidentified duck sp.			1
	April	Great blue heron	1		2
		Eastern meadowlark			1
		Unidentified feathers		1	1
		Mallard		2	
		Brown thrasher			1
	September	Great blue heron			2
		American coot	1		1
		Ovenbird			
		Brown-headed cowbird		1	
		Red-winged blackbird			1
	November	American coot		1	2
		Ring-billed gull	1		
		Bufflehead	2		
		Unidentified duck sp.		1	
		Red-winged blackbird			2
		Unidentified feathers			2
		Mallard	1		
		Blue-winged teal	1		
	December	Double-crested cormorant		1	
		American coot		1	
		Mallard		1	
1986	January	Ring-billed gull		1	
		American coot		2	1
		Mallard	1	4	
		Pigeon		1	
		Red-winged blackbird			1
	February	Mallard	2	4	
		Unidentified feathers		1	1
		Bufflehead	1		
		American coot		1	1
		Red-winged blackbird			4
		Red-bellied woodpecker		1	
	April	Red-winged blackbird	1		
		Blue-wing teal			1

Table 1. (cont)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1986	April	Gadwall			1
		American coot		1	3
		Greater yellowlegs	1		
		Unidentified feathers			2
		Shorebird sp.			1
	October	Pied-billed grebe	1		
		White pelican			1
		Blue-winged teal	1		
	November	Mallard			2
		Ring-billed gull	1		
		Red-winged blackbird			1
	December	Mallard	2	1	
		Red-winged blackbird			1
1987	January	Mallard	2		
	February	Mallard	1	4	3
		Lesser scaup	1		
	April	White pelican		1	
		Yellow rail			1
		Lesser yellowlegs	1		
		Pectoral sandpiper	2		
		Red-winged blackbird	1		
	November	Double-crested cormorant			3
		Black-crowned night heron			1
		Mallard			2
		Unidentified duck sp.			1
		American coot		2	1
		Passerine sp.	1		
	December	Mallard			1
1988	January	Double-crested cormorant		1	
		Mallard		2	
		Red-winged blackbird			1
	February	Double-crested cormorant		1	
		Mallard			1
		Gadwall		1	
		Common crow	1		
		Unidentified feathers			1

Table 2. Monthly bird numbers surveyed using areas adjacent to transmission facilities immediately prior to dead bird searches at Wolf Creek Generating Station.

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
1985	November	Hooded mergansers			15
		American coots		155	199
		Canada goose			40
		Mallards	25	124	161
		American wigeon		122	
		Bufflehead	2	2	3
		Green-winged teal		3	
	December	Ring-billed gull		1	
		Mallard		787	
		Bufflehead		6	
		American coot		99	
		American widgeon		55	
		Green-winged teal		25	
		Gadwall		14	
		Unidentified duck sp		21	
		Common merganser		7	
		Pintail		42	
		Bald eagle		2	
1986	January	Mallard	79	585	123
		Pintail		1	
		Bufflehead	9		
		American widgeon		8	
		Green-winged teal		13	
		Ring-billed gull		25	6
		Canada goose			18
		American crow		2	
		American coot		1	
	February	Mallard	226	304	31
		Bufflehead	93	15	3
		Pintail	10		1
		Goldeneye	2		
		Ring-billed gull		32	
		American widgeon		8	
		American coot	27	31	
		Green-winged teal	12	3	
		Killdeer	2		
		Common merganser	2		
		Canvasback			2
		Redhead duck			140
	April	Mallard	4	2	2
		Lesser scaup		6	

Table 2. (cont.)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
		American coot		156	142
		Blue-winged teal	8	2	9
		Double-crested cormorant		3	
		Killdeer	6		
		Shorebird sp.			12
		Greater yellowlegs		2	4
		Gadwall			1
	October	Blue-winged teal			58
		Great egret			1
		Great blue heron		2	3
		Osprey		1	
		American coot	2	1002	44
		Killdeer	12	8	
		Sandpiper sp.	20		
		Mallard	60	12	2
		Bufflehead	3		
		American widgeon		4	
	November	Goldeneye		6	
		Bufflehead	1	15	3
		American widgeon		250	
		American coot		150	
		Mallard	120	505	72
		Hooded merganser		2	
		Ring-billed gull		12	
		Gadwall		80	19
		Pied-billed grebe			3
		Green-winged teal		30	
		Canada goose			21
	December	Mallard	267	1239	259
		Bufflehead	26	12	2
		Great blue heron		2	
		American widgeon		12	
		Hooded merganser		2	
		Canada goose	9	42	6
		Green-winged teal		97	
		Goldeneye	9		
1987	January	Mallard	300	2145	90
		Hooded merganser		30	
		Canada goose	10	12	35
		Bufflehead	7		

Table 2. (cont.)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
	February	Mallard	891	835	1320
		Canada goose		15	382
		Green-winged teal			6
		American coot		5	
		Ring-necked duck	61		
		Bufflehead	84		
		Goldeneye	3		
		Redhead duck	69		
		Lesser scaup	14		
	April	Mallard	3	4	2
		Greater yellowlegs	16		
		Sandpiper sp.	46		
		American coot	1	11	247
		Bufflehead	33		
		Killdeer	8		
		Blue-winged teal	35	12	24
		Northern shoveler			11
		Gadwall			2
		Wilson's phalarope	2		
		Lesser yellowlegs	20		
		Pectoral sandpiper	16		
		Willet	2		
		Forster's tern		1	
	November	Mallard	150	167	110
		American coot	30	21	
		Canvasback	5		
		Bufflehead	9	2	
		Redhead duck	16		
	December	Mallard	15	1055	115
		Hooded merganser			3
		Great blue heron			1
		American coot		15	
		Canada goose		145	30
		Goldeneye		1	
		White-fronted goose		3	
1988	January	Bald eagle		14	
		Canada goose		305	6
		Mallard	90	895	35
		Great blue heron		4	

Table 2. (cont.)

Year	Month	Species	LSP	Cemetery Cove	Firing Range Cove
	February	Ring-billed gull		150	
		Mallard	10		30
		Bald eagle		2	
		Bufflehead	15		
		Canada goose			200
		Snow goose			30
		American coot			10

Figure 1. Dead birds found adjusted for common search biases compared with total bird usage of the cooling lake.

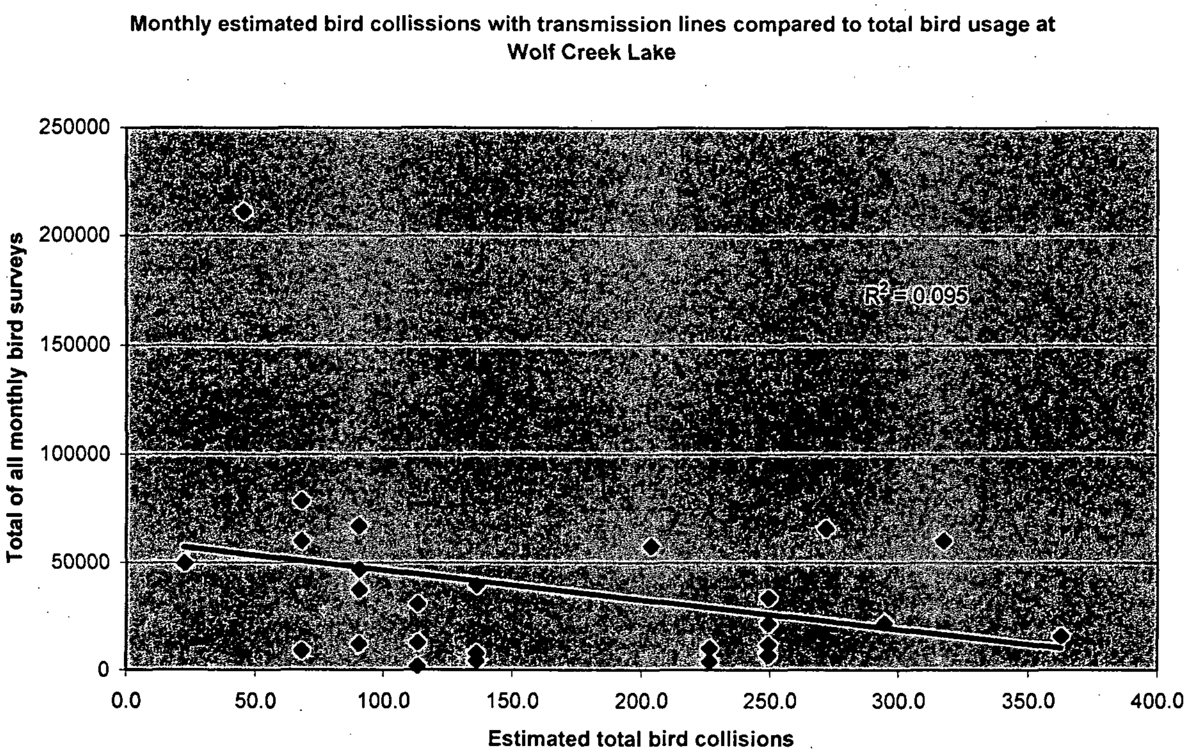
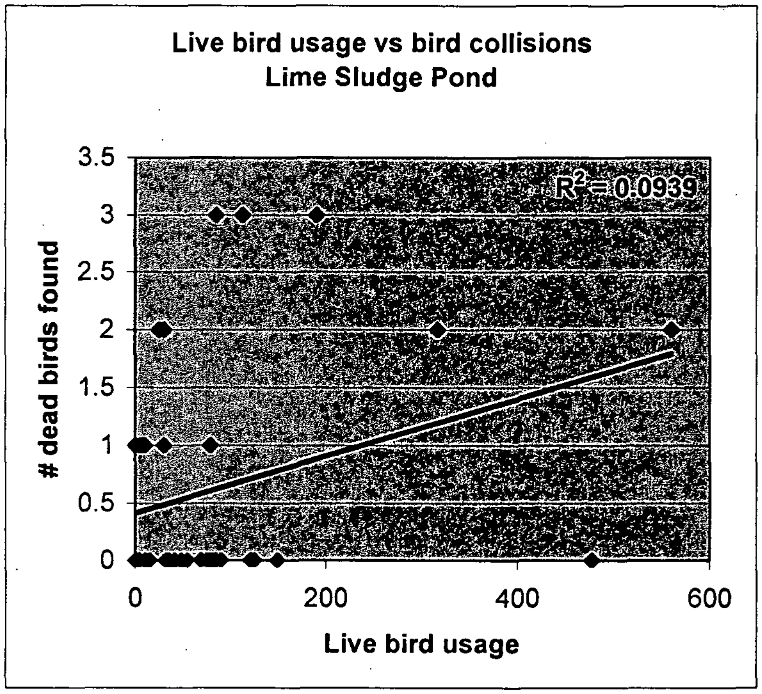


Figure 2. Live birds found in search areas immediately prior to dead bird searches. These totals do not reflect common search biases.



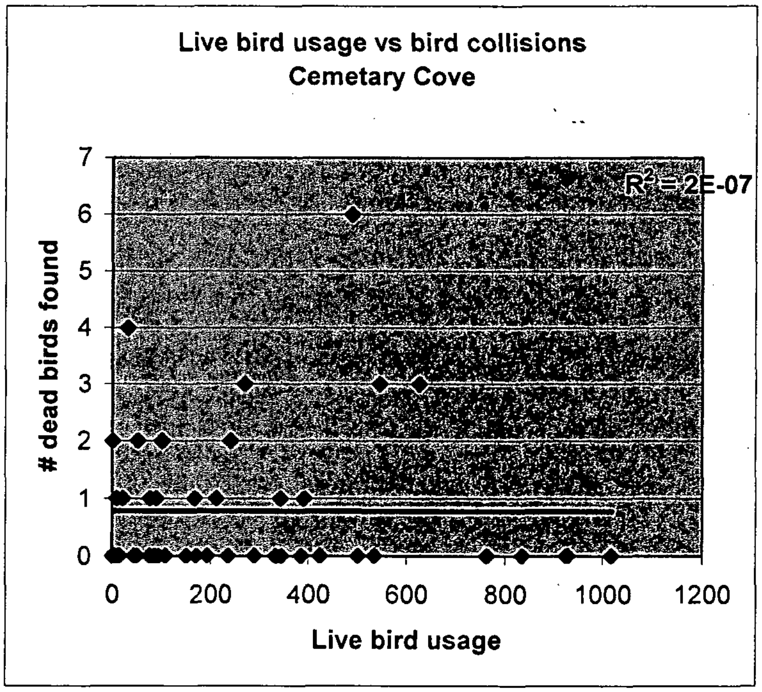
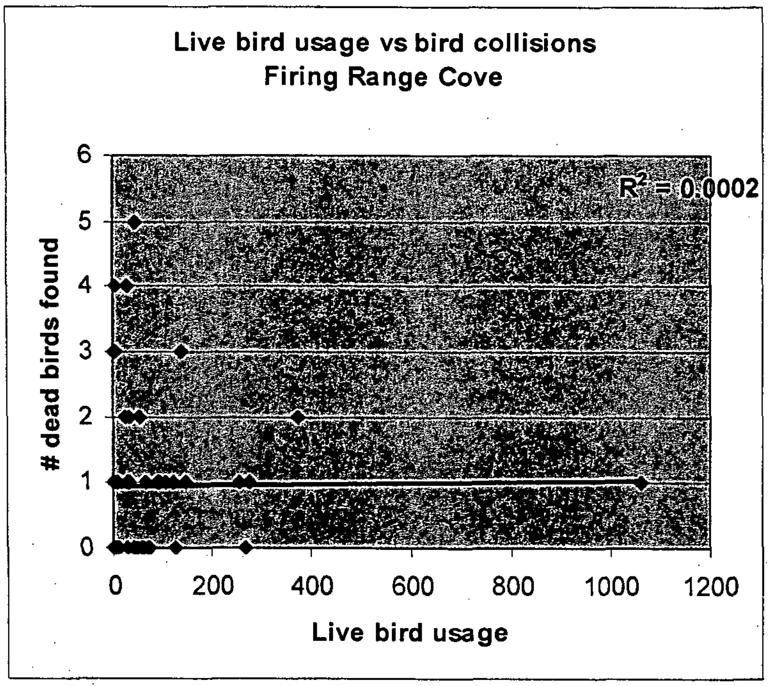


Figure 2. (cont).



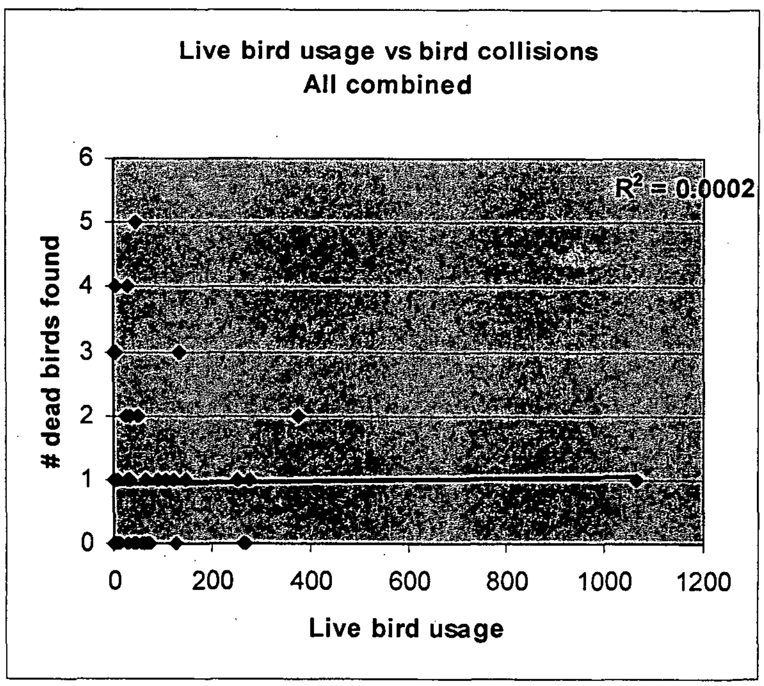
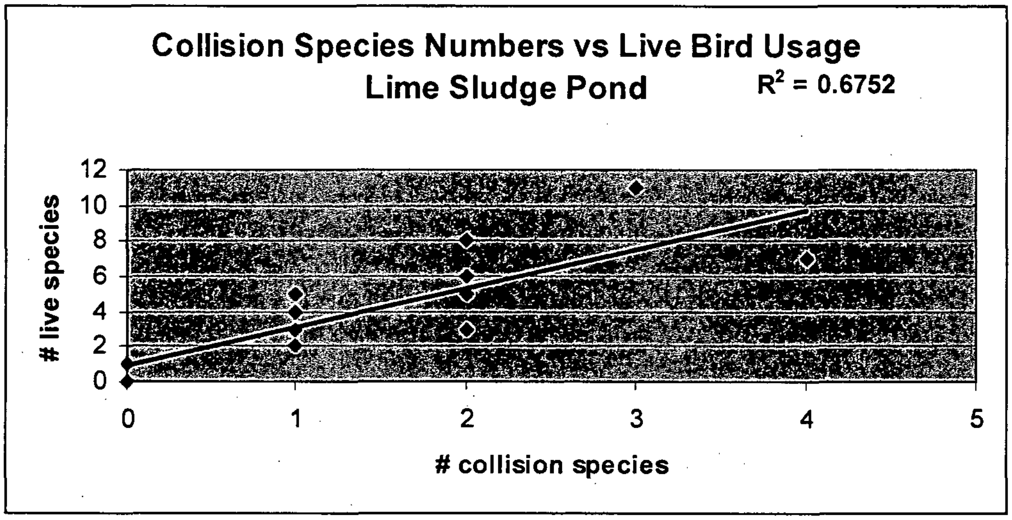
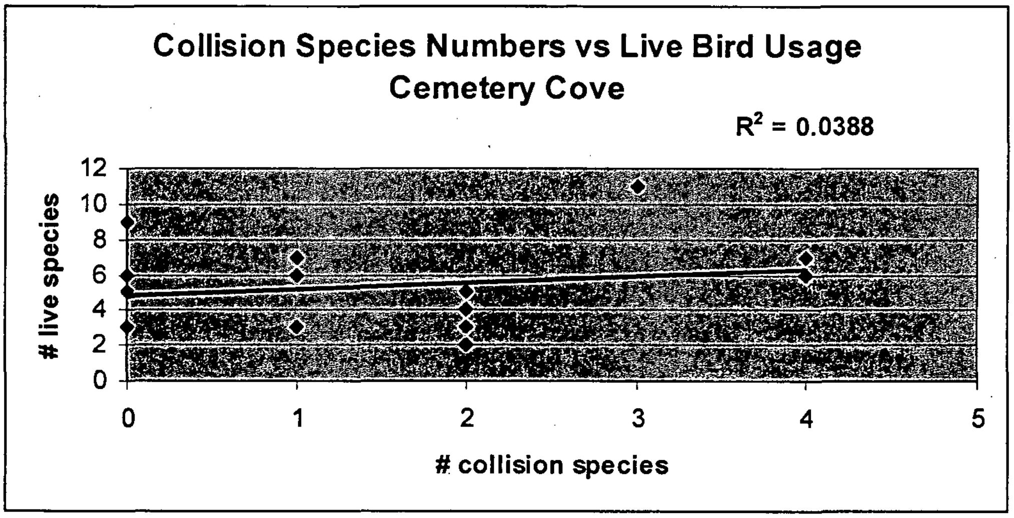
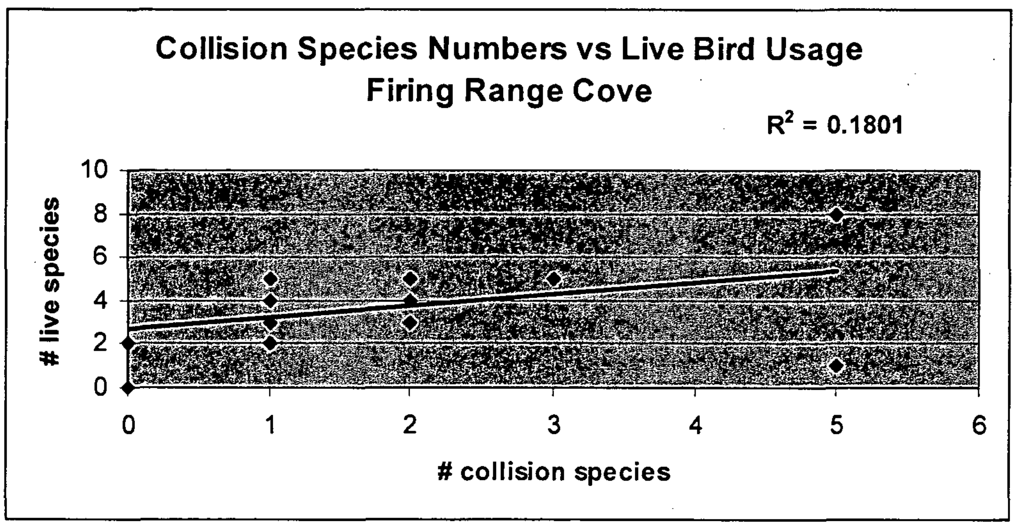


Figure 3. Species diversity of dead birds found compared to species diversity of live birds surveyed prior to searches.







ADDENDUM

TO

Avian Protection Plan

at

Wolf Creek Generating Station

February 14, 2007

These addendum statuses the improvement items for avian protection identified in Section 5.2. The protection item changes are as follows:

1. Perch deterrents have been installed on Pole 20 to discourage bald eagle roosting (see photo 1). Insulation will be installed on the center conductor from the bushing approximately three feet to further eliminate potential for bald eagle electrocution when scheduling will allow during an upcoming Construction Power Loop outage.

2. An alternate "safe" perch was installed on pole 54 (see photo 2). No further work is considered necessary for this pole.

   Pole 59 was reassessed, and due to conductor spacing, it was considered unlikely to cause bird electrocution. No further work is necessary for this pole.

   Plastic bird covers were placed on the center conductors of poles 56 through 58 (see photos 3). These poles are considered safe, and no further work is necessary.

   Insulation of the center conductor and jumper on Pole 55 will be installed when scheduling will allow during an upcoming Construction Power Loop outage.

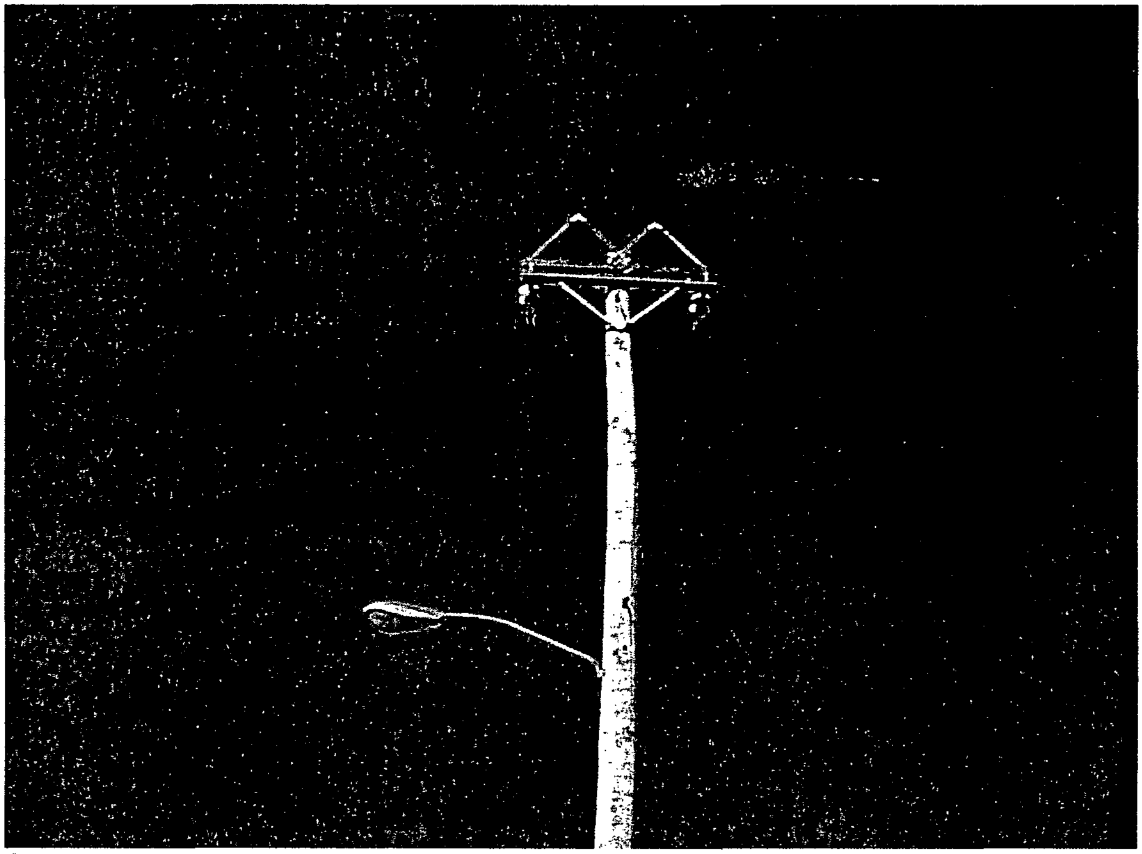


Photo 1. Bald eagle perch deterrents installed on Pole 20.

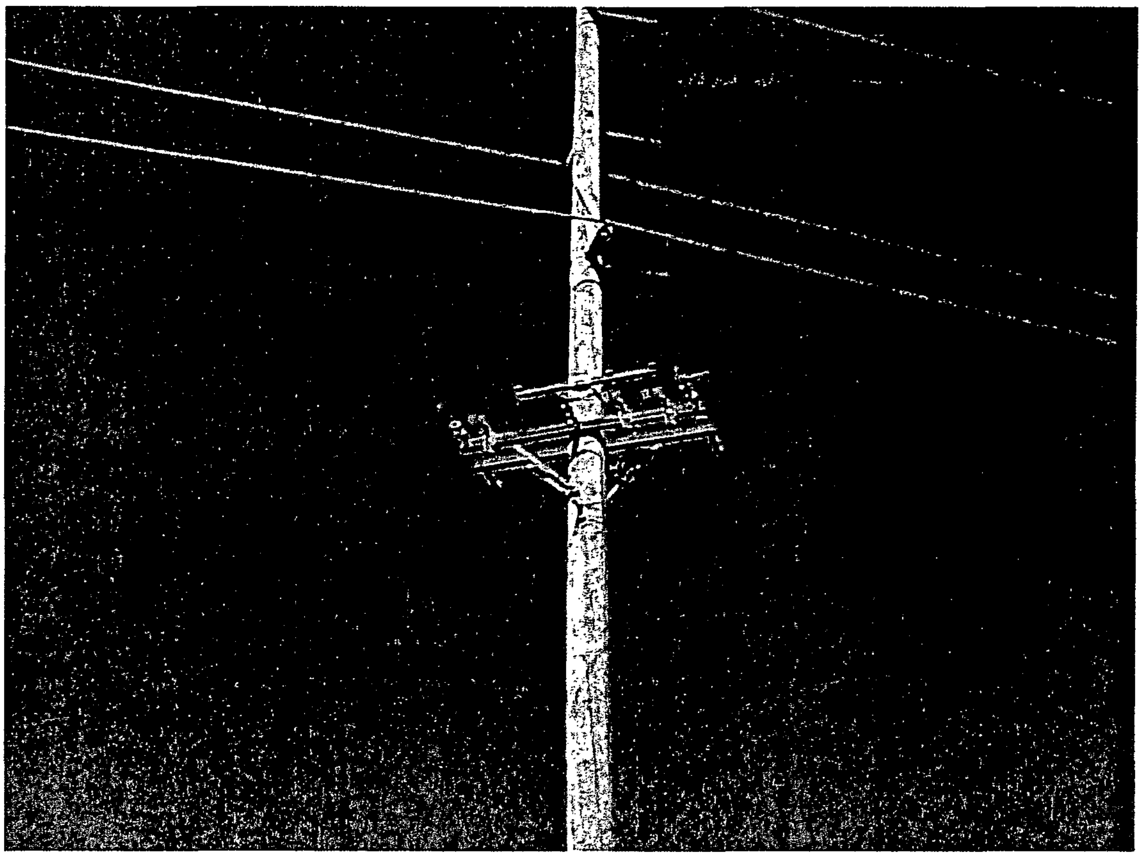


Photo 2. Cross-arm “safe” perch installed on Pole 54.

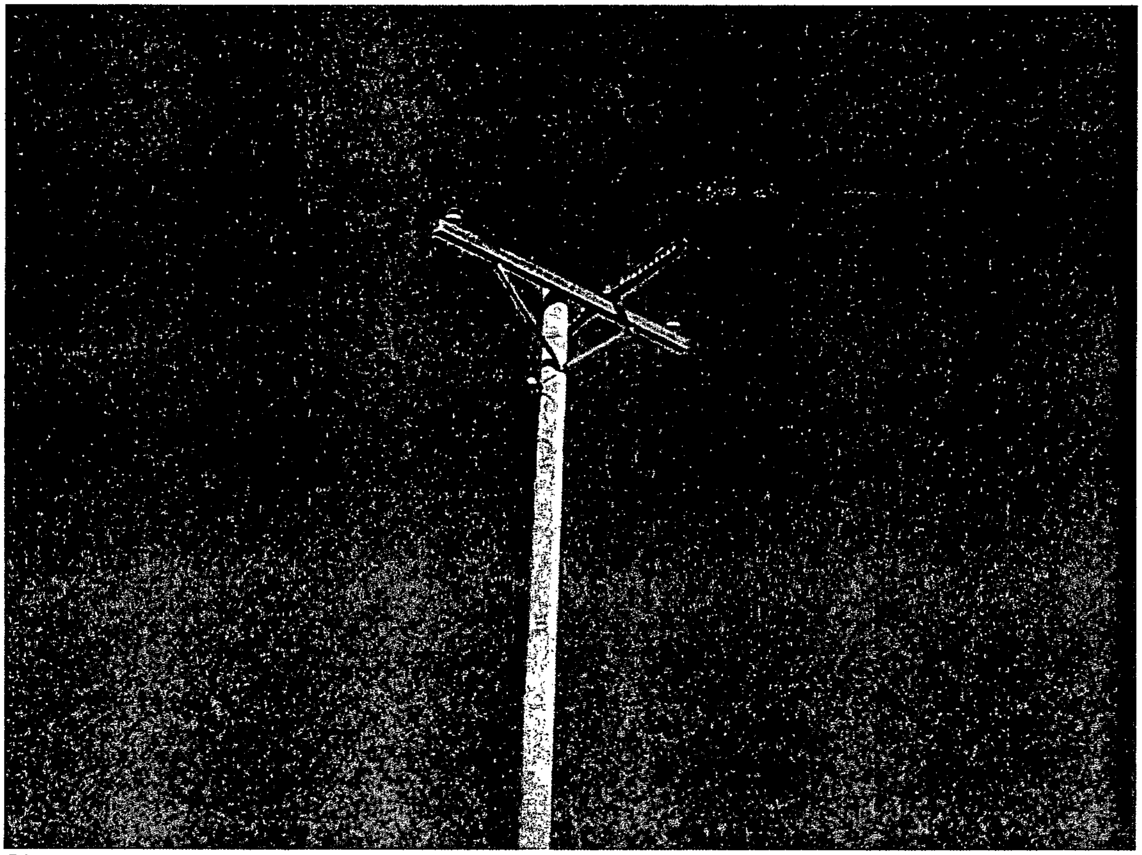


Photo 3. Plastic bird cover installed on center conductors on Pole 57. Similar bird protection devices installed on Poles 56 and 58, also.

LYON-COFFEY ELECTRIC COOPERATIVE, INC.
POLICY FOR
PREVENTION OF WILDLIFE CONTACTS

The scope of this policy is to provide direction by the Board of Directors, to prevent wildlife contacts with power lines. This cannot be accomplished in a short period of time as we many older services. However as time allows we shall continue to improve our system, and update our equipment.

The Board of Directors has determined that wildlife contacts should be eliminated as efficiently as possible. The outages to our consumers should be held to a minimum due to wildlife contacts.

The work practices of the Cooperative should change as needed to meet the problems as they occur on our system.

The Board of Directors realizes several Federal Laws protect different birds, and to provide a proactive program in the prevention of wildlife electrical contacts the Cooperative should strive to meet the following:
Bald eagles are known to occur in the Lyon-Coffey Service Area. Bald Eagles nest and feed near large bodies of water. To provide protection for these protected species, Lyon-Coffey should use "Suggested Practices for Raptor Protection on Power Lines" for all new construction within one hundred yards of a major river and within one mile of a federal reservoir or major body of water.

The cooperative should continue to update, and replace equipment as is economically feasible, with the limited resources and man-hours that are available.

Approved by Board of Directors ___/___/______ ________________________
President

Avian Protection Plan
Policy 3.01 - Bird Management Policy

Effective Date: 05/18/2004

Bird interactions with power lines may cause bird mortalities which, in turn, may result in outages, violations of bird protection laws, or raise concerns by employees, resource agencies and the public.

This policy is intended to ensure compliance with legal requirements while improving distribution system reliability. Westar Energy management and employees are responsible for managing bird interactions with power lines and are committed to reducing the detrimental effects of these interactions.

To fulfill this commitment, Westar Energy will:

- Implement and comply with its comprehensive Avian Protection Plan (APP)
- Ensure its actions comply with applicable laws, regulations, permits, and APP procedures.
- Document protected bird mortalities and problem nests.
- Provide information, resources, and training to improve its employees' knowledge and awareness of the APP.
- Construct all new or rebuilt lines, where appropriate, to raptor or Kansas raptor-safe standards.
- Retrofit or modify lines, poles, and equipment where a protected bird has died, in accordance with APP procedures.
- Participate with public and private organizations in investigations and research to reduce detrimental effects of bird interactions with power lines.

Westar Energy's customer service and regulatory compliance will be enhanced and risk to migratory birds will be reduced through the proactive and innovative resolutions of bird/power line interactions guided by this policy.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training

Effective Date: 05/18/2004

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.01 - Background

Effective Date: 05/18/2004

Westar Energy's service territory includes many resident raptors and smaller birds as well as migratory waterfowl, shorebirds, and raptors, including bald eagles, which overwinter and occasionally nest here. Golden eagles reside year-round in Kansas but are generally rare in our service territory. All of the birds typically encountered in Kansas are protected by the Migratory Bird Treaty Act except for three non-native invaders. These are the house sparrow, starling and pigeon (or rock dove).

Since original construction, Westar's distribution system design standards have been routinely upgraded to improve reliability. Both intentionally and unintentionally, these improvements have reduced bird mortalities. These improvements include use of 10 ft. crossarms, transformer wildlife guards, and insulated jumper wire. Beginning in 2003, Westar Energy has made design changes with avian protection as a goal. Training has been initiated to equip distribution system personnel with the ability to anticipate and avoid problem configurations, remediate proven problem spots and properly handle, report, and remediate when protected birds are killed or protected nests need to be moved.

Westar is a member of the Avian Power Line Interaction Committee (APLIC). As a result, Westar works cooperatively with other utilities and the U.S. Fish and Wildlife Service to identify, understand, and resolve problem interactions between protected birds, their nests, and electric power structures.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.02
- Training Scope

Effective Date: 05/18/2004

Westar distribution system workers and management are trained on the facets of our Bird/Power Line Program and given refresher training as significant program changes are made. These facets include:

- Regulatory Background and Protected Bird Species – employees are given information on the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act and a discussion of those birds which they are likely to encounter which are protected and not afforded protection under those acts.

- Bird Biology and Behavior – employees are informed of bird biology and behavior as it may cause interactions with power structures. This includes bird sizes, perching, nesting, hunting and feeding habits, as well as habitat preferences and flight path tendencies. These all may affect the chances for collision or electrocution.

- Bird/Nest Reporting – employees are required to report any protected bird species found dead in or around our facilities or active protected nests removed. They are instructed to report these on the Bird Impact Reporting Database (BIRD) via their dispatcher or system operator. Evaluation of bird carcasses and nests to determine species and, where applicable, cause of death, is also covered. This data base is also where the cause of the incident, if it is evident, is recorded along with remedial actions

- Distribution Line Construction Standards – workers are given an overview of Westar construction standards, separation and insulation concepts and specific applications are viewed and discussed. Separation standards for differing sizes of raptors are reviewed and hardware to mark and insulate lines and equipment is demonstrated. Expectations for corrective actions on lines and equipment where mortalities have occurred are discussed. Specific examples and corrective actions are reviewed, as well as circumstances where, due to weather, unavoidable biological interactions, or very rare contributory factors, no meaningful remedial steps can be reasonably taken. Bird behavior management through items such as perch preventers and substitute perches and nest platforms is also discussed.

- Evaluation of High Use Areas – areas of high year-round and seasonal bird concentrations are discussed. Generically, these may include wetlands for waterfowl, areas of flowing water (rivers or dam tailwaters) for overwintering Bald Eagles, or concentrations of carrion for turkey vultures or eagles. Location – specific solutions such as substitute perches, marking static wires to improve visibility, or perch preventers to direct birds away from conductors are reviewed. Westar will continue to seek to identify sites of potential interaction between high bird concentrations and power structures in an effort to eliminate bird impacts.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.03 - Permit Compliance

Effective Date: 05/18/2004

Per 50 CFR parts 13 and 21, the US Fish and Wildlife Service may issue permits governing the interaction with protected migratory bird species. A Special Purpose Permit is required if a nest containing eggs or young of a protected bird species must be moved. If an imminent danger is posed to birds or eggs, workers, or electrical service, the nest and contents may be removed and US Fish and Wildlife Service contacted afterward.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.04 - Construction Design Standards

Effective Date: 05/18/2004

Avian interactions are considered in the design and installation of new structures as well as operation and maintenance of existing facilities, per the Westar Line Construction Standards (Electric). While 60 inch separation between energized conductors and/or grounded hardware is an appropriate standard in those isolated areas where eagles are common, the 46 inch separation which applies for raptors up to the size of red-tailed hawks and great horned owls is the more ubiquitous standard across our service territory.

This 46 inch horizontal and 36 inch vertical separation amounts to a "Kansas Raptor Safe" standard, while the 60 inch horizontal and 48 inch vertical separation meets a "Raptor Safe" standard. The standards manual also includes retrofit devices which may be used on a case by case basis to avoid bird-powerline interactions or remediate where a collision or electrocution has occurred.

Where possible, new lines should avoid areas of high bird concentrations and use natural vegetation and features to reduce bird-powerline interactions.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.05 - Nest Management

Effective Date: 05/18/2004

The Migratory Bird Treaty Act affords protection for . . . any migratory bird, any part, nest, or eggs of such bird. Because of this, the active (occupied by eggs or young) nests of protected bird species are also protected. Except for eagles, unoccupied nests which need to be removed can be with no requirement to report. Because eagles have special status under the Bald and Golden Eagle Protection Act and because they may reuse their nests for several years, moving even inactive nests should be done only after consultation with management and permitting via USF&WS unless there is a clearly imminent danger posed to birds or eggs, workers or electrical service. Moving active nests of all types require management discussion and USF&WS permitting, again unless an imminent threat to the eggs, birds, workers, or electrical service exists. When workers are confident that such a threat exists and move the nest immediately, the USF&WS still must be consulted and a permit created for the incident afterwords. Westar personnel should be mindful of the options of substitute nests and nest platforms when the species involved and lack of urgency make these options desirable.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.06 - Avian Reporting System

Effective Date: 05/18/2004

Although Westar Energy is not required to report avian mortalities as a condition of federal or state permits, we choose to voluntarily report through our internal Bird Impact Reporting Database (BIRD). The form (Attachment 1) is used by field personnel for reporting, evaluating, and documenting their recommended remedial action, if any. The system administrator in Environmental Services then reviews the incident and remediation for completeness and can close it out. A year-end report is created, based on this database, and submitted to the USF&WS Special Agent, Topeka, Kansas by January 31 of the following year. The one exception to this end-of-year reporting is for eagles. Because of their special status, Bald and golden eagle mortalities are to be reported to USF&WS, via Environmental Services, without delay.

Avian Protection Plan
Policy 3.02 - Bird/Power Line Program Training
3.02.07 - Evaluation of High Use Areas

Effective Date: 05/18/2004

The distribution of protected bird species in Kansas varies dramatically seasonally and based on water features. Passerine and waterfowl species migrate through in the spring and fall. Shorebirds peak in mid-summer whereas Bald Eagles reach their highest Kansas numbers in mid to late winter as they migrate here from the north and concentrate near the outfalls of dams or power plant warm discharges where open water attracts waterfowl and gizzard shad may be caught. Although Bald Eagle nesting numbers have been increasing, the record high of 18 nests reported for 2003 still means a very low incidence once we emerge from our coldest winter period. Golden eagles are not dependent on open water and can be found in middle Kansas in very low numbers with higher numbers in western Kansas in winter. Golden eagles typically nest on rocky bluffs, making power structures unattractive and never used. Bald eagles, in contrast, may use these structures, particularly around reservoirs, wetlands, or streams, as a substitute for the large trees that they typically prefer. Both eagles desire high perches to hunt from and often choose power structures. As mentioned earlier, waterfowl move through Kansas in high numbers in spring and fall. In reservoir or wetland areas, given appropriate water and vegetation conditions, bird concentrations can number in the tens of thousands for short time periods. This same concentration spike can occur when few areas of open water remain on rivers or large reservoirs in midwinter and ducks and geese, pushed down by colder northern temperatures, congregate there. When high bird concentrations are combined with fog, rain, or snow, power lines in the vicinity of these waters are an increased risk for collisions.

While some species of hawks migrate through Kansas in spring and fall, the most noteworthy potential avian effect is the winter build up of red-tail hawks. Due to typically moderate weather and abundant grassland rodent populations, red-tail populations multiply as do the chances for interactions with power lines. It is impossible to target only certain areas of Westar's service territory for specialized hawk electrocution prevention because distributions of both their resident and winter migrant populations are nearly uniform across our broad warm and cool season grasslands.

Evaluations of our service territory for high bird use areas will continue over time based on scientific literature, input from ornithologists, breeding bird surveys, winter bird counts, and observations by Westar field personnel. Based on these, steps to insulate and separate equipment and lines, mark and locate lines, and provide substitute perches and nest sites which reduce or eliminate the risk of collision and electrocution will be evaluated and where warranted, implemented.

Avian Protection Plan
Policy 3.03 - Attachment 1
Bird impact Reporting Database Form

Effective Date: 05/18/2004

Attachment 1.rtf

Status: Pending

Finder and Location Information

Date: 01/02/2004

Time: 11:45

Finder's Name:

Finder's Supervisor:

Finder's Phone:

County:

Location:

Reference Pts:

Line Type: (See below choices)*

Pole Type: (See blow choices)**

Phase Type: (See below choices)***

Configuration Type: (See below choices)****

Equipment Attached: (See below choices)*****

Type of incident: (See below choices)******

(Comments can be edited until the document is saved;
then your name, date timestamp, and comment will be added to the Comments log.)

Current Comment:

Comments:

* Tangent, Running Angle, Corner, Dead End

** Single wooden pole, Wooden H-Frame, Wooden 3 – Pole, Steel, Other (use comments)

*** Single phase, Two phases, Three phases

**** Verticle, Horizontal

***** No Equipment, 1-Pot, 2-Pot, 3 Pot, More than 3

****** Dead Bird, Large Injured Bird, Small Injured Bird, Active Nest, Inactive Bald Eagle Nest

Created by Dolores D Crabtree on 01/02/2004 at 11:45 AM

68. Any available maps and aerial photographs of the WCGS plant site and the area within and adjoining the larger site boundary (which encompasses CCL) showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains.

See #1

• Clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Please claarify whether or not the referenced agricultural production areas are within the "Site Boundary" as shown on Figure 2-3. Identify any areas fenced to restrict human access and any areas fenced that may restrict wildlife access.

• Additional data on the avian collision studies that were ceased in 1986. Section 2.4 of the ER (WCGS, 1980) states that sufficient data had been collected by 1986. Provide any documentation of regulatory involvement and concurrence in this determination of sufficiency.

• Details on the power transmission system, including information on the design of the towers, the number and configuration of the lines on the towers within each right-of-way (ROW).

• Details regarding the maintenance procedures used in the transmission line ROWs, including mechanical, chemical, and biological control methods for vegetation management.

• More detailed maps/aerial photos of the transmission line ROWs showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains, and the location of the Sharpe Generating Station.

• Please provide information on the locations of transmission line ROWs crossings with parks, wildlife refuges, or wildlife management areas, or any major lakes (in addition to CCL), ponds, or streams? If so, please provide information on these crossings and their locations.

• Any available studies or other information about the issues raised in the letter from the U.S. Fish and Wildlife Service (November 14, 2005) regarding terrestrial threatened and endangered species.
For example:

-- Any assessments of the transmission lines for conformity with "Suggested Practices for Raptor Protection on Power Lines" (Raptor Research Foundation 1996)? Please provide any such assessments and details of transmission line construction relevant to raptor protection. Also provide a copy of "Suggested Practices," if available.

-- Any special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status.

• Any available maps and aerial photographs of the WCGS plant site and the area within and adjoining the larger site boundary (which encompasses CCL) showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains. * ?

• Any available information identifying natural communities and dominant species of plants and animals that utilize terrestrial habitats of the site and the transmission line ROWs, as well as semiaquatic species such as waterfowl that use Lime Sludge Pond and CCL.

69. Any available information identifying natural communities and dominant species of plants and animals that utilize terrestrial habitats of the site and the transmission line ROWs, as well as semiaquatic species such as waterfowl that use Lime Sludge Pond and CCL.

• Clarify discussions regarding site boundaries, land ownership, and land use within Section 2.4 and Figure 2-3 of the ER (WCGS, 1980). Clarify the difference between "Site Boundary" and the "Plant Site" on the map, with respect to whether these are a land ownership distinction, a physical fencing distinction, or some other regulatory or access distinction. Please claarify whether or not the referenced agricultural production areas are within the "Site Boundary" as shown on Figure 2-3. Identify any areas fenced to restrict human access and any areas fenced that may restrict wildlife access.

• Additional data on the avian collision studies that were ceased in 1986. Section 2.4 of the ER (WCGS, 1980) states that sufficient data had been collected by 1986. Provide any documentation of regulatory involvement and concurrence in this determination of sufficiency.

• Details on the power transmission system, including information on the design of the towers, the number and configuration of the lines on the towers within each right-of-way (ROW).

• Details regarding the maintenance procedures used in the transmission line ROWs, including mechanical, chemical, and biological control methods for vegetation management.

• More detailed maps/aerial photos of the transmission line ROWs showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains, and the location of the Sharpe Generating Station.

• Please provide information on the locations of transmission line ROWs crossings with parks, wildlife refuges, or wildlife management areas, or any major lakes (in addition to CCL), ponds, or streams? If so, please provide information on these crossings and their locations.

• Any available studies or other information about the issues raised in the letter from the U.S. Fish and Wildlife Service (November 14, 2005) regarding terrestrial threatened and endangered species.
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> -- Any special ROW maintenance procedures used to reduce the potential for impacts to Mead's milkweed or animals with federal or state listing status.

• Any available maps and aerial photographs of the WCGS plant site and the area within and adjoining the larger site boundary (which encompasses CCL) showing topographic features, major habitats/vegetation communities, land uses, wetlands, and floodplains.

#69

• Any available information identifying natural communities and dominant species of plants and animals that utilize terrestrial habitats of the site and the transmission line ROWs, as well as semiaquatic species such as waterfowl that use Lime Sludge Pond and CCL.

69

Circulating Water Discharge

The circulating water is pumped from the Circulating Water Screenhouse (CWSH) intake structure bays through a 12 foot-diameter inlet pipe to the steam condenser. The warmed water then flows from the condenser through a 12 foot-diameter outlet pipe to the circulating water discharge structure (CWDS). This structure has a discharge well which overflows into a 40-foot wide apron and then onto the surface of the Lake.

References:
1. Wolf Creek Updated Safety Analysis Report, Section 2.4.8.2.2, "Spillways", Revision 19.
2. FD-WL-02-WC, Rev 6, Cooling Lake Makeup Water and Blowdown System Makeup Water System, System Description.
3. Wolf Creek Generating Station Environmental Report, Operating License Renewal Stage, 2006, Section 3.1.2.

2) Provide information on potential riparian/ wetland communities in the project area, including along the transmission line.

WCNOC Response

This is a review of the potential riparian and wetland communities in the vicinity of Wolf Creek Generating Station (WCGS). Such communities applicable to WCGS include:

1. The riparian areas of Wolf Creek associated with Coffey County Lake (CCL) and the shoreline and shallow water areas of CCL,
2. Shoreline and shallow water areas of John Redmond Reservoir (JRR),
3. Riparian areas of the Neosho River and,
4. Riparian and wetland areas traversed by applicable transmission lines.

This review summarizes these natural communities based on past surveys, current literature, and staff biologist observations. It is not an exhaustive survey or data presentation, rather a general overview. Because there are no plans for refurbishment or additional construction, riparian or wetland resources will not be impacted to support WCGS license renewal.

Enclosure 2 to this letter contains the tables referenced in the following discussion.

Wolf Creek and Coffey County Lake

The riparian areas of Wolf Creek upstream and downstream of CCL are typical of the Oak-Hickory forests found in east-central Kansas. They are medium-tall, multilayered, broadleaf deciduous forests on the first and second terraces adjacent to streams (NRC 1975). Quantitative analyses of the lowland woods within the Oak-Hickory forests were conducted during the initial licensing process for WCGS (Kansas Gas and Electric, KGE, 1982). Table 1 of Enclosure 2 presents a list of the plant species and their relative abundance that were monitored for the lowland woods, which comprise the riparian areas of Wolf Creek.

Hackberry (*Celtis occidentatlis*) was dominant or codomiant within woodlands of Wolf Creek. Common associates were black walnut (*Juglans nigra*), American elm (*Ulmus americana*), white bitternut hickory (*Carya cordiformis*), silver maple (*Acer saccharinum*), bur oak (*Quercus macrocarpa*), green ash (*Fraxinus pennsylvanica*), and Kentucky coffee tree (*Gymnocladus dioica*). Inspection of tree species distribution of the lowland woods showed that silver maple, American elm, green ash, and sycamore (*Platanus occidentalis*) were more common within the frequently inundated sites, whereas hackberry, red bud (*Cercis canadensis*), Kentucky coffee tree, hickories (*Carya* spp.) and oaks (*Quercus* spp.) occurred on higher, well-drained sites (KGE 1982).

Shrub component species include coralberry (*Symphoricarpos orbiculatus*), poison ivy (*Rhus radicans*), wild gooseberry (*Ribes missouriense*), hackberry, and elms. Ground layer components included spreading chervil (*Chaerophyllum procumbens*), wood nettle (*Laportea canadensis*), Virginia wild rye (*Elymus virginicus*), clearweed (*Pilea pumila*), and fescue (*Festuca obtuse*), all typical floodplain species (NRC 1982).

The shoreline and shallow water habitat vegetation of CCL are typical of wet soil or periodically flooded habitats. Observations of the shoreline vegetation include species tolerant of various degrees of inundation or wet soil conditions. Initially, cottonwood (*Populus deltoides*), black willow (*Salix nigra*), and buttonbush (*Cephalanthus* occidentalis) are common along the shorelines. In areas more frequently flooded, shallow water plants such as cattails (*Typha* spp.), smartweeds (*Polygonum* spp.), and water primrose (*Ludwigia peploides*) are common. Emergent and submersed plants in shallow, but slightly deeper water include American lotus (*Nelumbo lutea*), pondweeds (P*otemogeton* spp., primarily *nodosus and foliosus*), and Naiad (*Najas minor*).

As CCL water level fluctuates, mudflat areas develop. Colonization of these areas by plants are expected to be similar to that studied at JRR (NRC 1975). Table 1 of Enclosure 2 identifies common species and relative abundance within the mudflat areas of JRR. These species are typical for this region, and can be expected along the CCL mudflats. Initially, two plant communities will occupy the mudflats. In poorly drained areas, plants typical of wet marshy areas of JRR will dominate. These include sedges (*Carex* spp.), cattails, black willow, and arrowhead (*Saggitaria latifolia*). In areas where re-inundation is infrequent (4 to 5 years), some advance seral communities will replace the pioneer communities. These include flood tolerant woody vegetation, such as black willow, buttonbush, and cottonwood.

Since WCGS operation began in 1985, riparian protection and enhancement activities have been completed. These include construction of approximately 25 acres of shallow water ephemeral wetlands, protection of old-growth oak-hickory woodland, planting of bottomland woods, establishment of native grasses for buffers along CCL shorelines, areas preserved for natural succession, and livestock exclusion.

John Redmond Reservoir

The wetland and shallow coves of JRR are dominated by swamp smartweed, in addition to other smartweed species (*Polygonum* spp.), bulrush (*Scirpus* spp.), cattail, spike-rush (*Eleocharis* spp.), and sedge (*Carex* spp.). Some stands of silver maple, black willow, and eastern cottonwood are also present. On the reservoir drawdown areas (mudflats) weedy annuals such as cocklebur (*Xanthium strumarium*), foxtail grass (*Setaria* spp.) and barnyard grass (*Echinocloa* spp.) are common species (U. S. Army Corp of Engineers, USACE, 2002).

A species list and relative abundance compiled during mudflat vegetation surveys of JRR (KGE 1982) is presented in Table 1 of Enclosure 2.

Neosho River

The riparian areas of the Neosho River upstream and downstream of JRR are characterized in USACE (2002). Basically, riparian woodlands are a bottomland hardwood type dominated by American elm, green ash, eastern cottonwood, black willow, black walnut, sycamore (*Plantanus occidentalis*), silver maple, burr oak, box-elder (*Acer negundo*), and hackberry. Downstream from JRR, most of the flood plain vegetation along the Neosho River and its major tributaries can be described as the riparian woodland type. Islands, point bars, and first terraces are dominated by more wet soil tolerant species such as eastern cottonwood, silver maple, and box-elder. Slightly higher elevation second terraces support eastern cottonwood, green ash, American elm, black walnut, hackberry, and burr oak.

Flood plain shrubland (under-story) growing along riparian areas include coralberry, greenbriar, rough-leaf dogwood (*Cornus drummondii*), American plum (*Prunus americana*), and wild grape (*Vitae* spp.). Downriver from JRR, these shrublands occupy recently scoured islands, point bars, and riverbanks. Sandbar willow (*Salix interior*), rough-leaf dogwood, and buttonbush invade rapidly and eventually are replced by black willow, silver maple, and eastern cottonwood.

Transmission Line Corridors

The transmission lines included in this review of riparian areas traversed include the Wolf Creek – Rose Hill 345 kilovolt (kV) line, the portion of the LaCygne – Benton 345 kV transmission line rerouted for WCGS, the WCGS to Sharpe Kansas Electric Power Cooperative (KEPCO) 69 kV line, and the Wolf Creek tap of the Burlington - Athens 69 kV line.

Wolf Creek – Rose Hill Transmission Line:

The Wolf Creek – Rose Hill line extends approximately 98 miles from WCGS in a southwesterly direction toward the Rose Hill substation east of Wichita, Kansas. Easements are 150 feet in width, which totals 1691 acres of right-of-way. General land use classifications traversed by this line include cropland, grazing, woodland, idle land, waterways and roads. This right-of-way traverses a total of 4,950 feet (18.2 acres) of riparian woods, and 480 feet (1.8 acres) of waterways (Table 2 of Enclosure 2). The riparian and waterways traversed by the line represents approximately 1 percent of the total right-of-way.

Major rivers and associated watersheds traversed by the Wolf Creek – Rose Hill transmission line include the Neosho River primarily in Coffey County, the Verdigris and Fall Rivers primarily in Greenwood County, and the Walnut River primarily in Butler County. Riparian areas within these watersheds are substantially similar to that described for the Neosho River above.

LaCygne – Benton Transmission Line (rerouted portion):

The portion of the LaCygne – Benton 345 kV transmission line rerouted around CCL is approximately 7.7 miles. Most of this line was constructed on WCGS lands. Assuming a 150 feet wide corridor, this rerouted line encompasses nearly 140 acres. Based on aerial photographs, land use types, including wetland and riparian habitats are presented in Table 3 of Enclosure 2. There are 12.1 acres of riparian, surface water, shoreline, and wetland acres included in the corridor, or 8.7 percent of the total.

WCGS Tap of Burlington – Athens 69 kV Transmission Line:

The WCGS tap of the Burlington – Athens 69 kV transmission line traverses approximately 4.1 miles, most of which are on WCGS lands. There are no streams or associated riparian areas traversed by this line, however, this line does cross over portions of CCL. Applying a corridor width of 150 feet, surface water, shoreline, and wetland acres included in the corridor total 4.7, or 6.4 percent of the total (Table 4 of Enclosure 2).

WCGS to Sharpe KEPCo 69 kV Transmission Line:

The WCGS to Sharpe KEPCo 69 kV transmission line is approximately 3 miles, and does not cross any wetland, shoreline, or riparian areas. Right-of-way for this line is primarily parallel to local roads.

3) **Provide the most recent data obtained from any microbiological monitoring program.**

<u>WCNOC Response</u>

Enclosure 3 includes the WCGS Construction Environmental Monitoring Program Report, February 1981 –January 1982 and the WCGS Operational Phase Environmental Monitoring Program Report, Final.

4) **ER Section 6.2 notes that routine mitigation and monitoring programs are conducted, including effluent chemistry monitoring and water quality and fishery monitoring of Coffey County Lake. Provide at a minimum the most recent set of these data.**

<u>WCNOC Response</u>

Enclosure 4 includes the most recent chemistry effluent monitoring data. Included is a figure and a map of the NPDES Outfall sampling points. WCGS sample analysis results from November 1, 2006 to November 30, 2006 are included in a table format. Also provided in the Enclosure are analytical results from an accredited environmental laboratory, circulating water bromination schedule, and log entries for discharges through outfall 003A and 003B.

Enclosure 5 includes fishery monitoring reports for years 2002, 2003, 2004 and 2005.

Riparian/Wetland Community Tables

Table 1, Plant species within the riparian (lowland woods) of Wolf Creek upstream and downstream of Coffey County Lake (from KGE 1982, Table 2.2-1). Wet and dry mudflat species from vegetation monitoring sites at John Redmond Reservoir.

Table 2, Land uses within the Wolf Creek – Rose Hill transmission line right-of-way (from KGE 1975, Table 3.9-1).

Table 3, Land uses within the rerouted right-of-way section of the LaCygne – Benton 345 kV transmission line in the vicinity of Wolf Creek Generating Station.

Table 4, Land uses within the right-of-way of the WCGS tap of the Burlington – Athens 69kV transmission line.

Cited Literature

TABLE 2.2-1

PHYLOGENTIC LISTING OF PLANT SPECIES SAMPLED NEAR WCGS, 1973-78

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
		Index of Relative Community Abundance[a]					
Coniferae							
Cupressaceae	Cypress Family						
Juniperus virginiana L.	Eastern redcedar				I		
Graminales							
Gramineae	Grass Family						
Bromus tectorum L.	Downy chess		I	A-D	I		
Bromus inermis Leyss.	Smooth brome		I	A-D			
Bromus japonicus Thunb.	Japanese brome		C	A-D	A-D		
Festuca elatior L.	Meadow fescue	I					
Festuca obtusa Biehler	Fescue	C					
Festuca paradoxa Desv.	Fescue					I	A-D
Poa compressa L.	Canada bluegrass		I	D	I		
Poa pratensis L.	Kentucky bluegrass		C	I-C	I		
Eragrostis pilosa (L.) Beauv.	Love grass					I	
Eragrostis spectabilis (Pursh) Steud.	Purple lovegrass		I	I			
Triodia flava (L.) Smyth.	Purple top			I	I		
Elymus canadensis L.	Canada wild rye		I				
Elymus virginicus L.	Virginia wild rye	D	C				
Hordeum pusillum Nutt.	Little barley		I	C	I-C		
Koeleria cristata (L.) Pers.	Prairie junegrass		I				
Agrostis hyemalis (Walt.) BSP	Red top		I				
Cinna arundinacea L.	Wood reed	I					
Muhlenbergia sp. L.	Muhly	I		I			
Muhlenbergia schreberi Gmel.	Nimble will			I	C		
Sporobolus asper (Michx.) Kunth.	Tall dropseed		I	I	I		
Sporobolus neglectus Nash.	Dropseed				I		
Sporobolus heterolepis Gray	Prairie dropseed		I				
Aristida oligantha Michx.	Three-awn		I				
Leptochloa filiformis (Lam.) Beauv.	Leptochloa					I	C
Leptochloa fascicularis (Lam.) Gray	Leptochloa					C	
Bouteloua curtipendula (Michx.) Torr.	Side-oats grama				I		
Phalaris caroliniana Walt.	Maygrass		I				
Phalaris arundinacea L.	Reed canary grass			I			
Leersia virginica Willd.	White grass	I			I		
Digitaria sanguinalis (L.) Scopu	Crab grass			I	I		
Paspalum ciliatifolium Michx.	Paspalum			C	I-C		
Panicum sp. L.	Panic grass		C	C	C		
Panicum capillare L.	Witch grass				I		
Panicum dichotomiflorum Michx.	Fall panic grass					D	A-D
Panicum praecocius Hitch & Chase	Panic grass		I				

Table 1. Plant species within the riparian (lowland woods) of Wolf Creek upstream and downstream of Coffey County Lake (from KGE 1982, Table 2.2-1). Wet and dry mudflat species from vegetation monitoring sites at John Redmond Reservoir.

Table 1. (Continued)

TABLE 2.2-1 (Sheet 2)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Liliaceae (continued)							
Smilacina racemosa (L.) Desf.	False Solomon's seal	I	I-C				
Polygonatum biflorum (Walt.) Ell.	Solomon's seal	I					
Smilax hispida Muhl.	Greenbrier	A					
Smilax rotundifolia L.	Greenbrier	I					
Salicales							
Salicaceae	Willow Family						
Populus deltoides Marsh.	Cottonwood	I					A-D
Salix nigra L.	Black willow	I					I
Juglandales							
Juglandaceae	Walnut Family						
Juglans nigra L.	Black walnut	A					
Carya cordiformis (Wang.) K. Koch.	Bitternut hickory	A					
Carya laciniosa (Michx. f.) Loud	Shellbark hickory	C					
Fagales							
Fagaceae	Beech Family						
Quercus macrocarpa Michx.	Bur oak	D					
Quercus borealis Michx. f.	Red oak	I					
Quercus palustris Muenchh.	Pin oak						
Quercus shumardii Buckl.	Shumard's oak	A					
Urticales							
Ulmaceae	Elm Family						
Ulmus sp. L	Elm				A		
Ulmus americana L.	American elm	A					
Ulmus rubra Muhl.	Slippery elm	C					
Celtis occidentalis L.	Hackberry	D					
Moraceae	Mulberry Family						
Maclura pomifera (Raf.) Schneid.	Osage-orange	I					
Morus rubra L.	Red mulberry	C					I
Urticaceae	Nettle Family						
Urtica dioica L.	Stinging nettle	C					
Laportea canadensis (L.) Wedd.	Wood-nettle	D					
Pilea pumila (L.) Gray	Clearweed	C	I				
Parietaria pensylvanica Muhl.	Pellitory	C	I				
Boehmaria cylindrica (L.) Sw.	False nettle	I					

Table 1. (Continued)

TABLE 2.2-1 (Sheet 3)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Polygonales							
Polygonaceae	Smartweed Family						
Rumex acetosella L.	Red sorrel			I			
Rumex crispus L.	Curly dock			I			
Polygonum sp. L.	Polygonum	I					
Polygonum lapathifolium L.	Smartweed					A	I
Polygonum pensylvanicum L.	Pennsylvania smartweed					D	
Polygonum punctatum Ell.	Dotted smartweed	I					
Polygonum persicaria L.	Lady's thumb					C	C
Polygonum virginianum L.	Smartweed	C					
Polygonum scandens	False buckwheat	I					
Caryophyllales							
Chenopodiaceae	Goosefoot Family						
Chenopodium sp. L.	Goosefoot	I					
Chenopodium album L.	Lamb's quarters	I					I
Chenopodium hybridum L.	Mapleleaf goosefoot	I					
Chenopodium leptophyllum Aellen	Goosefoot						I
Amaranthaceae	Amaranth Family						
Amaranthus sp. L.	Amaranth					C	
Amaranthus tamariscinus (Nutt.) Wood	Water hemp						I-C
Amaranthus retroflexus L.	Redroot						I
Aizoaceae	Carpetweed Family						
Mollugo verticillata	Carpetweed						I
Portulacaceae	Purslane Family						
Portulaca oleracea L.	Purslane					I	
Claytonia virginica L.	Spring beauty	I	I				
Caryophyllaceae	Pink Family						
Stellaria sp. L.	Chickweed			I			
Cerastium vulgatum L.	Mouse-ear chickweed		I	A	C		
Silene antirrhiana L.	Sleepy catchfly			I			
Silene stellata (L.) Ait. f.	Starry campion	I					
Ranales							
Ranunculaceae	Crowfoot Family						
Ranunculus sp. L.	Buttercup	I			I		
Ranunculus abortivus L.	Small-flowered crowfoot	C					

TABLE 2.2-1 (Sheet 4)

Table 1. (Continued)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Ranunculaceae (continued)							
Delphinium virescens Nutt.	Prairie larkspur	I					
Thalictrum sp. L.	Meadow rue	I					
Thalictrum polygamum Muhl.	Meadow rue	I					
Clematis sp. L.	Clematis	I					
Menispermaceae	Moonseed Family						
Menispermum canadense L.	Canada moonseed	C					
Papaverales							
Cruciferae	Mustard Family						
Lepidium sp. L.	Peppergrass						
Lepidium virginicum	Peppergrass			I	I		
Draba reptans (Lam.) Fern.	Draba			I			
Arabis shortii (Fern.) Gl.	Rock cress	I					
Arabis canadensis L.	Sickle-pod	I					
Rorippa islandica (Oeder) Borbas	Marsh cress				I-C		
Rosales							
Saxifragaceae	Saxifrage Family						
Ribes missouriense Nutt.	Missouri gooseberry	A					
Platanaceae	Plane-Tree Family						
Platanus occidentalis L.	Sycamore	C					
Rosaceae	Rose Family						
Fragaria virginiana Duchesne	Virginia strawberry		I	I	A-D		
Geum sp. L.	Avens				I		
Geum vernum (Raf.) T. & G.	Spring avens	C					
Geum canadense Jacq.	White avens	C		I			
Rubus allegheniensis Porter	Common blackberry			I			
Agrimonia sp. L.	Agrimony		I				
Rosa carolina L.	Carolina rose		I		C		
Prunus sp. L.	Cherry		I				
Prunus serotina Ehrh.	Black cherry	I	I				
Crataegus sp. L.	Hawthorn	I					
Mimosaceae	Mimosa Family						
Desmanthus illinoensis Willd.	Illinois bundleflower		I				
Caesalpiniaceae							
Cercis canadensis L.	Redbud	A					
Gleditsia triacanthos L.	Honey-locust	C		I	I		
Gymnocladus dioica (L.) K. Koch	Kentucky coffee-tree	C					

TABLE 2.2-1 (Sheet 5)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Fabaceae	Bean Family						
Baptisia leucophaea Nutt.	Wild indigo		I	I	I		
Trifolium sp. L.	Clover			I	I		
Trifolium repens L.	White clover				C		
Melilotus officinalis (L.) Desr.	Yellow sweetclover		I				
Psoralea esculenta Pursh.	Prairie turnip		I				
Psoralea tenuiflora Pursh.	Scurfpea		I				
Petalostemum sp. Michx.	Prairie-clover		I				
Petalostemum candidum (Willd.) Michx.	White prairie-clover		I				
Lespedeza stipulacea Mixim.	Korean lespedeza			C	D		I
Strophostyles leiosperma (T. & G.) Piper	Wild bean				I		
Strophostyles helveola (L.) Ell.	Wild bean			I			
Desmodium sp. Desv.	Tick-trefoil				I		
Geraniales							
Oxalidaceae	Wood-sorrel Family						
Oxalis sp. L.	Wood-sorrel			I	I		
Oxalis stricta L.	Yellow wood-sorrel			A			
Oxalis violacea L.	Violet wood-sorrel		C-A				
Geraniaceae	Geranium Family						
Geranium carolinianum L.	Crane's-bill		I				
Euphorbiaceae	Spurge Family						
Croton capitatus Michx.	Croton		I		I		
Acalypha gracilens Gray	Three-seeded mercury		C	C	I-C		
Euphorbia serpens HBK	Spurge					I	
Euphorbia preslii Guss	Nodding spurge					I	
Euphorbia glyptosperma Engelm.	Spurge						I
Euphorbia maculata L.	Wartweed					I	
Euphorbia humistrata Engelm.	Spurge					C	
Euphorbia corollata L.	Flowering spurge		C				
Euphorbia heterophylla L.	Fire-on-the-mountain	I					
Euphorbia marginata Pursh.	Snow-on-the-mountain						I
Sapindales							
Anacardiaceae	Cashew Family						
Rhus radicans L.	Poison ivy	A		I	I		
Rhus glabra L.	Smooth sumac				C-A		
Celastraceae	Staff-tree Family						
Euonymus atropurpureus Jacq.	Wahoo	C					

Table 1. (Continued)

TABLE 2.2-1 (Sheet 6)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Aceraceae	Maple Family						
Acer saccharinum L.	Silver maple	D					
Acer negundo L.	Boxelder	I					
Hippocastanaceae	Horse-chestnut Family						
Aesculus glabra Willd.	Ohio buckeye	I					
Balsaminaceae	Touch-me-Not Family						
Impatiens biflora Walt.	Jewelweed	I					
Rhamnales							
Vitaceae	Grape Family						
Vitis sp. L.	Grape	C	I				
Vitis aestivalis Michx.	Summer grape	I					
Parthenocissus quinquefolia (L.) Planch.	Virginia creeper	A					
Malvales							
Malvaceae	Mallow Family						
Sida spinosa L.	Sida					I	
Hibiscus trionum L.	Flower of an hour					C	I-C
Abutilon theophrasti Medic.	Velvetleaf					I	
Parietales							
Hypericaceae	St. John's wort Family						
Hypericum punctatum Lam.				I			
Violaceae	Violet Family						
Viola sp. L.	Violet	I					
Viola papilionacea Pursh.	Common blue violet	A					
Viola pedatifida G. Don.	Prairie violet		I	I			
Viola eriocarpa Schw.	Smooth yellow violet	A					
Cactales							
Cactaceae	Cactus Family						
Opuntia compressa (Salisb.) Macbr.	Prickly pear				I		
Myrtales							
Onagraceae	Evening Primrose Family						
Oenothera biennis L.	Common evening primrose		I				
Guara biennis L.	Biennial gaura						
Circaea quadrisulcata (Maxim.) Franch & Sav.	Enchanter's nightshade	I					

TABLE 2.2-1 (Sheet 7)

Table 1. (Continued)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Umbellales							
Umbelliferae	Parsley Family						
Sanicula gregaria Bickn.	Black snakeroot	D					
Cryptotaenia canadensis (L.) DC.	Honewort	I					
Osmorhiza sp. Raf.	Sweet cicely	I					
Chaerophyllum procumbens (L.) Crantz	Spreading chervil	D	I				
Pastinaca sativa L.	Wild parsnip		I				
Eryngium yuccifolium Michx.	Rattlesnake-master		I				
Cornaceae	Dogwood Family						
Cornus sp. L.	Dogwood	I	I		I		
Ebenales							
Ebenaceae	Ebony Family						
Diospyros virginiana L.	Persimon	I					
Primulales							
Primulaceae	Primrose Family						
Lysimachia quadrifolia L.	Whorled loosestrife	I					
Gentianales							
Oleaceae	Olive Family						
Fraxinus pennsylvanica Marsh.	Green ash	A			I		
Apocynaceae	Dogbane Family						
Apocynum sp. L.	Dogbane				I		
Apocynum cannabinum L.	Indian hemp		I	I	I	I-C	I
Asclepiadaceae	Milkweed Family						
Asclepias syriaca L.	Common milkweed		I				
Asclepias viridis Walt.	Spider milkweed		I				
Asclepias sullivantii Engelm.	Sullivant's milkweed			I			
Ascelpias variegata L.	White milkweed			I	I		
Polemoniales							
Convolvulaceae	Morning-glory Family						
Ipomoea lacunosa L.	Morning-glory					I	
Convolvulus sp. L.	Bindweed	I					
Convolvulus sepium L.	Hedge bindweed	I	I			I	I-C
Polemoniaceae	Phlox Family						
Phlox divaricata L.	Phlox	C					

Table 1. (Continued)

Table 2.2-1 (Sheet 8)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
		Index of Relative Community Abundance					
Hydrophyllaceae	Waterleaf Family						
Ellisia nyctelea L.	Nyctelea	C					
Boraginaceae	Borage Family						
Myosotis sp. L.	Forget-me-not		I				
Myosotis verna Nutt.	Forget-me-not		I	I			
Verbenaceae	Vervain Family						
Verbena sp. L.	Vervain	I					
Verbena canadensis (L.) Britt.	Large-flowered verbena		I				
Labiatae	Mint Family						
Prunella vulgaris L.	Self-heal			I	I		
Scutellaria parvula Michx.	Skullcap		I				
Lamium album L.	White dead nettle		I				
Salvia reflexa Hornem.	Sage		I				
Salvia pitcheri L.	Pitcher's sage		I				
Pycnanthemum flexuosum (Walt.) Bsp.	Mountain mint		C	C-A			
Lycopus americanus Muhl.	American bugle-weed			I			
Stachys tenuifolia Willd.	Hedge nettle	I					
Solanaceae	Nightshade Family						
Physalis sp. L.	Ground-cherry		I				
Solanum carolinense L.	Horse-nettle		I	I	I	I	C
Phrymaceae	Lopseed Family						
Phryma leptostachya L.	Lopseed	I					
Scrophulariaceae	Figwort Family						
Penstemon tubaeflorus Nutt.	Penstemon		I				
Veronica serpyllifolia L.	Speedwell				I		
Veronica peregrina L.	Speedwell				I		
Veronica officinalis L.	Speedwell			I			
Acanthaceae	Acanthus Family						
Ruellia strepens L.	Ruellia	C					
Plantaginales							
Plantaginaceae	Plantain Family						
Plantago virginica L.	White dwarf plantain		I	C	C		
Plantago rugelii Decne.	Rugel's plantain				I		
Plantago major L.	Common plantain			I			
Plantago lanceolata L.	English plantain			I			
Plantago aristata Michx.	Buckhorn plantain			I			

Table 1. (Continued)

TABLE 2.2-1 (Sheet 9)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
	Community Type:	Index of Relative Community Abundance					
Rubiales							
Rubiaceae	Madder Family						
Galium aparine L.	Cleavers	D	I				
Caprifoliaceae	Honeysuckle Family						
Sambucus canadensis L.	Common elder	I					
Symphoricarpos orbiculatus Moench	Coralberry	D		C	C-D		
Cucurbitales							
Cucurbitacea	Gourd Family						
Sicyos angulata L.	Bur-cucumber	I					
Campanulales							
Campanulaceae	Harebell Family						
Campanula americana L.	Tall bellflower	I-C					
Triodanis perfoliata (L.) Nieuwl.	Venus' looking glass		I				
Triodanis leptocarpa (Nutt.) Nieuwl.	Venus' looking glass		I				
Lobeliaceae	Lobelia Family						
Lobelia spicatata Lam.	Lobelia		I				
Asterales							
Compositae	Composite Family						
Helianthus annuus L.	Sunflower						C-D
Helianthus petiolaris Nutt.	Common sunflower						I
Helianthus laetiflorus Pers.	Sunflower		I-C				
Helianthus maximiliani Schrader	Maximilian sunflower		I				
Verbesina alternifolia (L.) Britt.	Wingstem	A					
Ratibida columnifera (Nutt.) Woot & Standle.	Prairie coneflower		I				
Bidens polylepis Blake	Beggar-ticks		I				
Bidens tripartita L.	Beggar-ticks	I					
Bidens frondosa L.	Beggar-ticks	I					
Silphium perfoliatum L.	Cup plant	I					
Iva ciliata Willd.	Rough sumpweed			I	I	C	C
Ambrosia trifida L.	Giant ragweed	C					
Ambrosia artemisiifolia L.	Common ragweed			A	A		
Ambrosia bidentata Michx.	Ragweed			I	C		
Ambrosia psilostachya DC.	Western ragweed			A-D			
Xanthium strumarium L.	Common cocklebur			I		A	A
Achillea millefolium L.	Yarrow		C	I	I-C		
Chrysanthemum leucanthemum	Ox-eye daisy				I		
Artemisia ludoviciana Nutt.	Louisiana				I		

Table 1. (Continued)

TABLE 2.2-1 (Sheet 10)

Scientific Name	Common Name	Lowland Woods	Abandoned Railroad Right-of-way	Open Pasture	Mixed Shrub and Grass Pasture	Wet Mudflat	Dry Mudflat
		Index of Relative Community Abundance[a]					
Compositae (continued)							
Solidago sp. L.	Goldenrod		I				
Solidago candensis L.	Canada goldenrod			I			
Solidago rugosa Mill.	Rough-leaved goldenrod			I			
Solidago graminifolia (L.) Salisb.	Narrowleaf goldenrod		I-C	C-A	C-A		
Gutierezia dracunculoides (DC.) Blake	Broomweed				C-A		
Aster sp. L.	Wild aster				I-C		
Aster ericoides L.	Heath aster		I-C	I	I		
Erigeron strigosus Muhl.	Rough fleabane		I	I-C	I		
Conyza canadensis (L.) Cronq.	Horseweed		I				
Gnaphalium purpureum L.	Everlasting				I		
Antennaria neglecta Greene	Field pussytoes			I	I		
Eupatorium purpureum L.	Joe-pye weed	I					
Eupatorium rugosum Houtt.	White snakeroot	I			I		
Eupatorium serotinum L.	Thoroughwort			C	C		
Liatris pycnostachya Michx.	Blazing star		I				
Liatris punctata Hook	Blazing star		I	I			
Vernonia fasciculata Michx.	Ironweed				C		
Vernonia baldwini Torr.	Ironweed		I	I	C		
Cirsium arvense (L.) Scop.	Canada thistle		I	I			
Prenanthes sp. L.	White lettuce	I					
Taraxacum officinale Weber	Dandelion				I		
Latuca sp. L.	Prickly lettuce	I					I
Latuca serriola L.	Prickly lettuce	I					
Latuca biennis (Moench) Fern.	Tall lettuce	I					

a D = community dominant; A = abundant; C = common; I = relatively infrequent.

Table 2. Land uses within the Wolf Creek – Rose Hill transmission line right-of-way (from KGE 1975, Table 3.9-1).

WCGS - ER

TABLE 3.9-1

LAND USE OF THE ROSE HILL TO WOLF CREEK TRANSMISSION LINE RIGHT-OF-WAY

Land Use Type	Linear Feet		Acreage		Percent of Total	
Cropland						
Row and Broadcast	84,405		290.7		17.2	
Forage	32,390		111.5		6.6	
Subtotal		116,795		402.2		23.8
Grazing						
Pasture	20,850		71.8		4.2	
Wooded Pasture	4,690		16.2		1.0	
Range	299,260		1030.5		60.9	
Wooded Range	19,930		68.6		4.1	
Subtotal		344,730		1187.1		70.2
Woodlands						
Woods	13,500		46.5		2.8	
Riparian Woods	4,190		14.4		0.9	
Hedgerows	720		2.5		0.1	
Subtotal		18,410		63.4		3.8
Idle Land		7,930		27.3		1.6
Waterways		650		2.2		0.1
Roads		2,525		8.7		0.5
TOTALS		491,040		1690.9		100.0

Table 3. Land uses within the rerouted right-of-way section of the LaCygne – Benton 345 kV transmission line in the vicinity of Wolf Creek Generating Station.

Land Use Types	Linear Feet	Acreage	Percent of Total
Cropland	7,953	27.4	19.7
Grazing	12,646	43.5	31.2
Hay meadow	4,498	15.5	11.1
Woodlands	2,021	6.9	5.0
Riparian	782	2.7	1.9
Shoreline/Wetland/Shallow water	2,216	7.6	5.5
Surface water	521	1.8	1.3
Wildlife lands (1)	6,610	22.8	16.4
Other (2)	3,194	11.0	7.9
Total	**40,441**	**139.3**	**100**

(1) Includes native grasses, grass-brush mix, and brush habitats.

(2) Includes roads, gravel areas, and WCGS yard areas.

Table 4. Land uses within the right-of-way of the WCGS tap of the Burlington – Athens 69kV transmission line.

Land Use Types	Linear Feet	Acreage	Percent of Total
Cropland	7,041	24.2	32.9
Grazing	652	2.2	3.0
Hay meadow	3,715	12.8	17.3
Woodlands	65	0.2	0.3
Riparian	0	0	0
Shoreline/Wetland/Shallow water	978	3.4	4.6
Surface water	391	1.3	1.8
Wildlife lands (1)	5,671	19.5	26.5
Other (2)	2,933	10.1	13.4
Total	**21,446**	**73.8**	**100**

(1) Includes native grasses, grass-brush mix, and brush habitats.

(2) Includes roads, gravel areas, and WCGS yard areas.

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Hooper Diane M

From: Haines Daniel E
Sent: Monday, March 19, 2007 2:47 PM
To: Hooper Diane M
Subject: Critical and Important Terrestrial Habitats

Critical and mportant Terrest...

Critical and Important Terrestrial Habitats

Need: Provide a discussion of other wildlife, including mammals, reptiles, invertebrates, and birds (other than eagle) that may be present in the transmission line corridor.

This is a review of potential terrestrial fauna that may be present within the transmission line corridors related to Wolf Creek Generating Station (WCGS). The transmission lines reviewed include the portion of the LaCygne – Benton 345 kilovolt rerouted around Coffey County Lake (CCL), and the Wolf Creek – Rose Hill 345 kilovolt line. These lines traverse habitat types common to eastern and south-central Kansas, and wildlife species common to these habitats can be expected to occur within the corridors. Except for invertebrates, potential terrestrial species present are characterized by generic habitat where they may be found.

The rerouted LaCygne – Benton line traverses approximately 7.7 miles around the northern reaches of CCL. Habitats traversed include the WCGS site, CCL and shorelines, native tall grass prairie, cropland, grazed rangeland, and hay meadows. The corridor is also adjacent to bottomland woodland and mixed shrub and grass areas.

The Wolf Creek – Rose Hill line traverses similar habitats, with much higher proportions of cropland and grazed native rangeland than the LaCygne – Benton line. This line is within Coffey, Greenwood, and Butler counties. It extends southwestward from WCGS for 98 miles to the Rose Hill Substation.

Terrestrial invertebrate species that may be present in the corridors include primarily arthropods. Theses include insects, spiders, mites, ticks, scorpions, daddy long legs, and others of the class Arachnida. A conservative estimate of the number of named species of this class is 30,000. It is not known exactly how many species of insects occur in the WCGS area, or in Kansas. 15,000 to 20,000 insect species may be exist in Kansas (White and Salsbury 2000). A representative checklist of Kansas insects is available online at www.gpnc.org (accessed December 15, 2006). There are no invertebrate species federally listed as threatened or endangered within any of the counties traversed by the transmission lines. One insect species, the prairie mole cricket (*Gryllotalpa major*), is listed by the Kansas Department of Wildlife and Parks (KDWP) as a species in need of conservation and present within Coffey County (KDWP 2006).

Terrestrial vertebrate wildlife includes amphibians, reptiles, birds and mammals. Table 1 summarizes representative amphibian and reptile species that may occur within the Coffey, Greenwood, and Butler Counties, Kansas, which includes WCGS and the applicable transmission line corridor. This summary is not an exhaustive species list, and some species may well be found in multiple habitat types. References used for this table were from Collins (1993).

Potential bird species within the three counties are numerous due to their mobility, and migratory nature, and the diversity of habitats present. Currently up to 465 bird species have been documented in Kansas (Kansas Ornithological Society, KOS, 2003). Table 2 lists common species that may be expected to occur within in the vicinity of WCGS and applicable transmission line corridor. References used to compile this list include WCGS (1984), Thompson and Ely (1989 and 1992), and KOS (2003).

Potential mammal species within the three counties are included in Table 3. Species account records were obtained in Bee et al, (1981), and Timm et al (2006).

Table 1. Representative amphibian and reptile species that may occur in the vicinity of WCGS or within the applicable transmission line corridors.

Species		Wetland/ aquatic	Wood-land	Mixed woodland/ prairie	Prairie
Amphibians					
Smallmouth salamander	*Ambystoma texanum*	x			
Tiger salamander	*Ambystoma tigrinum*	x			
American toad	*Bufo americanus*		x		
Great plains toad	*Bufo cognatus*				x
Woodhouse's toad	*Bufo woodhousii*		x		
Northern cricket frog	*Acris crepitans*	x			
Cope's gray treefrog	*Hyla versicolor*		x		
Spotted chorus frog	*Pseudacris clarkii*				x
Boreal chorus frog	*Pseudacris maculate*				
Western chorus frog	*Pseudacris triseriata*	x			
Crawfish frog	*Rana areolata*		x		
Plains leopard frog	*Rana blairi*	x			
Bullfrog	*Rana catesbeiana*	x			
Southern leopard frog	*Rana sphenocephala*	x			
Great plains narrowmouth toad	*Gatrophryne olivacea*				x
Reptiles					
Snapping turtle	*Chelydra serpentina*	x			
Common musk turtle	*Sternotherus odoratus*	x			
Painted turtle	*Chrysemys picta*	x			
Mississippi Map turtle	*Graptemys kohnii*	x			
False map turtle	*Graptemys pseudogeographica*	x			
River cooter	*Pseudemys concinna*	x			
Eastern box turtle	*Terrepene carolina*		x		
Ornate box turtle	*Terrepene ornata*				x
Slider	*Trachemys scripta*	x			
Spiny softshell	*Apalone spinifera*	x			
Collared lizard	*Crotaphytus collaris*			x	x
Texas horned lizard	*Phrynosoma cornutum*				x
Five-lined skink	*Eumeces fasciatus*		x		
Great plains skink	*Eumeces obsoletus*				x

Table 1. (Continued)

Species		Wetland/ aquatic	Wood-land	Mixed woodland/ prairie	Prairie
Southern prairie skink	*Eumeces obtusirostris*			x	x
Ground skink	*Scincella lateralis*		x		
Six-lined racerunner	*Cnemidophorus sexlineatus*				x
Western slender glass lizard	*Ophisaurus attenuatus*			x	x
Ringneck snake	*Diadophis punctatus*		x		
Eastern hognose snake	*heterodon platirhinos*				x
Flathead snake	*Tantilla gracilis*			x	
Plains blackhead snake	*Tantilla nigriceps*				x
Racer	*Coluber constrictor*				x
Great plains rat snake	*Elaphe emoryi*			x	
Rat snake	*Elaphe obsoleta*		x		
Prairie kingsnake	*Lampropeltis calligaster*			x	x
Common kingsnake	*Lampropeltis getula*		x		
Milk snake	*Lampropeltis trangulum*		x		
Rough green snake	*Opheodrys aestivius*		x		
Gopher snake	*Pituophis catenifer*		x	x	x
Ground snake	*Sonora semiannulata*				x
Plainbelly water snake	*Nerodia erythrogaster*	x			
Diamond back water snake	*Nerodia rhombifer*	x			
Northern Water snake	*Nerodia sipedon*	x			
Graham's crayfish snake	*Regina grahamii*	x			
Western ribbon snake	*Thamnophis proximus*	x			
Plains garter snake	*Thamnophis radix*				x
Common garter snake	*Thamnophis sirtalis*	x	x	x	
Lined snake	*Tropidoclonion lineatum*			x	x
Copperhead	*Agkistrodon contortrix*		x		
Massasauga	*Sistrurus catenatus*	x		x	x

Table 2. Representative bird species that may occur in the vicinity of WCGS or within the associated transmission line corridors.

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Ducks/Geese/Swans					
Greater white-fronted goose	x				
Snow goose	x				
Canada goose	x				
Trumpeter swan	x				
Tundra swan	x				
Wood duck	x	x			
Gadwall	x				
American wigeon	x				
American Black Duck	x				
Mallard	x				
Blue-winged teal	x				
Cinnamon teal	x				
Northern Shoveler	x				
Northern pintail	x				
Green-winged teal	x				
Canvasback	x				
Redhead	x				
Ring-necked duck	x				
Lesser Scaup	x				
Bufflehead	x				
Common goldeneye	x				
Hooded merganser	x	x			
Common merganser	x				
Red-breasted merganser	x				
Ruddy duck	x				
Pheasants/Grouse/Quail					
Ring-necked pheasant			x	x	
Greater prairie chicken				x	
Wild turkey		x	x		
Northern bobwhite		x	x		
Misc waterbirds					
Common loon	x				
Pied-billed grebe	x				
Horned grebe	x				
Eared grebe	x				
American white pelican	x				
Double-crested cormorant	x				
American bittern	x				
Least bittern	x				
Great blue heron	x				

Table 2. (Continued)

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Great egret	x				
Little blue heron	x				
Cattle egret				x	
Green heron	x				
Black-crowned night heron	x				
Yellow-crowned night heron	x				
White-faced ibis	x				
Sandhill crane	x				
Hawks/Falcons/Eagles/Vultures					
Osprey	x				
Northern harrier			x	x	
Sharp-shinned hawk		x	x		
Cooper's hawk		x			
Northern goshawk		x			
Red-shouldered hawk		x			
Broad-winged hawk		x	x		
Swainson's hawk			x	x	
Red-tailed hawk			x	x	
Rough-legged hawk			x	x	
American kestrel			x	x	
Merlin			x		
Peregrine falcon	x		x		
Prairie falcon				x	
Bald eagle	x	x	x		
Turkey vulture			x	x	
Rails/Gallinules					
King rail	x				
Sora	x				
American coot	x				
Plovers/Sandpipers/Shorebirds					
Black-bellied plover	x				
American golden plover				x	
Semipalmated plover	x				
Killdeer	x			x	
American avocet	x				
Black-necked stilt	x				
Greater yellowlegs	x				
Lesser yellowlegs	x				
Solitary sandpiper	x				
Willet	x				

Table 2. (Continued)

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Spotted sandpiper	x				
Upland sandpiper				x	
Hudsonian godwit	x				
Ruddy turnstone	x				
Sanderling	x				
Semipalmated sandpiper	x				
Western sandpiper	x				
Least sandpiper	x				
Whiter-rumped sandpiper	x				
Baird's sandpiper	x				
Pectoral sandpiper	x				
Dunlin	x				
Short-billed dowitcher	x				
Long-billed dowitcher	x				
Common snipe			x		
American woodcock		x			
Wilson's phalarope	x				
Gulls/Terns					
Franklin's gull	x				x
Ring-billed gull	x				x
Glaucous gull	x				
Herring gull	x				
Caspian tern	x				
Forster's tern	x				
Least tern	x				
Black tern	x				
Pigeons/Doves					
Rock dove					x
Mourning dove			x	x	
Cuckoos					
Black-billed cuckoo		x			
Yellow-billed cuckoo		x			
Owls/Goatsuckers					
Barn owl				x	
Great-horned owl		x	x		
Snowy owl					x
Barred owl		x			
Long-eared owl			x	x	
Short-eared owl				x	
Eastern screech owl		x			x
Common nighthawk				x	

Table 2. (Continued)

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Swifts/Hummingbirds					
Chimney swift					x
Ruby-throated hummingbird		x	x		x
Kingfishers					
Belted kingfisher	x				
Woodpeckers					
Red-headed woodpecker		x	x		
Red-bellied woodpecker		x	x		
Downy woodpecker		x	x		
Hairy woodpecker		x	x		
Northern flicker		x	x		
Pileated woodpecker		x			
Flycatchers					
Olive-sided flycatcher		x			
Eastern wood-pewee		x			
Willow flycatcher			x	x	
Least flycatcher			x	x	
Eastern phoebe		x			
Great-crested flycatcher		x			
Western kingbird			x	x	
Eastern kingbird		x	x		
Scissor-tailed flycatcher				x	
Shrikes					
Northern shrike				x	
Loggerhead shrike			x	x	
Vireos					
Bell's vireo			x		
Solitary vireo		x			
Yellow-throated vireo		x			
Warbling vireo		x	x		
Red-eyed vireo		x			
Jays/Crows					
Blue jay		x			x
American crow			x	x	
Larks					
Horned lark				x	

Table 2. (Continued)

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Swallows					
Purple martin					x
Tree swallow	x				
Northern rough-winged swallow	x				
Bank swallow	x		x		
Cliff swallow			x		
Barn swallow				x	x
Chickadees/Titmice					
Black-capped chickadee		x			
Carolina chickadee		x			
Tufted titmouse		x			
Nuthatches/Creepers					
White-breasted nuthatch		x	x		
Brown creeper		x			
Wrens					
Carolina wren		x	x		
House wren		x			x
Winter wren		x			
Kinglets					
Golden-crowned kinglet		x			
Ruby-crowned kinglet		x			
Gnatcatchers					
Blue-gray gnatcatcher		x			
Thrushes					
Eastern bluebird			x	x	
Veery		x			
Wood thrush		x			
American robin			x		x
Thrashers					
Gray catbird			x		
Northern mockingbird			x		
Brown thrasher			x		
Starlings					
European starling					x

Table 2. (Continued)

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Pipits					
Water pipit	x				
Waxwings					
Cedar waxwing			x		
Warblers					
Nashville warbler		x			
Northern parula		x			
Yellow warbler		x			
Chestnut-sided warbler		x			
Magnolia warbler		x			
Yellow-rumped warbler		x			
Blackburnian warbler		x			
Bay-breasted warbler		x			
Cerulean warbler		x			
Black-and-white warbler		x			
American redstart		x			
Ovenbird		x			
Northern waterthrush	x	x			
Kentucky warbler		x			
Common yellowthroat	x				
Wilson's warbler	x	x			
Tanagers					
Summer tanager		x			
Sparrows					
Rufous-sided towhee (???)		x			
American tree sparrow			x		
Chipping sparrow			x	x	
Field sparrow				x	
Vesper sparrow				x	
Lark sparrow			x	x	
Savannah sparrow				x	
Grasshopper sparrow				x	
Fox sparrow			x	x	
Song sparrow			x	x	
Lincoln's sparrow				x	
Swamp sparrow	x				
White-throated sparrow			x		
White-crowned sparrow			x		
Harris' sparrow			x		x
Dark-eyed junco			x		x
Lapland longspur				x	

Table 2. (Continued)

Species	Wetland/ Aquatic	Woodland	Mixed Prairie/ Woodland	Prairie/ open area	Urban and Other
Snow bunting				x	x
Grosbeaks/Buntings					
Northern cardinal		x	x		x
Rose-breasted grosbeak		x			
Blue grosbeak			x		
Indigo bunting			x		
Dickcissel				x	
Blackbirds/Orioles					
Bobolink	x				
Red-winged blackbird	x				
Eastern meadowlark				x	
Western meadowlark				x	
Yellow-headed blackbird	x				
Rusty blackbird	x				
Brewer' blackbird	x				
Great-tailed grackle				x	
Common grackle	x			x	
Brown-headed blackbird				x	
Orchard oriole		x	x		
Northern oriole		x	x		
Northern finches					
Purple finch		x			
Pine siskin		x			x
American goldfinch			x		x
House finch			x		x
Old world sparrow					
House sparrow					x

Table 3. Representative mammal species that may occur in the vicinity of WCGS or within the associated transmission line corridors.

Species		Wet-land/ Aquatic	Wood-land	Mixed Prairie/ Wood-land	Prairie/ open area	Urban and Other
Virginia opossum	*Didelphis virginiana*	x	x			
Southern short-tailed shrew	*Blarina carolinensis*		x	x	x	
Least shrew	*Cryptotis parva*		x	x	x	
Eastern mole	*Scalopus aquaticus*		x	x	x	
Eastern pipistrelle	*Pipistrellus subflavus*		x	x		x
Big brown bat	*Eptesicus fuscus*				x	x
Red bat	*Lasiurus borealis*		x			
Hoary bat	*Lasiurus cinerus*		x	x		x
Nine-banded armadillo	*Dasypus novemcinctus*		x	x		
Eastern cottontail	*Sylvilagus floridanus*			x	x	x
Black-tailed jackrabbit	*Lepus californicus*				x	
Woodchuck	*Marmota monax*		x	x		
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*				x	
Franklin's ground squirrel	*Spermophilus franklinii*		x			
Gray squirrel	*Sciurus carolinensis*		x			
Fox squirrel	*Sciurus niger*		x	x		
Pocket gopher	*Geomys bursarius*				x	
Hispid pocket mouse	*Chaetodipus hispidus*				x	
Beaver	*Castor canadensis*	x				
Plains harvest mouse	*Reithrodontomys montanus*				x	
Western harvest mouse	*Reithrodontomys megalotis*			x	x	
Deer mouse	*Peromyscus maniculatus*				x	
White-footed mouse	*Peromyscus leucopus*		x	x		
Hispid cotton rat	*Sigmadon hispidus*	x			x	
Eastern wood rat	*Neotoma floridana*		x	x		
Prairie vole	*Microtus ochrogaster*				x	
Woodland vole	*Microtus pinetorum*		x	x		
Muskrat	*Ondatra zibethicus*	x				

Table 3. (Continued)

Species		**Wet-land/ Aquatic**	**Wood-land**	**Mixed Prairie/ Wood-land**	**Prairie/ open area**	**Urban and Other**
House mouse	*Mus musculus*		x	x	x	x
Meadow jumping mouse	*Zapus hudsonius*			x		
Coyote	*Canis latrans*			x	x	
Red fox	*Vulpes vulpes*		x	x		x
Gray fox	*Urocyon cinereoargenteus*		x			
Racoon	*Procyon lotor*		x	x		
Long-tailed weasel	*Mustela frenata*		x	x	x	
Mink	*Mustela vison*	x				
Badger	*Taxidea taxus*				x	
Striped skunk	*Mehpitis mephitis*			x		
Eastern spotted skunk	*Spilogale putorius*			x	x	
Bobcat	*Lynx rufus*		x			
White-tailed deer	*Odocoileus virginianus*		x	x		

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- **Would additional transmission infrastructure be necessary if purchased power replaced Wolf Creek's capacity, i.e., do existing transmission lines have sufficient capacity to support purchased or imported power? Would any new utility ROW be necessary? Would existing ROW need to be expanded or otherwise modified? Would existing ROW be retired and return to other uses? What are the impacts of these actions?**

  Response: As mentioned in Section 7.2.1.3, WCNOC anticipates that additional transmission infrastructure would be needed in the event that the owners of WCGS purchase power to replace WCGS capacity.

  Given that additional transmission infrastructure would be needed in the event that the owners of WCGS purchase power to replace WCGS capacity, new utility rights-of-way and/or expansion of existing rights-of-way would be needed. Possible routes for new transmission lines are speculative. However, as much as 250 miles of new transmission line rights-of-way could be needed under the purchased power alternative.

  As discussed in Section 3.1.3 of the ER, the existing transmission lines (and rights-of-way) would remain a permanent part of the transmission system after WCGS is decommissioned. Therefore, if purchased power replaced WCGS capacity, the existing transmission lines and rights-of-way would remain in use.

  To the extent possible, transmission lines under the purchased power alternative would be routed along existing transmission line or pipeline corridors, rail lines, and roadways. Environmental impacts of construction/expansion of transmission line rights-of-way are well known and would include:

  Land Use – Land use impacts would be minimal. Transmission lines would be developed primarily on vacant/undeveloped land. Small areas of rangeland used for grazing and forage, agricultural lands, and mining could be permanently removed from production by tower foundations and spur roads, where necessary.

  Visual – Visual impacts would increase with effects on views from highways, residences, and recreational areas, as well as on natural scenic quality. The first transmission line or industrial linear feature (i.e., rail line) built in a natural setting usually will cause the most noticeable incremental change because of the contrast of form, line, color, and texture to the surroundings. Each successive change, such as expansion of an existing transmission right-of way, becomes less noticeable than the first.

  Cultural Resources – Construction of new transmission lines would not directly affect cultural resources within the corridor if ground disturbance activities occur outside of the historic/archaeological site boundaries. To the extent possible, transmission line rights-of-way would be routed to avoid historic properties and archaeological sites. Careful placement of new transmission line towers, work areas, and access roads would reduce incremental impacts to any cultural resources that may occur with the transmission line corridor.

  Biological Resources – Biological impacts would occur during construction of new transmission lines, ground disturbance and noise may cause some wildlife in the vicinity of the project to relocate. However, the impacts would be temporary.

  Earth and Water Resources – The construction of new transmission facilities could increase the potential for wind and water soil erosion, stream bank degradation, and sedimentation in water bodies. The amount of ground disturbance would be minimized by using, to the extent possible, existing rights-of-way that parallel existing roads. The use of silt fences, water sprays and other dust control measures would further reduce impacts to these resources.

- **Can construction begin on a new facility at the Wolf Creek site while WCGS is in operation? Can a new plant be constructed that would use Wolf Creek's cooling system prior to the retirement of WCGS? Can a new plant be constructed on previously disturbed areas of the site prior to retirement of WCGS? If not, what are the impacts of building a new, alternative plant on a Greenfield site or of constructing and operating a new cooling system?**

  Response: Electric utilities often co-locate new generating facilities with existing facilities. Multi-unit sites generally undergo phased development such that new units are constructed as the need for additional generating capacity arises. Multi-unit sites often share resources such as cooling water systems. With proper planning, new generating units could be constructed and connected to the WCGS cooling water system (during a regularly scheduled outage). It is likely that the new generating unit would be isolated from the WCGS cooling water system, via redundant shut-off valves, until WCGS is retired. Enough previously disturbed land is available at the WCGS site for construction of alternative generating units.

- **What is the current attainment status (Clean Air Act) of the region within which WCGS is situated?**
  Response: Air quality attainment status is addressed in Section 2.10.

  "Coffey County is in attainment for all air quality standards as are all counties in the State of Kansas (40 CFR 81.317, 70 FR 974, and 70 FR 7070)."

- **PM2.5 is a Clean Air Act criteria pollutant. Please provide any available information on how much PM2.5 would be emitted using the coal, oil or gas alternatives to license renewal.**
  Response: For the coal-fired alternative, PM2.5 emissions would be 0.145 tons per year. In Section 7.2.1.5 of the ER, WCNOC determined that the oil-fired alternative was not a reasonable alternative due to the high fuel cost and lack of obvious environmental advantage. Consequently, air emissions for the oil-fired alternative were not evaluated. For the gas-fired alternative, all particulate emissions are less than 1.0 micron; hence, all particulate emissions are PM2.5. Therefore, PM2.5 emissions would be 49 tons per year.

- **What is the heat rate for Wolf Creek? How would the differential levels of heat rejection from the sited appropriate alternative energy sources affect the heating of CCL? Would you be aware of any significant effects to water quality or ecology should the thermal output to the lake change in conjunction with alternative energy sources?**
  Response: 3565 Mwth (100%power). It is unlikely that any affect would be observed. Any generating facility that would replace WCGS would comply with the thermal limits in Section 316(a) of the Federal Water Pollution Control Act, as amended. We are not aware of any significant effects to water quality or ecology.

- **Provide the annual average capacity factor for WCGS for the ten year period ending in 2006. Please indicate those years during which refueling outages occurred.**
  Response:

  See attached data

- **Provide the gross and net electrical output of WCGS based on summer and winter conditions.**

  Response: See attached data

- **What does WCNOC view to be a realistic schedule for implementing the alternatives evaluated in detail in the ER (gas, coal, nuclear)? Please provide a simplified permitting, design and construction schedule for each such alternative.**

  Response:

- **Provide the range of WCNOC employee salaries. Also, provide the range of salaries for permanent contract employees at WCGS.**

  Response: The salary range expressed as an hourly rate for all WCNOC employees is Low=$10.69 and High=$170.00. No permanent contract employees.

- **Is there a gas transmission line in the immediate WCGS vicinity to support a gas-fired alternative? What is the distance that a new gas line would need to be run to support gas fired operations at the WCGS site and what would be the diameter of the line? Also, is there adequate capacity in the nearest gas transmission lines to support gas-fired operations at the WCGS site?**

  Response: Coffey County is underlain by a large natural gas reservoir and several well development projects are being implemented in the County to utilize this resource. A large interstate natural gas transmission line with a general east-west orientation is located approximately 8 miles north of WCGS. There are several other interstate pipelines in the vicinity of WCGS. Due to post 9/11 security issues, the available capacity for these lines is not readily available, but we assume that capacity would be available if the gas-fired alternative was pursued. As discussed in Section 7.2.2.1, WCNOC assumed that a new16-inch diameter pipeline approximately 10 miles long would be required.

- **Please update the information presented in Section 7.2 of the ER to show both Generating Capacity and Generation by fuel type for the years 2000 through 2006 inclusive.**

  Response: WCNOC used Generating Capacity and Generation by Fuel Type data from 2002 because it was the most recent data available at the time the ER was drafted. Data for the years 2000 through 2004 are available online from the Energy Information Administration at http://www.eia.doe.gov/cneaf/electricity/st_profiles/kansas.pdf. Data for 2005 and 2006 have not been published.

- **WCNOC has limited its analysis of coal fired alternatives to pulverized coal systems (ER Section 7.2.1). However, the WCGS operating license does not expire until 2025 which is 18 years off. At this point in time integrated gasification combined cycle systems are well under development and it's likely that these and other advanced coal utilization systems will be operational by the time the WCGS license expires. Please provide updated information including a brief assessment of the state of advanced coal utilization technologies, whether such technologies could be employed at the WCGS site and the potential benefits of the new technologies. In particular, the possible environmental advantages of advanced coal systems should be mentioned including reduced air emission in comparison to pulverized coals burners. The purpose of addressing advanced coal technologies would not be to**

consider those technologies as formal "alternatives" to license renewal but rather to generally update the information presented in the alternatives analysis.

Response: Information on these advanced coal technologies is available from DOE at http://www.doe.gov/energysources/coal.htm.

There are a number of advanced coal systems that are being developed with funding from the Department of Energy (DOE), including gasification combined cycle and carbon sequestration systems. While many of these systems look promising, a number of technical issues need to be resolved before they would be considered "reasonable" alternatives. It is possible that the technical issues for some of these advanced coal systems would be resolved by the time the WCGS license expires, but predictions for when these systems would become viable are speculative.

- **Most license renewal Environmental Impact Statements contain an analysis of a combination of alternatives to replace the output of a generating station should the operating license not be renewed. Please provide an analysis of at least one combination alternative that WCNOC considers feasible.**

Response: We believe evaluation of combination of generating sources is beyond the scope of the ER. In the GEIS (NRC 1996, Section 8.1) NRC states:

> "While many methods are available for generating electricity, and a huge number of combinations or mixes can be assimilated to meet a defined generating requirement, such expansive consideration would be too unwieldy to perform given the purposes of this analysis. Therefore, NRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable."

In response to public comments on the proposed 10 CFR 51 Rule for Renewal of Nuclear Power Plant Operations Licenses and Supporting Documents, NRC stated:

> "The NRC agrees that a mix of alternative generating sources could conceivably replace the generating capacity lost if license renewal were not chosen. However, consideration of all the various mixes of alternative energy sources would logically yield an infinite number of alternatives. The NRC and CEQ NEPA regulations require the consideration of a reasonable range of alternatives. Therefore, NRC believes that consideration of discrete alternative sources of energy is reasonable and appropriate given the circumstances. ...(I)mpacts from the range of reasonable alternatives will inherently bound all expected environmental impacts from various combinations of alternative energy sources." (NUREG-1529, Vol. 2, Response to Concern Number ALT.011)

In addition, we are not aware of any previous applicant for license renewal that has included analysis of a combination of alternatives in their ER.

Consistent with the NRC determination and ERs prepared by previous license renewal applicants, WCNOC did not evaluate mixes of generating sources. However, WCNOC did state in Section 7.2.1 that the impacts from coal- and gas-fired generation presented in this chapter would bound the impacts from any combination of the two technologies. The information provided in the WCGS ER is consistent with that provided by previous applicants for license renewal and determined to be sufficient by NRC Staff.

- **With regard to Section 7.2.1.4, please identify the range of conservation, efficiency and load management programs being conducted in Kansas. This should list each**

program, identify its sponsor and goals, and provide information relative to the success of the effort.

Response: A summary of demand side management programs offered in Kansas is provided in a report prepared for the State entitled "*Energy Efficiency and Conservation in the Public, Residential, Commercial and Industrial Sectors.*" The report is available at http://kec.kansas.gov/reports/EE_and_C_Final%20Report.pdf.

- **ER Section 7.2.1.3 addresses purchased power. Please provide a chart showing Kansas power imports for the last ten years. Also, identify transmission line constraints, if any, to importing power into the state.**

Response: Net annual energy imports/exports, including electricity, for the years 1990 through 2003 are available from the Energy Information Administration at http://www.eia.doe.gov/emeu/states/sep_use/total/pdf/use_ks.pdf. Data for the years 2004 through 2006 have not been published.
There are a number of transmission constraints with the Southwest Power Pool (SPP) RTO, which includes the entire state of Kansas. Documents describing the SPP system constraints are available at http://www.spp.org/.

Alternatives Construction Schedule

Basis: Construction commences at groundbreaking and ends when plant goes online.

Coal – Fired 36 to 42 months (fifth power plan)

Gas – Fired 24 months (fifth power plan)

Advanced Nuclear 7 to 8 years (Vogtle ESP)

References:

Northwest Power and Conservation Council 2005. "The Fifth Northwest Electric Power and Conservation Plan" May 2005. Available online at http://www.nwcouncil.org/energy/powerplan/plan/Default.htm

Vogtle Early Site Permit Application, Revision 1, Part 3, Environmental Report, Section 3.9. NRC Accession # ML06321056

Reference: WCGS Applicant's ER (Operating License Renewal Stage) Chapter 2.1

11,300 owned acres - 5090 lake = 6210 acres

6210 acres - 135 site footprint = 6075 acres

6075 acres - 60 Dam = 6015 acres

Coal - Fired Option would use approx. 5,200,000 tons/year (ER Sec. 7.2.2.2)

Typical Railcar holds 100-120 tons of coal.
Unit train would have 100-125 rail cars

Assuming each unit train has 100 cars and each car holds 100 tons of coal - 10 Deliveries per week.

5,200,000tons/year X 1 year/52weeks X 1 railcar/100 tons X 1 train/100 railcar = 10 trains per week

Assuming each unit train has 120 railcars and each railcar contains 130 tons of coal – 6 to 7 deliveries per week

5,200,000tons/year X 1 year/52weeks X 1 railcar/120 tons X 1 train/125 railcar = 6.7 trains per week

Reference: Power Engineering 2005. "Bringing Coal Yards into the 21st century" July 2005

Hooper Diane M

From: Medenciy Charlie M
Sent: Friday, April 20, 2007 3:23 PM
To: Hooper Diane M
Subject: Source of Refueling Outage Dates

The WCGS Paperless Environment is the source of the data for WCGS refueling outages.

Refuel Outage Dates			
Refuel	Start	Finish	Duration
1	10/16/86 Time 0201	12/21/86 Time 0958	66 days 7 hrs 57 min
2	9/27/87 Time 0201	1/05/88 Time 1330	100 days 10 hrs 58 min
3	10/07/88 Time 0200	1/04/89 Time 1207	89 days 10 hrs 7 min
4	3/09/90 Time 0027	5/16/90 Time 0017	67 days 23 hrs50 min
5	9/20/91 Time 0125	1/15/92 Time 0004	116 days 22 hrs 39 min
6	3/4/93 Time 2353	5/17/93 Time 0719	73 days 8 hrs 26 min
7	9/16/94 Time 0001	11/02/94 Time 1231	47 days 12 hrs 30 min
8	2/03/96 Time 1800	4/7/96 Time 1113	63 days 17 hrs 13 min
9	10/04/97 Time 0001 Time 0001	12/1/97 Time 0539 Time 1213	58 days 5 hrs 38 min-1st Bkr 58 days 12 hrs 12 min-2nd Bkr
10	04/03/99 Time 0001 Time 0001	05/09/99 Time 2033 05/10/99 Time 0505	36 days 20 hrs 32 min-1st Bkr 37 days 5 hrs 4 min-2nd Bkr
11	09/29/00 Time 2351	11/07/00 Time 0118 11/07/00 Time 0545	38 days 1 hr 27 min-1st Bkr 38 days 5 hrs 54 min-2nd Bkr
12	03/23/02 Time 0005	04/27/02 Time 2022 04/28/02 Time 0702	35 days 19 hrs 17 min – 1st Bkr 36 days 5 hrs 58 min – 2nd Bkr
13	10/18/03 Time 0000	12/02/03 Time 1256 12/02/03 Time 1812	45 days 13 hrs 56 min – 1st Bkr 45 days 19 hrs 12 min – 2nd Bkr
14	04/09/05 Time 0000	05/19/05 Time 07:23	40 days 07 hrs 23 min
15	10/7/06 Tim	11/12/06 Time	34 days 07 hrs 8 min

	0000	0708	

Forced Outage Dates				
Year	Start	Finish	Duration	Cause
1985	9/23/85 Time 0350	9/23/85 Time 2047	0 day 16 hrs 57 min	Reactor trip on S/G 'D' Lo-Lo level after 'D' Main Feed Reg Valve failed shut
	10/07/85 Time 1400	10/09/85 Time 2127	2 days 7 hrs 27 min	Loss of Circulating Water due to moss buildup on the intake screens.
	10/10/85 Time 0224	10/10/85 Time 1958	0 day 17 hrs 34 min	Turbine trip/Reactor trip on S/G 'C' Hi-Hi level
1986	2/22/86 Time 0400	2/24/86 Time 1316	2 days 9 hrs 16 min	Tripped on S/G Lo-Lo level after a speed sensor card in the EHC system failed causing turbine control valves to shut.
	4/08/86 Time 1037	4/25/86 Time 0137	16 days 15 hrs 0 min	Reactor trip by accidentally tripping main generator output breaker in the switchyard.
	6/04/86 Time 0128	6/11/86 Time 2147	7 days 20 hrs 19 min	Manual shutdown to rewire Limitorque operators
	6/30/86 Time 1331	7/01/86 Time 0557	0 day 16 hrs 26 min	Reactor trip on loss of all three Condensate pumps
	7/01/86 Time 0625	7/01/86 Time 1308	0 day 6 hrs 43 min	Reactor trip on S/G 'A' Lo-Lo level during plant startup
	7/24/86 Time 0042	7/26/86 Time 1912	2 days 18 hrs 30 min	Reactor trip on S/G 'B' Lo-Lo level while reducing power to fix water leaks on Main Gen
	12/22/86 Time 0900	12/22/86 Time 2217	0 day 13 hrs 17 min	Reactor trip on S/G 'A' Lo-Lo level due to failure of feedwater flow controlling channel
1987	1/08/87 Time 1818	1/12/87 Time 1453	2 days 20 hrs 35 min	Reactor trip/SI caused by isolating wrong transmitter during STS-IC-507A
	1/20/87 Time 1800	1/22/87 Time 0017	1 day 6 hrs 17 min	Reactor trip on turbine trip due to Turbine-Generator bearing high vibration
	4/19/87 Time 0846	4/19/87 Time 2154	0 day 13 hrs 08 min	Reactor trip during LCO ramping down for Rod Control urgent failure

	4/23/87 Time 1223	4/24/87 Time 2124	1 day 9 hrs 1 min	Reactor trip on Hi Neg. flux rate due to failure in Rod control cabinet
	5/28/87 Time 1429	5/29/87 Time 1247	0 day 21 hrs 18 min	Reactor trip after loss of power to PG11k when a spark occurred after shutting a breaker
	6/29/87 Time 0649	6/30/87 Time 2047	1 day 13 hrs 58 min	Reactor trip on Lo-Lo S/G level after Feedwater Pump 'A' trip
	7/20/87 Time 2306	7/26/87 Time 0826	5 days 9 hrs 20 min	Reactor trip due to switchyard bus failure
	9/10/87 Time 2009	9/12/87 Time 0549	1 day 9 hrs 40 min	Turbine trip/Reactor trip on Generator phase differential due to phase 'B' line failure going to switchyard
1988	1/21/88 Time 2129	2/16/88 Time 1914	25 days 21 hrs 45 min	Manual shut down due to Vessel outer O-ring leakage
1989	1/23/89 Time 1322	1/23/89 Time 2230	0 day 9 hrs 8 min	Turbine-Generator vibration
	2/02/89 Time 1324	2/04/89 Time 0730	1 day 18 hrs 6 min	'C' MSIV fast close - 'C' S/G LO-LO level
	7/11/89 Time 0217	7/11/89 Time 0649	0 day 4 hrs 32 min	Turbine off line (Reactor critical) - repair 'A' Main Feed Reg Valve
1990	2/06/90 Time 0907	2/08/90 Time 1454	2 days 5 hrs 47 min	Reactor trip due to RCP 'A' lockout relay picking up
	5/17/90 Time 2146	5/18/90 Time 1920	0 days 21 hrs 34 min	Reactor trip after taking turbine off line to repair leak on 'A' Main Feed Pump seal water return orifice
	5/19/90 Time 2353	5/21/90 Time 0025	1 day 0 hrs 32 min	Reactor trip on 1st stage MSR drain tank 'A' level high
1991 (None)				
1992	2/19/92 Time 2110	3/27/92 Time 1034	35 days 13 hrs 24 min	NN Inverter failed, RCS crossover loop saddle block noise
	11/10/92 Time 1103	11/11/92 Time 1757	1 day 6 hrs 54 min	Rose Hill line fault
1993				

(None)				
1994	1/15/94 Time 0908	1/17/94 Time 1915	2 days 10 hrs 7 min	Planned shutdown to modify Reactor cavity cooling duct work
	1/27/94 Time 0423	1/29/94 Time 1534	2 days 11 hrs 11 min	T.S. shutdown due to bad thyristor in rod control
1995	3/08/95 Time 1445	3/14/95 Time 2230	6 days 7 hrs 45 min	Reactor trip from 100 % power while performing surveillance testing on reactor trip breakers.
1996	1/30/96 Time 0347	2/03/96 Time 1800	3 days 14 hrs 13 min	Circ Water traveling screens sheared pins and froze due to cold temperatures. Plant entered NUE due to loss of 'A' ESW by ice blockage.
	4/20/96 Time 0538	4/20/96 Time 2135	0 days 15 hrs 57 min	Manual shutdown for turbine balance shot.
	6/06/96 Time 1320	6/08/96 Time 1421	2 days 1 hr 1 min	Tripped from 100% power due to Lo-Lo level in S/G 'C' when 'C' main feed reg valve failed closed due to failure of roll pin connecting stem and plug.
	8/19/96 Time 0137	8/19/96 Time 2258	0 days 21 hrs 21 min	Power reduction to 55% to repair crack in 'B' MFP seal water return line at the connection to the condenser
	8/20/96 Time 0840	8/21/96 Time 0133	0 days 16 hrs 53 min	Power reduction to 55% due to 'A' MFP speed oscillations
	10/25/96 Time 1617	10/26/96 Time 1653	1 day 0 hrs 27 min	Power reduction to 55% to repair the 120 VAC power supply wire to 'A' MFP speed controller. Further power reduction for QPTR > 1.02.
1997	5/03/97 Time 0359	5/04/97 Time 1328	1 day 9 hrs 29 min	Power reduction to 65% to find and plug a tube leak in Low Pressure Feedwater Heater 2C
	5/20/97 Time 1457	5/25/97 Time 0001	4 days 8 hrs 4 min	Manual reactor trip due to increasing body to bonnet steam leak from AFLV058C.
1998 (None)				
1999	1/15/99	1/18/99	2 days 17 hrs 29 min	Power reduction to 70% to find

Time 2038	Time 1407		and plug leak in Low Pressure Feedwater Heater 2A
2/08/99 Time 1500	2/10/99 Time 0530	1 day 14 hrs 30 min	Power reduction to 92% to find and plug leak in Low Pressure Feedwater Heater 1A.
8/05/99 Time 1258	8/06/99 Time 1351	1 day 0 hrs 53 min	Reactor trip due to lo lo level in S/G D caused by valve controller circuitry card failure allowing the MFRV to close.
8/27/99 Time 0305	8/27/99 Time 1502	0 days 11 hrs 57 min	Power reduction to 91% to replace section of line from 1st Stage Reheater Drain Tank D to HP Heater 6B due to minimum wall thickness concerns. Work was delayed after power reduction and unit returned to 100% at System OPS request due to grid power needs.
8/27/99 Time 2100	8/28/99 Time 0935	0 days 12 hrs 35 min	Power reduction to 91% to replace section of line from 1st Stage Reheater Drain Tank D to HP Heater 6B due to minimum wall concerns.
11/30/99 Time 0459	11/30/99 Time 1758	0 days 12 hrs 59 min	Tech Spec shutdown due to failed power supply for SA036D. Power reduction was halted at approximately 30% when the power supply was declared operable after recalibration.
12/01/99 Time 0219	12/10/99 Time 1318	0 days 11 hrs 59 min	Tech Spec shutdown due to failed power supply for SA036D. Power reduction was halted at 54% when the power supply was declared operable after being replaced. Power increase was held at 65% for replacement of failed power supply for steam dump controller card AB PK-507 and then increased to 100%.

	12/31/99 Time 1213	01/01/00 Time 0824	0 days 20 hrs 11 min	Precautionary power reduction to 52% for Y2K contingency.
2000	02/02/00 Time 2100	02/03/00 Time 0142	0 days 4 hrs 42 min	Power reduction to 97% for repair to cooler on heater drain pump A
	02/13/00 Time 1230	02/14/00 Time 1040	0 days 22 hrs 10 min	Power reduction to 90% for low pressure heater 1B tube repair
	5/09/00 Time 0903	5/11/00 Time 1900	2 days 9 hrs 57 min	Power reduction to 91% for pipe replacement due to wall thinning on AF32-GBD-6
	7/29/00 Time 1235	7/30/00 Time 0700	18 hrs 25 min	Rose Hill line off line
	9/04/00 Time 1123	9/07/00 Time 1305	3 days 1 hr 42 min	Phase to phase ground on unit auxiliary transformer
2001	03/17/01 Time 0430	03/18/01 Time 0849	1 day 4 hrs 19 min	Unit auxiliary transformer installation
	03/22/01 Time 1742	03/23/01 Time 0142	8 hrs	Power reduction to 80% to repair leak on main generator hydrogen cooler
	05/11/01 Time 0300	5/11/01 Time 2300	20 hrs	Power reduction to 62% to replace speed probes on 'A' MFWP
	05/29/01 Time 0303	05/29/01 Time 0735	4 hrs 32 mins	Power reduction to 88% due to failure of the NN14 inverter
	10/19/01 Time 0830	10/19/01 Time 1600	7 hrs 30 mins	Power reduction to 97% for furmanite of Heater Drain Pump A stuffing box.
	11/09/01 Time 0805	11/09/01 Time 1230	4 hrs 25 mins	Power reduction to 97% for furmanite of Heater Drain Pump A stuffing box.
2002	02/01/02 Time 1146	02/01/02 Time 2346	12 hrs	Rose Hill line off line. Power reduction to 80%.
	05/08/02 Time 1707	05/10/02 Time 0959	40 hrs 52 mins	Reactor trip due to S/G "D" Lo-Lo Level. Cause was a failed circuit card in the FRV controller
	05/11/02 Time 2100	05/11/02 Time 2300	2 hrs	PAF01A failure of mechanical seal. Power reduction to 97% to secure pump. Return power to 100%.

	05/13/02 Time 1617	05/20/02 Time 1206	6 days 12 hrs 52 mins	Forced outage to Mode 5 due to identification of loose parts in S/G "D"
2003	01/03/03 Time 1101	01/04/03 Time 1206	1 day 1 hr 5 mins	Reactor trip caused by opening of the RDMG Set output breaker due to operator error
	01/07/03 Time 2000	01/07/03 Time 2238	2 hrs 38 mins	Power reduction to 97% to take PAF01A off-line to replace mechanical seal and repair AFLV0001
	08/18/03 Time 1558	08/19/03 Time 1107	1 day 19 hrs 9 mins	Reactor trip caused by closure of AEHV0040
2004	02/13/04 Time 0810	02/16/04 Time 0340	2 day 19 hr 30 mins	Reactor trip caused by failure of solid pin holding valve plug to stem on Feed Reg Valve AEFCV0540
	07/30/04 Time 0301	08/01/04 Time 0953	2 days 6 hrs 52 mins	Emergent work due to condenser tube leak. Power reduced to <30% due to Action Level 1 on all four SG'S.
	08/22/04 Time1010	08/24/04 Time 1000	1 day 23 hrs 50 mins	Reactor trip while improperly restoring from STS IC-211B.
	10/07/04 Time 1150	10/08/04 Time 1648	1 day 04 hrs 58 mins	Reactor trip due to Lightning induced EMF causing false signal to Turbine HI-HI Vibration trip.
	10/11/04 Time 1000	10/12/04 Time 1644	1 day 06 hrs 44 mins	Reduced Power to 950Mwe due to loss of switchyard west bus.
	01/22/2005 Time 1800	02/04/05 Time 0505	12 days 11 hrs 05 mins	Reduced Power to take unit off-line to repair water leak in Main Generator.

Hooper Diane M

From: Medenciy Charlie M
Sent: Tuesday, March 20, 2007 9:23 AM
To: Hooper Diane M
Subject: FW: WCSTATS0107.XLS

Attached is a spreadsheet of the information requested by the NRC for the Environmental Audit. The information is gathered and compiled by Mary Ballengee for submittal to INPO.

What is the heat rate for Wolf Creek?

Provide the annual average capacity factor for WCGS for the ten year period ending in 2006. Please indicate those years during which refueling outages occurred.

Provide the gross and net electrical output of WCGS based on summer and winter conditions.

-----Original Message-----
From: Ballengee Mary E
Sent: Monday, March 05, 2007 3:14 PM
To: Medenciy Charlie M
Subject: WCSTATS0107.XLS

Charlie - this should take care of your question.

Mary

WCSTATS0107.XLS

CAPACITY FACTOR (DESIGN)

NET GEN / (DESIGN ELECT RATING X PER HRS)

MO/YR	MONTH	YTD	CUMULATIVE	CONSTANT
Jan-96	95.1%	95.1%	77.0%	1,170
Feb-96	0.0%	48.2%	76.4%	1,170
Mar-96	0.0%	31.3%	75.8%	1,170
Apr-96	69.1%	40.7%	75.8%	1,170
May-96	100.2%	52.8%	76.0%	1,170
Jun-96	91.4%	59.2%	76.1%	1,170
Jul-96	99.6%	65.0%	76.3%	1,170
Aug-96	98.1%	69.3%	76.4%	1,170
Sep-96	100.5%	72.7%	76.6%	1,170
Oct-96	100.0%	75.5%	76.8%	1,170
Nov-96	101.6%	77.8%	77.0%	1,170
Dec-96	101.8%	79.8%	77.1%	1,170
Jan-97	101.7%	101.7%	77.3%	1,170
Feb-97	101.6%	101.7%	77.5%	1,170
Mar-97	101.3%	101.6%	77.7%	1,170
Apr-97	101.2%	101.5%	77.8%	1,170
May-97	83.4%	97.8%	77.9%	1,170
Jun-97	100.3%	98.2%	78.0%	1,170
Jul-97	99.6%	98.4%	78.2%	1,170
Aug-97	99.9%	98.6%	78.3%	1,170
Sep-97	100.3%	98.8%	78.5%	1,170
Oct-97	5.6%	89.3%	78.0%	1,170
Nov-97	0.0%	81.1%	77.4%	1,170
Dec-97	95.1%	82.3%	77.6%	1,170
Jan-98	102.2%	102.2%	77.7%	1,170
Feb-98	102.2%	102.2%	77.9%	1,170
Mar-98	102.1%	102.2%	78.0%	1,170
Apr-98	101.8%	102.1%	78.2%	1,170
May-98	101.3%	101.9%	78.4%	1,170
Jun-98	100.9%	101.8%	78.5%	1,170
Jul-98	100.1%	101.5%	78.6%	1,170
Aug-98	100.7%	101.4%	78.8%	1,170
Sep-98	101.1%	101.4%	78.9%	1,170
Oct-98	101.6%	101.4%	79.1%	1,170
Nov-98	101.9%	101.4%	79.2%	1,170
Dec-98	101.9%	101.5%	79.4%	1,170
Jan-99	100.7%	100.7%	79.5%	1,170
Feb-99	100.9%	100.8%	79.6%	1,170
Mar-99	101.9%	101.2%	79.8%	1,170
Apr-99	2.5%	76.5%	79.3%	1,170
May-99	64.9%	74.2%	79.2%	1,170
Jun-99	101.2%	78.6%	79.3%	1,170
Jul-99	100.4%	81.8%	79.5%	1,170
Aug-99	94.7%	83.5%	79.5%	1,170
Sep-99	101.0%	85.4%	79.7%	1,170
Oct-99	101.6%	87.0%	79.8%	1,170
Nov-99	100.8%	88.3%	79.9%	1,170
Dec-99	100.8%	89.3%	80.1%	1,170
Jan-00	101.7%	101.7%	80.2%	1,170
Feb-00	101.5%	101.6%	80.3%	1,170
Mar-00	101.4%	101.5%	80.4%	1,170

CAPACITY FACTOR (DESIGN)

NET GEN / (DESIGN ELECT RATING X PER HRS)

MO/YR	MONTH	YTD	CUMULATIVE	CONSTANT
Apr-00	101.2%	101.4%	80.5%	1,170
May-00	100.5%	101.3%	80.6%	1,170
Jun-00	100.5%	101.1%	80.8%	1,170
Jul-00	99.4%	100.9%	80.9%	1,170
Aug-00	99.8%	100.7%	81.0%	1,170
Sep-00	78.4%	98.3%	81.0%	1,170
Oct-00	0.0%	88.2%	80.5%	1,170
Nov-00	73.9%	86.9%	80.5%	1,170
Dec-00	101.9%	88.2%	80.6%	1,170
Jan-01	102.0%	102.0%	80.7%	1,170
Feb-01	102.1%	102.1%	80.8%	1,170
Mar-01	95.8%	99.9%	80.9%	1,170
Apr-01	101.7%	100.4%	81.0%	1,170
May-01	100.9%	100.5%	81.1%	1,170
Jun-01	101.4%	100.6%	81.2%	1,170
Jul-01	100.4%	100.6%	81.3%	1,170
Aug-01	100.5%	100.6%	81.4%	1,170
Sep-01	101.3%	100.6%	81.5%	1,170
Oct-01	101.8%	100.8%	81.6%	1,170
Nov-01	101.8%	100.9%	81.7%	1,170
Dec-01	102.0%	101.0%	81.8%	1,170
Jan-02	102.1%	102.1%	81.9%	1,170
Feb-02	101.7%	101.9%	82.0%	1,170
Mar-02	70.0%	90.9%	82.0%	1,170
Apr-02	4.9%	69.4%	81.6%	1,170
May-02	71.6%	69.9%	81.5%	1,170
Jun-02	100.9%	75.0%	81.6%	1,170
Jul-02	100.3%	78.7%	81.7%	1,170
Aug-02	100.4%	81.5%	81.8%	1,170
Sep-02	101.0%	83.6%	81.9%	1,170
Oct-02	101.8%	85.5%	82.0%	1,170
Nov-02	101.9%	86.9%	82.1%	1,170
Dec-02	102.0%	88.2%	82.2%	1,170
Jan-03	95.5%	95.5%	82.3%	1,170
Feb-03	101.9%	98.5%	82.3%	1,170
Mar-03	101.7%	99.6%	82.4%	1,170
Apr-03	101.6%	100.1%	82.5%	1,170
May-03	101.4%	100.4%	82.6%	1,170
Jun-03	100.9%	100.5%	82.7%	1,170
Jul-03	100.3%	100.4%	82.8%	1,170
Aug-03	92.5%	99.4%	82.8%	1,170
Sep-03	100.7%	99.6%	82.9%	1,170
Oct-03	53.1%	94.8%	82.8%	1,170
Nov-03	0.0%	86.2%	82.4%	1,170
Dec-03	92.8%	86.7%	82.4%	1,170
Jan-04	101.5%	101.5%	82.5%	1,170
Feb-04	88.6%	95.3%	82.6%	1,170
Mar-04	101.3%	97.3%	82.6%	1,170
Apr-04	101.5%	98.4%	82.7%	1,170
May-04	101.1%	98.9%	82.8%	1,170
Jun-04	100.5%	99.2%	82.9%	1,170

CAPACITY FACTOR (DESIGN)

NET GEN / (DESIGN ELECT RATING X PER HRS)

MO/YR	MONTH	YTD	CUMULATIVE	CONSTANT
Jul-04	96.2%	98.7%	82.9%	1,170
Aug-04	93.1%	98.0%	83.0%	1,170
Sep-04	100.0%	98.2%	83.1%	1,170
Oct-04	95.6%	98.0%	83.1%	1,170
Nov-04	101.7%	98.3%	83.2%	1,170
Dec-04	101.7%	98.6%	83.3%	1,170
Jan-05	71.1%	71.1%	83.2%	1,170
Feb-05	91.1%	80.6%	83.3%	1,170
Mar-05	101.6%	87.8%	83.3%	1,170
Apr-05	24.9%	72.1%	83.1%	1,170
May-05	37.8%	65.1%	82.9%	1,170
Jun-05	100.5%	70.9%	83.0%	1,170
Jul-05	99.9%	75.2%	83.0%	1,170
Aug-05	100.1%	78.3%	83.1%	1,170
Sep-05	100.6%	80.8%	83.2%	1,170
Oct-05	101.5%	82.9%	83.3%	1,170
Nov-05	101.8%	84.6%	83.3%	1,170
Dec-05	101.8%	86.1%	83.4%	1,170
Jan-06	101.8%	101.8%	83.5%	1,170
Feb-06	101.8%	101.8%	83.6%	1,170
Mar-06	101.9%	101.9%	83.6%	1,170
Apr-06	101.7%	101.8%	83.7%	1,170
May-06	101.5%	101.8%	83.8%	1,170
Jun-06	100.5%	101.5%	83.8%	1,170
Jul-06	99.9%	101.3%	83.9%	1,170
Aug-06	99.9%	101.1%	84.0%	1,170
Sep-06	100.6%	101.1%	84.0%	1,170
Oct-06	17.8%	92.6%	83.8%	1,170
Nov-06	66.5%	90.2%	83.7%	1,170
Dec-06	101.9%	91.2%	83.8%	1,170

GROSS GENERATION MWH

(SYSTEM OPS-WICHITA)

MO/YR	MONTH	YTD	CUMULATIVE	MONTHLY AVE. MW
Jan-96	863,196	863,196	86,122,116	1,160.2
Feb-96	0.0	863,196	86,122,116	0.0
Mar-96	0.0	863,196	86,122,116	0.0
Apr-96	615,248.0	1,478,444	86,737,364	855.7
May-96	908,362.0	2,386,806	87,645,726	1,220.9
Jun-96	804,513.0	3,191,319	88,450,239	1,117.4
Jul-96	903,592.0	4,094,911	89,353,831	1,214.5
Aug-96	890,838	4,985,749	90,244,669	1,197.4
Sep-96	883,075	5,868,824	91,127,744	1,226.5
Oct-96	908,958	6,777,782	92,036,702	1,220.1
Nov-96	890,923	7,668,705	92,927,625	1,237.4
Dec-96	921,360	8,590,065	93,848,985	1,238.4
Jan-97	922,233	922,233	94,771,218	1,239.6
Feb-97	831,563	1,753,796	95,602,781	1,237.4
Mar-97	917,739	2,671,535	96,520,520	1,233.5
Apr-97	886,558	3,558,093	97,407,078	1,233.0
May-97	762,387	4,320,480	98,169,465	1,024.7
Jun-97	879,030	5,199,510	99,048,495	1,220.9
Jul-97	904,020	6,103,530	99,952,515	1,215.1
Aug-97	905,780	7,009,310	100,858,295	1,217.4
Sep-97	880,268	7,889,578	101,738,563	1,222.6
Oct-97	63,221	7,952,799	101,801,784	84.9
Nov-97	0	7,952,799	101,801,784	0.0
Dec-97	859,730	8,812,529	102,661,514	1,155.6
Jan-98	920,900	920,900	103,582,414	1,237.8
Feb-98	830,604	1,751,504	104,413,018	1,236.0
Mar-98	920,285	2,671,789	105,333,303	1,236.9
Apr-98	887,673	3,559,462	106,220,976	1,234.6
May-98	915,317	4,474,779	107,136,293	1,230.3
Jun-98	882,770	5,357,549	108,019,063	1,226.1
Jul-98	905,212	6,262,761	108,924,275	1,216.7
Aug-98	910,208	7,172,969	109,834,483	1,223.4
Sep-98	883,896	8,056,865	110,718,379	1,227.6
Oct-98	918,891	8,975,756	111,637,270	1,233.4
Nov-98	889,510	9,865,266	112,526,780	1,235.4
Dec-98	917,669	10,782,935	113,444,449	1,233.4
Jan-99	908,693	908,693	114,353,142	1,221.4
Feb-99	821,439	1,730,132	115,174,581	1,222.4
Mar-99	917,340	2,647,472	116,091,921	1,233.0
Apr-99	33,137	2,680,609	116,125,058	46.1
May-99	597,242	3,277,851	116,722,300	802.7
Jun-99	885,385	4,163,236	117,607,685	1,229.7
Jul-99	909,144	5,072,380	118,516,829	1,222.0
Aug-99	859,907	5,932,287	119,376,736	1,155.8
Sep-99	885,391	6,817,678	120,262,127	1,229.7
Oct-99	921,349	7,739,027	121,183,476	1,236.7
Nov-99	883,282	8,622,309	122,066,758	1,226.8
Dec-99	910,799	9,533,108	122,977,557	1,224.2
Jan-00	917,906	917,906	123,895,463	1,233.7
Feb-00	856,808	1,774,714	124,752,271	1,231.0
Mar-00	915,660	2,690,374	125,667,931	1,230.7

GROSS GENERATION MWH
(SYSTEM OPS-WICHITA)

MO/YR	MONTH	YTD	CUMULATIVE	MONTHLY AVE. MW
Apr-00	883,143	3,573,517	126,551,074	1,228.3
May-00	909,141	4,482,658	127,460,215	1,222.0
Jun-00	879,725	5,362,383	128,339,940	1,221.8
Jul-00	900,618	6,263,001	129,240,558	1,210.5
Aug-00	904,927	7,167,928	130,145,485	1,216.3
Sep-00	693,018	7,860,946	130,838,503	962.5
Oct-00	0	7,860,946	130,838,503	0.0
Nov-00	651,900	8,512,846	131,490,403	905.4
Dec-00	917,691	9,430,537	132,408,094	1,233.5
Jan-01	919,040	919,040	133,327,134	1,235.3
Feb-01	831,502	1,750,542	134,158,636	1,237.4
Mar-01	865,365	2,615,907	135,024,001	1,163.1
Apr-01	886,976	3,502,883	135,910,977	1,233.6
May-01	910,550	4,413,433	136,821,527	1,223.9
Jun-01	885,350	5,298,783	137,706,877	1,229.7
Jul-01	907,229	6,206,012	138,614,106	1,219.4
Aug-01	907,815	7,113,827	139,521,921	1,220.2
Sep-01	884,818	7,998,645	140,406,739	1,228.9
Oct-01	919,354	8,917,999	141,326,093	1,234.0
Nov-01	889,074	9,807,073	142,215,167	1,234.8
Dec-01	918,850	10,725,923	143,134,017	1,235.0
Jan-02	919,971	919,971	144,053,988	1,236.5
Feb-02	827,945	1,747,916	144,881,933	1,232.1
Mar-02	635,451	2,383,367	145,517,384	854.1
Apr-02	55,580	2,438,947	145,572,964	77.3
May-02	655,325	3,094,272	146,228,289	880.8
Jun-02	882,217	3,976,489	147,110,506	1,225.3
Jul-02	906,625	4,883,114	148,017,131	1,218.6
Aug-02	907,616	5,790,730	148,924,747	1,219.9
Sep-02	882,445	6,673,175	149,807,192	1,225.6
Oct-02	918,813	7,591,988	150,726,005	1,233.3
Nov-02	889,985	8,481,973	151,615,990	1,236.1
Dec-02	919,943	9,401,916	152,535,933	1,236.5
Jan-03	863,453	863,453	153,399,386	1,160.6
Feb-03	830,452	1,693,905	154,229,838	1,235.8
Mar-03	918,050	2,611,955	155,147,888	1,233.9
Apr-03	886,920	3,498,875	156,034,808	1,233.5
May-03	916,351	4,415,226	156,951,159	1,231.7
Jun-03	882,100	5,297,326	157,833,259	1,225.1
Jul-03	905,556	6,202,882	158,738,815	1,217.1
Aug-03	838,835	7,041,717	159,577,650	1,127.5
Sep-03	880,099	7,921,816	160,457,749	1,222.4
Oct-03	485,650	8,407,466	160,943,399	651.9
Nov-03	0	8,407,466	160,943,399	0.0
Dec-03	840,536	9,248,002	161,783,935	1,129.8
Jan-04	917,440	917,440	162,701,375	1,233.1
Feb-04	751,416	1,668,856	163,452,791	1,079.6
Mar-04	914,283	2,583,139	164,367,074	1,228.9
Apr-04	886,162	3,469,301	165,253,236	1,232.5
May-04	913,564	4,382,865	166,166,800	1,227.9
Jun-04	879,840	5,262,705	167,046,640	1,222.0

GROSS GENERATION MWH

(SYSTEM OPS-WICHITA)

MO/YR	MONTH	YTD	CUMULATIVE	MONTHLY AVE. MW
Jul-04	871,237	6,133,942	167,917,877	1,171.0
Aug-04	844,801	6,978,743	168,762,678	1,135.5
Sep-04	875,531	7,854,274	169,638,209	1,216.0
Oct-04	866,224	8,720,498	170,504,433	1,162.7
Nov-04	888,855	9,609,353	171,393,288	1,234.5
Dec-04	917,180	10,526,533	172,310,468	1,232.8
Jan-05	650,885	650,885	172,961,353	874.8
Feb-05	745,135	1,396,020	173,706,488	1,108.8
Mar-05	916,318	2,312,338	174,622,806	1,231.6
Apr-05	223,720	2,536,058	174,846,526	311.2
May-05	354,284	2,890,342	175,200,810	476.2
Jun-05	879,393	3,769,735	176,080,203	1,221.4
Jul-05	903,375	4,673,110	176,983,578	1,214.2
Aug-05	905,090	5,578,200	177,888,668	1,216.5
Sep-05	879,748	6,457,948	178,768,416	1,221.9
Oct-05	917,369	7,375,317	179,685,785	1,231.4
Nov-05	889,130	8,264,447	180,574,915	1,234.9
Dec-05	918,294	9,182,741	181,493,209	1,234.3
Jan-06	917,918	917,918	182,411,127	1,233.8
Feb-06	828,905	1,746,823	183,240,032	1,233.5
Mar-06	919,238	2,666,061	184,159,270	1,235.5
Apr-06	886,723	3,552,784	185,045,993	1,233.3
May-06	915,238	4,468,022	185,961,231	1,230.2
Jun-06	877,928	5,345,950	186,839,159	1,219.3
Jul-06	903,338	6,249,288	187,742,497	1,214.2
Aug-06	903,448	7,152,736	188,645,945	1,214.3
Sep-06	878,727	8,031,463	189,524,672	1,220.5
Oct-06	170,326	8,201,789	189,694,998	228.6
Nov-06	589,492	8,791,281	190,284,490	818.7
Dec-06	917,663	9,708,944	191,202,153	1,233.4

NET GENERATION MWH

(SYSTEM OPS-WICHITA)

MO/YR	MONTH	YTD	CUMULATIVE	MONTHLY AVE. MW
Jan-96	828,168	828,168	82,265,019	1,113.1
Feb-96	-16,237	811,931	82,248,782	-23.3
Mar-96	-12,577.0	799,354	82,236,205	-16.9
Apr-96	581,521.0	1,380,875	82,817,726	808.8
May-96	872,191.0	2,253,066	83,689,917	1,172.3
Jun-96	769,603.0	3,022,669	84,459,520	1,068.9
Jul-96	867,137.0	3,889,806	85,326,657	1,165.5
Aug-96	854,163.0	4,743,969	86,180,820	1,148.1
Sep-96	847,031	5,591,000	87,027,851	1,176.4
Oct-96	871,848	6,462,848	87,899,699	1,170.3
Nov-96	856,170	7,319,018	88,755,869	1,189.1
Dec-96	885,850	8,204,868	89,641,719	1,190.7
Jan-97	885,674	885,674	90,527,393	1,190.4
Feb-97	798,848	1,684,522	91,326,241	1,188.8
Mar-97	881,996	2,566,518	92,208,237	1,185.5
Apr-97	851,161	3,417,679	93,059,398	1,183.8
May-97	726,357	4,144,036	93,785,755	976.3
Jun-97	844,561	4,988,597	94,630,316	1,173.0
Jul-97	867,244	5,855,841	95,497,560	1,165.7
Aug-97	869,651	6,725,492	96,367,211	1,168.9
Sep-97	845,280	7,570,772	97,212,491	1,174.0
Oct-97	48,810	7,619,582	97,261,301	65.5
Nov-97	-17,017	7,602,565	97,244,284	-23.6
Dec-97	827,890	8,430,455	98,072,174	1,112.8
Jan-98	889,605	889,605	98,961,779	1,195.7
Feb-98	803,378	1,692,983	99,765,157	1,195.5
Mar-98	888,947	2,581,930	100,654,104	1,194.8
Apr-98	856,317	3,438,247	101,510,421	1,191.0
May-98	881,909	4,320,156	102,392,330	1,185.4
Jun-98	850,134	5,170,290	103,242,464	1,180.7
Jul-98	871,686	6,041,976	104,114,150	1,171.6
Aug-98	876,503	6,918,479	104,990,653	1,178.1
Sep-98	851,442	7,769,921	105,842,095	1,182.6
Oct-98	885,922	8,655,843	106,728,017	1,189.2
Nov-98	858,214	9,514,057	107,586,231	1,192.0
Dec-98	886,661	10,400,718	108,472,892	1,191.7
Jan-99	876,962	876,962	109,349,854	1,178.7
Feb-99	793,072	1,670,034	110,142,926	1,180.2
Mar-99	886,728	2,556,762	111,029,654	1,191.8
Apr-99	21,352	2,578,114	111,051,006	29.7
May-99	565,228	3,143,342	111,616,234	759.7
Jun-99	852,094	3,995,436	112,468,328	1,183.5
Jul-99	873,677	4,869,113	113,342,005	1,174.3
Aug-99	824,073	5,693,186	114,166,078	1,107.6
Sep-99	850,993	6,544,179	115,017,071	1,181.9
Oct-99	885,945	7,430,124	115,903,016	1,189.2
Nov-99	849,182	8,279,306	116,752,198	1,179.4
Dec-99	877,313	9,156,619	117,629,511	1,179.2
Jan-00	884,897	884,897	118,514,408	1,189.4
Feb-00	826,181	1,711,078	119,340,589	1,187.0
Mar-00	883,049	2,594,127	120,223,638	1,186.9
Apr-00	851,125	3,445,252	121,074,763	1,183.8

NET GENERATION MWH

(SYSTEM OPS-WICHITA)

MO/YR	MONTH	YTD	CUMULATIVE	MONTHLY AVE. MW
May-00	875,094	4,320,346	121,949,857	1,176.2
Jun-00	846,482	5,166,828	122,796,339	1,175.7
Jul-00	865,454	6,032,282	123,661,793	1,163.2
Aug-00	869,163	6,901,445	124,530,956	1,168.2
Sep-00	660,140	7,561,585	125,191,096	916.9
Oct-00	-10,571	7,551,014	125,180,525	-14.2
Nov-00	622,431	8,173,445	125,802,956	864.5
Dec-00	887,389	9,060,834	126,690,345	1,192.7
Jan-01	888,118	888,118	127,578,463	1,193.7
Feb-01	803,086	1,691,204	128,381,549	1,195.1
Mar-01	833,873	2,525,077	129,215,422	1,120.8
Apr-01	855,348	3,380,425	130,070,770	1,189.6
May-01	878,069	4,258,494	130,948,839	1,180.2
Jun-01	853,966	5,112,460	131,802,805	1,186.1
Jul-01	873,972	5,986,432	132,676,777	1,174.7
Aug-01	874,542	6,860,974	133,551,319	1,175.5
Sep-01	853,335	7,714,309	134,404,654	1,185.2
Oct-01	887,293	8,601,602	135,291,947	1,191.0
Nov-01	857,462	9,459,064	136,149,409	1,190.9
Dec-01	887,593	10,346,657	137,037,002	1,193.0
Jan-02	888,357	888,357	137,925,359	1,194.0
Feb-02	799,266	1,687,623	138,724,625	1,189.4
Mar-02	608,945	2,296,568	139,333,570	818.5
Apr-02	41,519	2,338,087	139,375,089	57.7
May-02	623,618	2,961,705	139,998,707	838.2
Jun-02	849,793	3,811,498	140,848,500	1,180.3
Jul-02	872,827	4,684,325	141,721,327	1,173.2
Aug-02	873,897	5,558,222	142,595,224	1,174.6
Sep-02	850,467	6,408,689	143,445,691	1,181.2
Oct-02	886,975	7,295,664	144,332,666	1,190.6
Nov-02	858,367	8,154,031	145,191,033	1,192.2
Dec-02	887,671	9,041,702	146,078,704	1,193.1
Jan-03	831,072	831,072	146,909,776	1,117.0
Feb-03	801,210	1,632,282	147,710,986	1,192.3
Mar-03	885,555	2,517,837	148,596,541	1,190.3
Apr-03	854,714	3,372,551	149,451,255	1,188.8
May-03	882,299	4,254,850	150,333,554	1,185.9
Jun-03	850,274	5,105,124	151,183,828	1,180.9
Jul-03	872,780	5,977,904	152,056,608	1,173.1
Aug-03	805,442	6,783,346	152,862,050	1,082.6
Sep-03	848,540	7,631,886	153,710,590	1,178.5
Oct-03	462,620	8,094,506	154,173,210	621.0
Nov-03	-12,790	8,081,716	154,160,420	-17.8
Dec-03	807,951	8,889,667	154,968,371	1,086.0
Jan-04	883,896	883,896	155,852,267	1,188.0
Feb-04	721,298	1,605,194	156,573,565	1,036.3
Mar-04	881,977	2,487,171	157,455,542	1,185.5
Apr-04	853,917	3,341,088	158,309,459	1,187.6
May-04	879,963	4,221,051	159,189,422	1,182.7
Jun-04	846,910	5,067,961	160,036,332	1,176.3
Jul-04	837,005	5,904,966	160,873,337	1,125.0
Aug-04	810,094	6,715,060	161,683,431	1,088.8

NET GENERATION MWH

(SYSTEM OPS-WICHITA)

MO/YR	MONTH	YTD	CUMULATIVE	MONTHLY AVE. MW
Sep-04	842,667	7,557,727	162,526,098	1,170.4
Oct-04	833,054	8,390,781	163,359,152	1,118.2
Nov-04	856,664	9,247,445	164,215,816	1,189.8
Dec-04	885,291	10,132,736	165,101,107	1,189.9
Jan-05	618,685	618,685	165,719,792	831.6
Feb-05	716,081	1,334,766	166,435,873	1,065.6
Mar-05	884,712	2,219,478	167,320,585	1,189.1
Apr-05	209,235	2,428,713	167,529,820	291.0
May-05	329,357	2,758,070	167,859,177	442.7
Jun-05	846,487	3,604,557	168,705,664	1,175.7
Jul-05	869,375	4,473,932	169,575,039	1,168.5
Aug-05	871,289	5,345,221	170,446,328	1,171.1
Sep-05	847,341	6,192,562	171,293,669	1,176.9
Oct-05	884,564	7,077,126	172,178,233	1,187.3
Nov-05	857,647	7,934,773	173,035,880	1,191.2
Dec-05	886,172	8,820,945	173,922,052	1,191.1
Jan-06	886,275	886,275	174,808,327	1,191.2
Feb-06	800,601	1,686,876	175,608,928	1,191.4
Mar-06	887,370	2,574,246	176,496,298	1,192.7
Apr-06	855,828	3,430,074	177,352,126	1,190.3
May-06	883,329	4,313,403	178,235,455	1,187.3
Jun-06	846,602	5,160,005	179,082,057	1,175.8
Jul-06	869,974	6,029,979	179,952,031	1,169.3
Aug-06	869,842	6,899,821	180,821,873	1,169.1
Sep-06	847,422	7,747,243	181,669,295	1,177.0
Oct-06	155,136	7,902,379	181,824,431	208.2
Nov-06	560,443	8,462,822	182,384,874	778.4
Dec-06	887,447	9,350,269	183,272,321	1,192.8