

## Appendix C

### Big Muddy National Fish and Wildlife Two Year Traffic Counter Report

In the fall of 2005 the Big Muddy National Fish and Wildlife Refuge purchased 5 traffic counters to establish an estimation of visitation on the refuge. Four inductive loop counters called the Traffic Tally 41 and one infrared trail counter TTC-4420 were purchased from Diamond Traffic Products out of Oakridge, Oregon.



Inductive loop counters count vehicles by a buried inductive loop (wire) under a road bed. The loop gives off a slight magnetic signal and when a large metal vehicle passes over that loop the counter counts. The system has proven successful and will operate for over a year on a set of batteries.

Infrared trail counters use an invisible infrared beam passed across a trail between the counter and a reflector. When ever the beam is broken the counter counts. The counters beam is placed at waist height approximately 4 feet. This system is the most widely used trail counter system.

#### Counter Location Justification

The Big Muddy National Fish and Wildlife Refuge currently has eight units. These eight units do not have equal public access and visitation to each unit varies greatly. The refuge choose four sites to install the inductive loop counters that represented a range from highly accessible, close to a major thoroughfare and larger communities to more remote away from communities and a distance from major thoroughfare.

The trail counter was placed on a trail completed in 2004 with the highest probability of diverse hikers spurred from trails and experiences on adjacent Arrow Rock State Historical Site and campground.

## Description of Locations

### Overton Bottoms North Unit

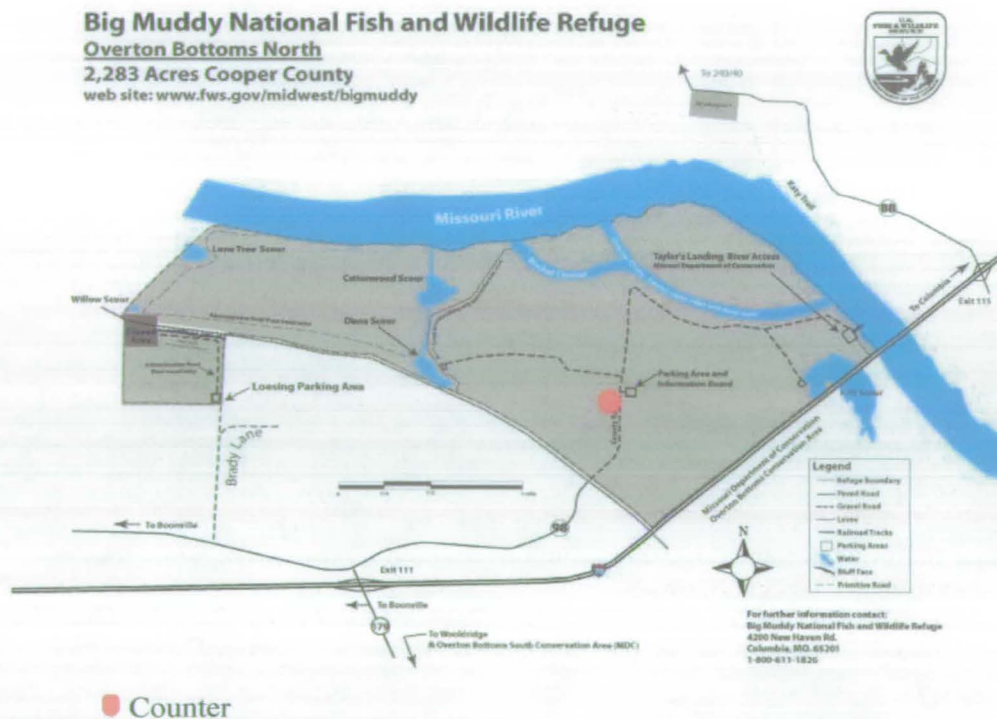
An inductive loop counter was placed under a county road that passes through this unit. This is the refuge's most accessible unit with almost 4 miles of road passing through it. The roads dead end at two parking areas and a boat ramp so visitors must pass over the counter twice.

The boat ramp is owned and maintained by the Missouri Department of Conservation. The counter can not differentiate between a vehicle pulling a trailer and one that did not. The counter was placed about a half mile into the entrance of the refuge.

At the entrance is a train track and there was a concern that if the counter was too close to the tracks vehicles may park over the counter while waiting for the train. Or the train vibrations could possibly trigger additional counts.

Counter was placed under a lone tree in order for it to be easily located as heavy vegetation could easily conceal it.

The counter was installed on December 22, 2005. This unit is in close proximity to interstate 70 and the communities of Boonville and Columbia. See map for reference.



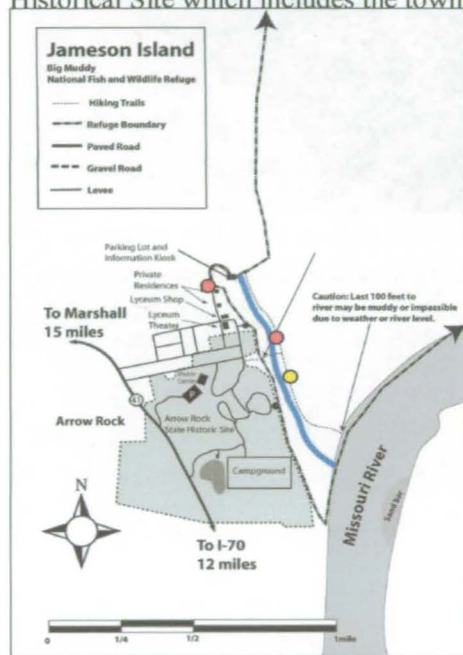


### Jameson Island Unit

An inductive loop counter was placed under a county road leading to a parking area of this unit of the refuge. There are no interior roads in this unit so all vehicles traveling to this road must return. Installed 12/21/2006

In addition to the inductive loop counter, an inferred trail counter was placed along the Lewis and Clark Trail of discovery. Installed 12/19/2005, removed 10/06 reinstalled on 1/18/08.

The Jameson Island Unit has a unique location situated next to Arrow Rock State Historical Site which includes the town of Arrow Rock. The State Historical site and attractions in the town of Arrow Rock receive almost 250,000 visitors a year. (Friends of Arrow Rock Website) The State Historic Site includes a visitor center-museum, campground and hiking trails. The town also has the Lyceum Theater, Missouri's oldest regional operating theater.



Starting in October 2006 the Jameson Island Chute project began which dramatically impacted the traffic on the road monitored by the inductive loop. Heavy equipment was transported down this road. Contractors conducting the work traveled up and down the road daily.

Circles represent traffic counter locations:

### Lisbon Bottoms Unit

The traffic counter for the Lisbon Bottom Unit was placed on the access road to the parking lot. This parking lot is located off graveled Howard County road 317. The counter was not placed on the county road as the road is used for quarry operations moving rock from the quarry just down the road from the parking lot. Installed 1/3/2006.

This unit represents a more isolated situation for a refuge visitor. This survey area represents approximately 50 percent of our refuges public accessibility to refuge units. Several of our units are in isolated areas, and would represent a destination for the informed visitor. Occasionally a casual visitor would stumble across these locations.

Casual visitors traveling along the county road would possibly be enticed to pull off the county road to the parking lot as the information kiosk visible from the county road and signs directing visitors to it would spark visitors to pull into the area for more information. (See photo below of county road and access road to parking area.)

This counter proved to be the most consistent overall with counts that reflected overall use of the area.

The area receives considerable hunting during the Missouri firearms deer season. This information comes from direct observations from refuge Law Enforcement officer who patrols the area frequently during the season. All users do not use the parking lot as the county road provides access to numerous locations.



**Big Muddy National Fish and Wildlife Refuge**  
**Lisbon and Jameson Island Units**  
 Saline and Howard Counties 3,885 Acres  
 website: [www.fws.gov/midwest/bigmuddy](http://www.fws.gov/midwest/bigmuddy)



The map demonstrates how the county road serves as a hunting access along the east side of the property boundary in the Lisbon Unit. Many of the hunters who use the unit do not visit the parking lot as the desired hunting area may be closer to the county road. Several blocked roads into the unit provide enough room to park a vehicle. The shoulder of the county road provides areas to park as well

and hunters and other refuge users are likely to utilize these locations other than the parking area because it provides easier access to areas they want to utilize on the refuge. Direct observations on the amount of users that utilize the parking area verses the other access areas was difficult to obtain. A professional judgment of the use is approximately



25% of the refuge users in the area visit the parking lot to park or gather information from the kiosk.

### **Boone's Crossing Unit**

The traffic counter at the Boone's Crossing unit is also located under the road into the parking area for the unit. Unlike the Lisbon unit this is more likely the only area hunters and other refuge specific users utilize to access the area. First installed 1/13/2006.

A large parking lot adjacent to the refuge lot was built by the city of Chesterfield to provide access for people to utilize ball playing fields built next to this refuge unit. The refuge receives occasional visitors that walk from that parking lot into the refuge, and thus are not counted. To offset that count it is assumed that some users of the ball fields may utilize the refuge parking lot because trees adjacent to the refuge parking lot provide shade for vehicles that the city parking lot does not. This is typical of the summer months when refuge use is at its lowest and ball field use is at its highest.



A new multipurpose paved trail built by the city of Chesterfield in 2007-08 on top of the levee adjacent to this unit will increase the use of the refuge by foot. A short refuge trail was built on the refuge with help from a local Girl Scout troop and a future trail counter would help to estimate use of the trail, which will likely increase as the new trail gets utilized and more users discover the refuge.



On this aerial photo and refuge outline in yellow the thickest red line represents Interstate 64. The medium red line represents the new multipurpose trail and the small red line represent a mulched trail on refuge and adjacent city property. Johnson Island of this unit is totally separated by a permanent side channel of the Missouri River. The island is getting used by hunters but seldom by other visitors. Mosely's landing provides a visitors information kiosk and access steps up the bank. The majority of the use in this unit of the refuge is on the 131 acre mainland parcel.

This unit is located in St. Louis County and within the city limits of Chesterfield. Chesterfield is a suburb of St. Louis and the area has seen dramatic growth in the last 10 years. The use of this unit is expected to grown as more people discover its location and use increases of the new multi-purpose paved trail.

#### **Traffic Counter Success**

Over the two years that these counters have been installed there were wide variations in counts. Two inductive loop counters were damaged by water getting into the circuitry. The trail counter was also damaged by water that got into the circuitry by a whole chewed into the counters plastic case covering. Either a squirrel or mouse was the vandal in this situation.

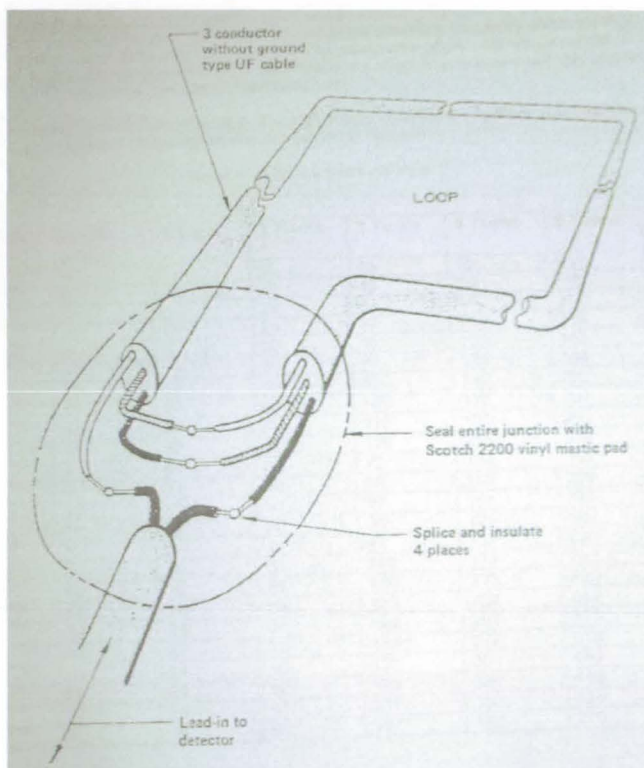
Another problem encountered were the cables of the inductive loop counters would get wet where they were spliced together under the road bed. This would cause the counters to quit counting, or over count. All of the loops were dug up and re-spliced and sealed with and epoxy to make sure that water did not get into the spliced wire. The counts we more productive after the splices were sealed.





Diamond Traffic Products recommended tar to seal the splice. JB Weld Quickset epoxy or similar flexible epoxy was used to seal the splice. It provided a cleaner and quicker method than tar. After the two parts of the epoxy were mixed you had approximately 5 minutes to seal the splice before the epoxy set. The photo shows the sealed splice for the counter at Lisbon. Wire nuts were used in this case but butt splices were more effective and easier to tape after

the epoxy set. Epoxy was used to cover the entire splice and any exposed wire. After the epoxy set the entire splice was wrapped in electrical tape.



This diagram shows the formation of the inductive loop. This loop was typically buried under the gravel road at least 6 inches. The loop averaged 12 feet long by 6 feet wide. To complete the entire loop and lead into the counter required approximately 50 feet of wire. The wire was 14 AWG (American Wire Gauge). The wire is required to be in three strands insulated impervious to water, sunlight, and other destructive residues.

The wire is available at most retail home improvement centers and at the time of this writing was available for approximately .66 cents a linear foot.

Each counter will be described in detail and a summation of the counts will be formulated to the best professional judgment on the amount of use in the particular area of the traffic counter.

### **Overton Bottoms North Counter**

The Overton Bottoms North counter was installed on December 22, 2005. The counter appeared to work steadily through June 2006. On June 19<sup>th</sup>, the inductive loop wire was dug up to the splice and filled with epoxy to keep water out of the connection under the road. After the splice was completed the traffic counter worked well after several crossing attempts.

On June 21<sup>st</sup> I checked the counter in the peak time of day. It was extremely hot 90 plus and the counter was not counting. I adjusted the delay without success. On June 27<sup>th</sup> I checked the counter again on a cooler part of the day and the counter counted my vehicle at each crossing. This lead me to the conclusion that there may be a problem with the counter under extreme conditions. I called the company and they informed me there may be a problem with the circuitry in the unit.

I was unable to test the unit until September 26<sup>th</sup>-27<sup>th</sup> To conduct the test I switched the Lisbon unit with the Overton Unit. The Lisbon counter was counting steadily but I concluded that the Overton count would be more beneficial so I switched the two. I got no improvement at Overton so I concluded that it had to be a problem with the inductive loop. I dug up the cable again and re-spliced the connection. This corrected the problem and the traffic counter continued with steady counts until May 8<sup>th</sup> 2007. In the meantime I replaced the batteries on this unit on April 14, 2007.

On May 8<sup>th</sup> I found that the traffic counter at Overton had been flooded with rainwater. My plan was to remove it due to the predicted flood crest on May 11<sup>th</sup>. The heavy rain events had saturated the ground enough to flood the counter before the flood waters of the river reached the counter. It was removed for replacement

The flood on May 11<sup>th</sup> reached the location of the counter at Overton. The wooden box that protected the counter floated out of the ground and was tethered by the inductive loop cable. If not it would have floated away. On May 17<sup>th</sup> Wedge Watkins and myself while inspecting the flood at Overton moved the box to a more secure location under a tree. The cable was disconnected from the box and dropped into the flood waters. The rest of the cable was still buried under the road and 2 feet of floodwater.

On May 21<sup>st</sup> I reconnected the Boone's Crossing counter to the Overton site. I removed the Boone's Crossing unit because of flood threat there as well. I found the cable and cleaned it and connected it to the counter on May 21<sup>st</sup>. The counter worked, the cable and splice had held after being under flood waters for over a week. The counter worked steadily through August 23<sup>rd</sup>. At some point between this date and August 4<sup>th</sup> the Cooper county road crew graded up the gravel road and ripped out the inductive loop cable in the



road. Fortunately the counter was not damaged. I scoured the road looking for the cable and finally found it in several pieces in the graded gravel along the side of the road.

The cable was reburied on September 22<sup>nd</sup> with help from scout troop 707. The digging was difficult but the scouts prevailed and the new cable was buried approximately 8 inches deep. Splices were sealed with epoxy. Sand was used to cushion the cable from the sharp rocks in the road around the cable in the ditch.

The traffic counter is currently counting to the date of this report.

#### **Summary of Counts at Overton**

<b>Dates</b>	<b>Counts</b>
<b>12/22/05-8/21/06 8 months</b>	<b>8,802 = 1,100 visitors a month</b>
<b>9/27/06-4/19/07 7 months</b>	<b>7,144 = 893 visitors a month</b>
<b>5/21/07-8/23/07 3 months summer</b>	<b>4,327 = 1,442 visitors a month</b>
<b>9/22/07-1/9/08 4 months fall-winter</b>	<b>3,564 = 891 visitors a month</b>

The traffic counter at Overton considers each count of the counter as a visitor even though the traffic counter counts each vehicle twice. Due to observations most vehicles contain at least two individuals. The peak of use at Overton is during the summer when days are longer and more traffic is visiting especially Taylors Landing boat ramp.

There is a slight rise during the hunting seasons between October through December of the average of 900 visitors a month but it is not significant. The low typically occurs between December and March where certain counts have dropped below 200 visitors per month.

The Missouri Department of Conservation (MDC) conducted a Missouri River Recreation survey from January 2004 to January 2005. In this survey, individuals were stationed at various Missouri River access points to establish some finite statistics on the recreational use of the Missouri River. One of the access points surveyed was Taylor's Landing. This landing is the access point in the Overton Bottoms North Unit of the refuge. In speaking with Steve Sheriff of MDC he informed refuge staff that he would probably have good estimates of use from Taylors Landing from March 2004 to January 2005. He would share that information when the entire project becomes finalized.

#### **Jameson Island Unit**

The Jameson Island unit traffic inductive loop counter was installed on December 21, 2005. The counter experienced some technical difficulty in the first few months of operation it would occasionally miss a count on checks. On June 12<sup>th</sup> 2006 the inductive loop wire was dug up and the connection was re-spliced and sealed with epoxy. The counter was reset to 0. The counter seemed to work correctly from that time on. It had

previously counted when the unit was bumped. The re-splicing also seemed to correct the problem.

In October of 2006 the Jameson Island Chute construction project started. This project slightly impacted the count on the road as the contractor used the access road exclusively to transport equipment and workers to the construction site.

On April 19<sup>th</sup> 2007 batteries of the unit were replaced, and the counter was reset to zero. The access road had apparent damage due to construction equipment traveling on the road.

Due to the construction project, and the malfunctions in the unit in the first months of operation, the best estimate on true traffic counts occurred between June and October of 2006.

#### **Summary of Counts at Jameson Island Unit**

<b>Dates</b>	<b>Counts</b>
<b>12/21/05-6/12/06 6 months</b>	<b>4,389 = 732 visitors a month</b>
<b>6/12/06-12/12/06 6 months</b>	<b>4057 = 676 visitors a month</b>
<b>12/12/06-4/19/07 5 months, construction</b>	<b>6,530 = 1306 visitors a month</b>
<b>4/19/07-10/16/07 6 months construction</b>	<b>5,617 = 936 visitors a month</b>
<b>10/16/07-1/18/08 3 months (worst counts)</b>	<b>28,623 = 9541 visitors a month (invalid?)</b>
<b>6/12/06-10/23/06 4 months (best counts)</b>	<b>2,576 = 644 visitors a month</b>

The extremely high count between October 2007 and January 2008 were possibly because of the movement of equipment from the construction project. The contractor was required to move all equipment off the site. A large earth mover parked and idling over the counter could have attributed to the extremely high counts?

#### **Lewis and Clark Trail of Discovery**

The infrared trail counter installed on the Lewis and Clark Trail of discovery has not produced any effective counts. The counter was damaged by a rodent, which allowed water to get into the unit. The reflector was continually moved and got in the way of mowing the trail. The counter was completely removed on September 20<sup>th</sup> 2006.

The counter was reinstalled on December 13<sup>th</sup> 2007, it was checked on January 18, 2008 and showed 429 counts. This is a possible number and needs to be correlated with more connections with people counts to deer counts. A trail camera could be placed at this location to get an idea of the amount of trail use by people vs. deer. It is possible that more counts will indicate more accurate use of the trail.



### **Lisbon Bottoms Counter**

The Lisbon Bottoms Counter was installed on January 3<sup>rd</sup> 2006. Because of the remote location and requirement for the visitor to travel off the county road to the parking area the counts were expected to be low the other units. The first two months indicated that with approximately 240 visitors a month.

The next traffic counts showed extreme spike in counts for no apparent reason. The best count that was more indicative to the area was 130 in between May 18, 2006 to June 27 2006.

On March 3<sup>rd</sup> 2007 the cable at Lisbon was pulled and sealed. The counter was thoroughly checked after the flood on May 11<sup>th</sup> 2007 and was unaffected by the floodwaters. The counts after the cable was sealed seemed to reflect the more typical counts expected at this units parking area.

### **Summary of Counts at Lisbon Bottom Unit**

<b>Dates</b>	<b>Counts</b>
<b>1/3/2006-5/18/2006</b>	<b>7981 = 1596 visitors a month</b>
<b>5/18/06-6/27/06</b>	<b>130 = 130 visitors for month</b>
<b>6/27/06-12/13/06</b>	<b>6110 = 1018 visitors a month</b>
<b>12/13/06-03/07/07</b>	<b>9880 = 3293 visitors a month</b>
<b>03/07/07-5/21/07</b>	<b>367 = 183 visitors a month</b>
<b>5/21/07-11/28/07</b>	<b>721 = 120 visitors a month</b>
<b>11/28/07-1/18/08</b>	<b>140 = 70 visitors a month</b>

The counts after the inductive loop was sealed appear to be more accurate than the high counts prior. The productive count during the May-June period in 2006 may have occurred during a period of favorable weather where the oxidation of the unsealed splice may have not been a concern.

After the inductive loop was sealed the higher counts in the spring were possibly attributed to the spring turkey hunting and the greater occurrences of casual drivers that tend to travel back roads in the spring to get out after the winter.

The total for a 10 month count came out to 116 visitors a month. The can also be interpreted to 58 vehicles a month utilizing the parking area over a 10 month period from March until January. As with the other two locations each vehicle is estimated to contain two visitors. The peak of visitation at this unit was probably during the firearms deer season. Direct observations from the refuge law enforcement officer counted up to 8 vehicles in the parking area at one time.

### **Boone's Crossing Counter**

The Boone's Crossing counter was installed on January 13, 2006. This counter experienced numerous problems for the first year. Someone tampered with it and reset it within the first six months of its installation. On July 10<sup>th</sup> 2006 a wooden box was constructed and buried to conceal the counter from the public. Previously it had been hidden behind a large rock adjacent to the parking area. To check the counter from this point on required a ¼ hex head bit and drill to remove the board from the top of the box to check the counter.

This counter was not checked again until February 5, 2007. On that date a high recording of 15,282 was on the counter and it did not record any additional counts after several attempts. The counter was checked again on 3/14/07 and it had the same number as February. The counter was pulled from the box and was full of water. The electronics were in need of full replacement.

The constructed wooden box at one time had filled with rainwater and could not drain because of the high clay content in the soil. On 4/17/07 a repaired counter was reinstalled. A French drain was constructed under the box with a one inch pipe to allow draining of rain water from the box. The splice on the inductive loop wire was also sealed at this time. On 5/9/07 the counter had to be removed because of threat of the area to flooding. This counter was put at Overton after the flood waters receded. The repaired Overton counter was installed at Boone's Crossing on 6/12/07. The best counts on this counter were between April and May 07 and June through October 07. The additional counts will not be considered.

The last count taken at Boone's crossing was on 1/24/08. Another extremely high count had occurred which leads to concern that the counter has experienced another set back in counting.

### **Summary of Counts at Boone's Crossing Unit**

<b>Dates</b>	<b>Counts</b>
<b>4/17/07-5/9/07</b>	<b>860 = 860 visitors a month</b>
<b>6/12/07-10/14/07</b>	<b>746 = 186 visitors a month</b>

The 186 visitors a month is the most probable count that can be considered for this counter. A short count between June 12 2007 and July 2 was taken showing 108 counts. The 860 count between April and June is probable as that covered Spring Turkey hunting and numerous counts during the final trail mulching project in which trucks crossed the counter numerous times on April 29<sup>th</sup>.



## Summary

Traffic counters create challenges in interpreting the data collected. Numerous conditions can affect the count. They cannot inform you of the intended use of the visitor but they can give you an idea of visits.

The assumed successful counts taken from the inductive loop counters on the refuge will give the refuge a number of visitors to help understand impact to refuge resources, such as roads and parking areas. The average counts of 1200 visitors a month at Overton supported the refuge belief that this was our highest visited unit. Also the 600-800 visitors a month put the Jameson unit at half the visitors of Overton. Looking at vehicles, Overton is receiving an average of 20 vehicles per day and Jameson 12 vehicles per day.

The traffic counter at Boone's Crossing and Lisbon reflected visitors going specifically to the refuge parking area. The lower numbers of 95 visitors a month at Lisbon and 186 visitors at Boone's Crossing indicated that the parking areas are visited much less frequently but are still receiving an average of 1 to 2 vehicles per day.

To improve the future of the data it is recommended to gather information from the counters at least twice a month. This would help monitor monthly use and possibly show spikes in use that may correspond with hunting seasons, considered one of the highest uses of the refuge. A weekly count before and after weekends would help in monitoring possible increase use on the weekend.

Further collection of the data with existing counters will produce better statistics and help in monitoring problems that arise with the counters. Use of activity ratios to estimate visits for recreational or educational activities that are not monitored by traffic counters or direct head-count, including hunting, fishing, wildlife observation, photography, and other compatible uses. Acceptable sources of information for calculating activity ratios: Visitor Satisfaction Survey results, Surveys conducted by other agencies, visitor registers, law enforcement reports, especially for hunting and fishing. (Introduction to Visitation Estimation on National Wildlife Refuges and Wetland Management Districts) Dr. John B. Davis University at Albany, State University of New York.

The survey conducted by the Missouri Department of Conservation on the recreational use of the river will provide an excellent source to establish a visitor ratio at the Overton Bottoms Unit of the refuge.

Other methods considered in (Introduction to Visitation Estimation on National Wildlife Refuges and Wetland Management Districts) Dr. John B. Davis University at Albany, State University of New York.

#### Direct Observation

Direct observation means that the visitor is monitored visually or by video camera. One very common method of direct observation is to have a receptionist, volunteer, or staff member use a hand-held counter to tally each visitor who enters a visitor center or contact station. Direct observation is also used to calibrate traffic counters, determine activity ratios, and count the number of participants in programs. Obviously, direct observation can provide highly accurate counts, but can also be time-consuming. Direct observation in the field is indispensable when it is incorporated as a periodic supplement to other counting methods in order to obtain estimates of critical multipliers (such as the number of persons per vehicle) or activity ratios.

#### Patrols

In the patrol method, a refuge employee or volunteer walks, drives, or takes a boat to specific locations where visitors participate in recreational or educational activities. Typical locations for patrols include boat ramps, parking lots, and fishing areas. Patrols are the recommended method for use on wetland management districts. The purpose of a patrol is to observe a sample of visitors, vehicles, or boats at visitor use areas and extrapolate an estimate of the total number of visitors using those areas. Patrols can be specifically scheduled for this purpose, or they may be collateral to other duties, such as law enforcement patrols during hunting season. The greatest drawback to the patrol method is that it is time-consuming, but for refuges that have too many areas to monitor with traffic counters, patrols may be the best solution.

#### Self-Registration

Applications of this method include: guest books at visitor centers, trail registers, and voluntary permits for hunters or anglers. The respondent may be asked to indicate the number of persons in the party, the types of activities selected, and the length of his or her stay. Information about the types of activities selected is particularly helpful because it can be used to estimate activity ratios. Self-registration tools are inexpensive and may be the only feasible methods at remote trailheads or parking areas. However, accuracy of the counts is always limited by uncertainty about the degree of compliance. Many visitors do not bother to register. Repeat visitors and local residents are highly unlikely to register each time they visit.

#### Entrance Fee Stations and Permits

Entrance fees may be collected at a staffed entrance station, a visitor center, or a self-pay station such as an "iron ranger." Examples of user permits, both with and without fees, include campground registration, permits for river access, and hunting permits (such as



those assigned by lottery for specific areas). User permits can be very accurate sources of information for particular activities, such as boating or hunting, especially if the refuge devotes sufficient time to permit checks and enforcement. Entrance fees are also a valuable source of data regarding trends in the number of visitors, but they do not provide complete information about the number of visitors unless there is a staffed fee booth where all visitors must stop before entering the refuge. The entrance fees collected at a self-pay station usually can not be used to estimate the total number of visitors to a refuge.

### Surveys

Surveys include mail-back questionnaires placed on windshields; traffic-stop surveys conducted by volunteers, contractors or staff; contracted telephone or mail surveys; and hunter reports at check-in stations. Surveys are very accurate if properly conducted. They can provide a wealth of information about the number of persons per vehicle, the type of activity in which each party participates, and even marketing data, such as demographics and activity preferences. However, surveys performed by contractors are expensive. One additional complication is that visitor surveys must be approved through a formal procedure requiring significant advance notice.

### Indirect Estimation Based on Professional Judgment

This method includes two types of estimation: (1) extrapolating the total number of visitors to the refuge or the number participating in a specific activity, using a very small sample of visitors and (2) estimating visitor numbers based on an assumption about the visitors' behavior. This is the least accurate method of visitation estimation, but there are cases where no other method is practical, especially for remote and roadless refuges. The manager who uses these methods should strive to make the most reasonable estimates possible and document the logical reasons for the estimates