OZARK NATIONAL SCENIC RIVERWAYS

SOLID WASTE MANAGEMENT STUDY

1973

NATIONAL PARK SERVICE

UNITED STATES DEPARTMENT OF INTERIOR

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SUMMARY

General

Ozark National Scenic Riverways (ONSR) was authorized in 1964 as part of National Park Service System under the administration of U.S. Department of Interior. Although land acquisition began in 1966, the ONSR did not become a fully operative Park until 1969, and has been under continual improvement and development.

Due to the geographical distribution of activity centers and the nature of road network, the ONSR was divided into four (4) maintenance management district. Each district has a maintenance foreman, directed by the Park Maintenance Supervisor, operating under the Park Superintendent's supervision. Solid waste management has required up to 40% of the area maintenance foreman's time in the past as it has evolved to present day practices.

Basically at the time the Engineers made their field survey in the summer of 1973, the Park was collecting all of the solid waste and disposing of it in dumps adjacent to the four district. During the period of the study and evaluation by the Engineers, the Park let a contract to a private contractor to dispose of the solid waste from the four districts in an approved landfill. Also during that period the Park acquired three additional small (5 cubic yard) compactor units each mounted on a GSA rental truck. These, with the one previously purchased, are now used to collect the refuse from the campgrounds, picnic areas, etc. in the

various district. The units then dump their pick-ups into the Contractor's 6 cubic yard containers located at strategic points close to the major generation areas.

Prior to August 15, 1973, the collection and disposal system was completely operated by Park personnel and equipment. Since that time the Park collects the solid waste and the disposal, including transportation to the disposal site is done by the private contractor.

Containers for refuse are 32 gallon (with cover), 55 gallon (uncovered) and 6 cubic yard bulk containers located throughout the Park with GSA plastic liners being provided for all 32 and 55 gallon containers. River cleaning is made by john boats powered by outboard motors and river crews. The river refuse is deposited in the 6 cubic yard bulk containers for pick-up by the contractor. With the exception of one location, namely Akers Ferry, the contractor apparently is now providing the 6 cubic yard bulk containers. The Park still provides a bulk container at this location and transports it to and from Round Spring each day during the summer season.

The Contractor is required to empty the 6 cubic yard bulk containers daily during the Summer season. The frequency of collection is reduced to twice a week in Fall and Spring and once a week in the Winter.

The estimated present waste generation in ONSR is about 275 tons and the estimated present solid waste management costs approximate $96,325 annually, including the private disposal service and general administration cost.

Occasional heavy rainfall in the area creates flooding in some of the river campgrounds. These occur on an average of twice a year, and creates many problems for the river cleaning crews.

Waste Characteristics and Generation Rate

Actual solid waste sampling was conducted in July 1973 to determine the composition of solid waste as well as rate of generation from each source area. The results are summarized as follows:

Composition -	Food Waste	38%
	Other Combustibles	23%
	Non-Combustibles	39%

Rate of Generation - 1.31 pounds/Camper-Day
0.41 pounds/Picnicker
3.33 pounds/Occupant-Day

The refuse generated from campgrounds, picnic areas and staff residences constitutes 78.3% of the total generation. Waste from river cleaning amounts to 9% of the total. Therefore, rates of generation from other sources becomes insignificant. These data will assist NPS in determining total quantitative waste generation should conditions changed in future planning.

The categorical activities contained in the Monthly Public Use Records were studied and analyzed through data processing equipment. This indicates an average of 21% per year in Park usage. However, it should be pointed out that the information available dates only from 1971. Knowing the present rate of waste generation and the trend of increasing generation per capita, the future solid waste generation in ONSR is projected through year 1983. Approximately 1,100 tons per year are predicted

to be generated in ONSR for 1983.

Alternative ONSR Solid Waste Management Systems

All current methods of solid waste collection and disposal were investigated. However, the quantity of refuse generated at the present time and projected for future is so small that composting, recycling, pyrolysis, etc. cannot be practically and economically applied to ONSR waste management system. As a result of this, only two (2) alternative solid waste management systems were considered for ONSR, namely, incineration and complete operation by the Park.

On-site incinceration requires 4 package incinerators equipped with afterburner sections and continuous feeding mechanism located on each at Alley Spring, Round Spring, Powder Mill and Big Spring. The estimated annual owning and operating costs for such system is about $136,000. It is questionable that commercially available small package units will continue to meet the recently published emission standards, to say nothing of more stringent standards of the future.

The other alternative solid waste management system considered was an NPS operated centrally located sanitary landfill. Five acres of land, preferably near Eminence, are required for the anticipated quantity of waste being generated for the next 10 years. The annual owning and operating costs for such operation is estimated to be $136,000. Reason for costs being so high is due to operating cost of the present collection system and the transportation to the landfill

site. Efficient landfill operation is not realized due to short seasonal operation.

RECOMMENDATIONS

1. The 55 gallon refuse containers must be replaced by 32 gallon containers as the Missouri Solid Waste Management Plan (MSWMP) calls for manually lifted containers not to exceed 35 gallons in capacity. In addition, all containers require covers.

2. The 6 cubic yard containers and the dump truck operation at Akers Ferry should be phased out, since the operation is uneconomical and does not meet the requirements set forth in the Guidelines for Review of Comprehensive Solid Waste Management Plans published by the Missouri Division of Health.

3. Continue the river cleaning operation and refuse pick-ups by the 5 cubic yard compactors as presently operated by NPS, except in those primitive camping areas where collections are made only once a week - these areas should be collected at least twice a week to conform to MSWMP requirements.

4. Continue the privately operated disposal service, as it appears to be the most economical disposal method available at this time.

The Guidelines for Review of Comprehensive Solid Waste Management Plans issued by the Division of Health of Missouri calls for at least twice per week service for community bulk container systems. Obviously, once per week collection from December 1 through March 31 as called for in the NPS contract with Diamond Sanitation Co. does not

satisfy this requirement. However, arrangements can be made between NPS and the private contractor so that the specific date of collection once a week by NPS and placement in the containers will be followed by a pick-up the following day by the contractor. This will essentially minimize the duration of storage in the bulk container and in effect the bulk containers will serve as a transfer station rather than storage containers. This method meets the Guideline requirements.

5. Due to the present relatively small quantities of refuse generated per day even during the summer months, it is recommended that the daily collection in campgrounds, picnic areas, etc., in all districts be accomplished by the driver of the 5 cubic yard compactor truck. The elimination of the helper-laborer could save NPS almost $9,000 per year. When the generation rate increases sufficiently to warrant the addition of a helper on each truck, it should not be difficult to go back to a two man per truck operation.

6. NPS should maintain separate accounts for solid waste collection and disposal. This is especially important in view of the present use of the new 5 cubic yard truck mounted compactors. Operational and maintenance costs of these units should be maintained to evaluate their efficiency and effectiveness.

7. River contamination due to flooding should be studied further to determine the short and long term effects due to submersion of the solid waste containers during such floods. Although this was not included as a part of the scope of this study, it should be thoroughly

investigated in the near future and steps taken to minimize this problem.

Finally, NPS should establish good communications with the three regional planning commissions that are charged with the responsibility of developing area solid waste management systems. It may be possible that in the future sanitary landfills may be established in close proximity to the various districts in the Park that can be utilized at more economical costs than presently exist.

I. INTRODUCTION

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A. Study Objective and Scope of Work

Officials in the National Park Service are cognizant of the problems of managing the solid waste generated within the Ozark National Scenic Riverways. Moreover, the recent acquisition of Akers Ferry by the Park Service has imposed more burden on the inadequate existing refuse handling equipment. To act in accord with the future development program of ONSR and to eliminate past dumping practice, the NPS sought professional assistance to conduct a study and provide alternative solutions to the present solid waste management practice for ONSR.

This study is to:

1. Identify sources of solid waste generation
2. Determine the waste characteristics and rate of generation from each source
3. Project future generation of solid waste
4. Evaluate the existing waste management system and determine its adequacy in handling present and projected future waste load
5. Provide alternative waste management systems and their associated costs for implementation
6. Recommend the most feasible system based on environmental requirements, engineering and economy

B. Park History

Authorized under the Public Law 88-492 and signed into law on

August 27, 1964 by Lyndon B. Johnson, the Ozark National Scenic Riverways (ONSR) under the administration of the National Park Service (NPS), United States Department of Interior, became the first riverway to be included in the National Park Service. See Map on Page I-4.

Although the land acquisition began in 1966, the ONSR never was a fully operative Park until 1969 and it has been under continual programmed development since then. Hawes Campground, formerly administered by the National Forest Service, was turned over to NPS in 1972 and the Akers Ferry, privately owned resort area, was acquired by NPS in the summer of 1973.

C. Geography, Geology and Soils

The ONSR is located in the south central part of Missouri, approximately 120 airline miles southwest of St. Louis and 225 airline miles southeast of Kansas City. However, by road these distances approach 165 and 295 miles respectively. It embraces about 113 square miles of land and 140 lineal miles of riverways along the banks of the Current and Jacks Fork Rivers. The Park is accessible from a number of county roads via Routes 19, 106 or State Highway 60.

The Ozarks are the remaining vestige of an ancient mountain range. Uplift followed by surface erosions and percolation of groundwater has resulted in many cavities renowned by the numerous springs in the area. The majority of the soil is stony (Clarksville) with a very small per cent of the soil along the creeks and rivers which is deep top soil with a clay sub soil base (Huntington). Top soils are shallow--ranging from 2 to 3 inches

or less. Most of the bottom soils are subject to overflow. However, they are not inundated for prolonged periods of time.

D. Climate and Economy

The various surface conditions and the difference in altitude tend to create certain variations in climate in the mountain areas. However, there is an average of 275 days of sunshine in a year with an average temperature of 65F. The average temperatures for summer and winter are 80F and 35F respectively. The area receives ample rainfall averaging 35 inches per year.

The ONSR is surrounded by Mark Twain and Clark National Forests, having abundant timber for future cutting of the virgin yellow pine. Small lumbering operations are the primary industry in the area, followed by the poultry industry, egg production, turkey and geese.


MONTAUR SPRINGS
MONTAUR STATE PARK
Cedargrove
AKERS FERRY
ROUND SPRING
TAIL LANDING
Ellington
Summersville
TWO RIVERS
ST JACKS
Eminence
Mountain View
Birch Tree
Winona
Van Buren
Fremont
Eastwood
CAVE SPRING
HOWES
NATIONAL FOREST
CAMPGROUND
CAMPSITE
A ACCESS
P PICNIC AREA
SPRING
T TRAIL

II. BACKGROUND OF STUDY

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A. Legislation and Regional Planning

The Solid Waste Disposal Act (Title II of Public Law 89-272) enacted by Congress in 1965 further supported by 1970 Resources Recovery Act established Federal guidelines for state legislations to enact in the area of solid waste management and for all Federal agencies to comply with such guidelines. Subsequent to Executive Order No. 11282 of May 26, 1966, open burning of solid waste at Federal installations was banned to control the smoke emission.

Section 5 of the state of Missouri Senate Bill No. 387 requires that each county and city submit, on or before June 30, 1974, to the Division of Health an officially adopted solid waste management plan serving areas within its jurisdiction. The Missouri Division of Health released guidelines for review of comprehensive solid waste management plans which incorporated the Senate Bill No. 387 and the Missouri Solid Waste Management Plan. In addition, the guidelines stress specifically the following points, which are relevant to this study:

Containers:

1. Complete enclosure for solid waste containers
2. If manually lifted, the containers should not exceed 35 gallons in capacity or weigh more than 75 pounds when full.

Collection and Transportation

1. Bulk container system should receive at least twice

per week collection

2. Solid waste collection vehicles must have leakproof and cleanable covered bodies

Processing and Disposal

1. Phasing out and properly closing of open dumps
2. Establishment of acceptable processing facilities and land disposal sites, which should have the capacity to provide for processing and disposal for a minimum of ten years with population projections and future solid waste generation taken into account

Subsequent to Senate Bill No. 387, twenty regional planning commissions were established in the state of Missouri. The Ozark National Riverways lies in three solid waste regional planning commissions (South Central, Meramec, Ozark Foothills), four counties (Carter, Dent, Shannon, Texas), and two congressional districts.

B. Seasonal Activities and Sources of Solid Waste Generation

Ozark National Scenic Riverways includes approximately 140 lineal miles of riverways along the banks of the Current and Jacks Fork Rivers. The Park is open to the public the year around. The summer activities, mainly camping and canoeing, start right after Memorial Day and diminish after Labor Day. Hunting is the major sport in the area during the winter months.

There are 598 regular campsites in ONSR which provide drinking water and toilet facilities to the campers, this includes the 20 campsites at Powder Mill that have been listed as primitive campsites, but now have the same facilities as other regular campsites. Campers are required to register

at the ranger's station with a fee charged during the summer season. Primitive campgrounds are scattered along the river bank. There is no designated number of such campsites. In most primitive campsites, pit toilets are provided and access can generally be had from county roads except for a few sites which can only be reached from the rivers. On July 21, 1973, a typical Saturday weekend, 2,317 campers were registered in the regular campgrounds including the 117 campers at Powder Mill.

There are 2 group campsites at Alley Spring, 3 each at Pulltite and Round Springs, and 4 at Powder Mill. The usage of these group campgrounds appears rather infrequent.

Picnic areas are located near the regular campgrounds although in some remote primitive campsites picnic tables are provided. On July 21, 1973, 972 picnickers were counted in four major areas, namely Alley Spring, Round Spring, Pulltite, Powder Mill and Big Spring.

The only trailer court in ONSR is in Big Spring which is operated by a concessionaire and is equipped with electric, water and sewer hook-ups for 7 trailers. A fee of $2.50 per trailer per day is being charged at the present time.

Canoeing is the most active sport on the river. A concessionare at Akers Ferry alone owns about 600 canoes. During the peak season, it is quite common for 850 or more canoes to be floating on the river. Litter in the river by the canoers creates solid waste collection problems for NPS.

There are 16 concessionaires in the area operating primarily canoe rental, soft drink stands and gift shops. The concessionaire at Big Springs

operates 15 cabins and a dining lodge in addition to a concession stand.

There are 20 permanent and 13 seasonal residences within the Park. Ranger stations are located in all major camping areas. Also there are a number of private residences in the Park.

The administrative headquarters of ONSR are in Van Buren, Missouri, which is outside the Park boundary.

Maintenance shops are maintained by the NPS at Round Spring, Powder Mill, Alley Spring and Big Spring.

The only visitor center in the Park is located near Powder Mill on the north side of the Current River along Highway 106.

C. NPS Operated Solid Waste Management System

1. General

a. Administration - The Ozark National Scenic Riverways is divided into four management districts, directed by the Park Maintenance Supervisor, operating under the general supervision of the Park Superintendent. Each district's solid waste management is under the direction of a maintenance foreman. Besides regular solid waste collection and disposal work, each district performs other Park maintenance tasks as well. These four districts and their headquarters are:

Name of District	Headquarters
Jacks Fork District	Alley Spring
Upper Current District	Round Spring
Cardareva District	Powder Mill
Lower Current District	Big Spring

operates 15 cabins and a dining lodge in addition to a concession stand.

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Name of District	Headquarters
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Upper Current District	Round Spring
Cardareva District	Powder Mill
Lower Current District	Big Spring

b. Containers - There are three different types of containers used throughout the Park. 32-gallon containers with lids and supports anchored on the ground are used in all regular campgrounds and the campgrounds in Powder Mill and Two Rivers. 55-gallon containers without covers are located in some remote areas and the primitive campsites along the river bank. GSA plastic liners are provided for all the 32 and 55-gallon containers. The park also uses 21 6-cubic yard steel containers. Sixteen of these are strategically distributed in Upper Current, Jacks Fork and Cardareva District with 4 located at the maintenance area at Powder Mill. The locations and number of the large containers are as follows:

District	Location	No. of 6 cu. yd. Containers	
Upper Current	Cedar Grove	2	
" "	Akers Ferry	4	
" "	Sinking Creek	1	Sub-total 7
Cardareva	Jerktail Landing	1	
"	Two Rivers	1	
"	Goose Bay	1	
"	Powder Mill	1	
"	Log Yard	1	
"	Paint Rock	1	Sub-total 6
Jacks Fork	Bay Creek	1	
" "	Blue Spring	1	
" "	Buck Hollow	1	Sub-total 3
			Total 16

c. Collection Equipment and Frequencies - The operation of solid waste collection in ONSR can be classified into 3 categories, namely: river cleaning, 32 and 55-gallon container collection, and the 6 cu. yd. container collection.

The Park maintains 5 John boats, one for each district and one standby. The sizes of John boats, powered by an outboard motor, vary from 14 to 24 feet. The river cleaning in each district is performed by a two-man crew on a 4 to 5 days per week operation, Monday through Friday. Occasional adjustments of river cleaning schedules are made as necessary to meet the actual need.

The collection of refuse from the regular campgrounds, and the campsites in Powder Mill and Two Rivers, picnic areas, staff residences, rangers' stations, concessionaires operation, visitor center, roadsides, etc. is made primarily by three 1-ton low stake body GSA rental trucks and one 5-cubic yard compactor on a 3/4 ton GSA rental truck chassis, occasionally other GSA rental trucks are utilized in the refuse collection operation. The NPS is presently acquiring 3 more compactors so that in the future each district will have a compactor for their refuse collection in lieu of stake body truck. Pick-ups are made daily, except during the peak usage weekends when certain picnic areas and campsites may require two or even three pick-ups per day.

The NPS owns an old Army surplus hydraulically operated dump truck stationed at Powder Mill. This dump truck and a driver make pick-ups from 6-cubic yard containers on an 8-hour per day, 5-day per week operation. The frequency of collection is on an as needed basis .

The private concessionaire in Akers Ferry does the refuse collection in this area with a 1/2 ton stake body truck and a driver. The refuse is picked up from campgrounds, ferry, store, etc. twice on weekdays and 3 times during the weekend.

d. Disposal - Until very recently, NPS maintained 4 dumps, one each in Pulltite Spring, Alley Spring, Powder Mill and Big Spring. In all cases, trenches were constructed for refuse deposit. Covering of refuse was infrequent, but final cover was applied when the trench was filled.

NPS sought an alternate disposal method. They contractor for private disposal service by issuing an invitation for bids for refuse collection and disposal on June 7, 1973. Specifications called for furnishing of a minimum of 3 6-cubic yard containers at each pick-up site to be located within one mile of Big Spring, Alley Spring, Cardareva and Round Spring. Hauling equipment specified was commercial compactor truck with a minimum of one container from each pick-up site per collection in accordance with the following schedule:

May 15 thru September 15 - Daily collection

September 16 thru November 30 - Bi-weekly collection (Monday and Friday)

December 1 thru March 31 - Once per week - Friday

April 1 thru May 14 - Bi-weekly (Monday and Friday)

Bids were received on July 15, 1973. Contract has only recently been awarded to the low bidder.

2. Jacks Fork District

Jacks Fork District covers approximately 45 miles of Jacks Fork

River. Buck Hollow, a primitive campground located on the west of state Highway 17, is provided with one 6-cu. yd. container. Blue Spring, a primitive campsite accessible from Route OO has 4 picnic tables and one 6-cu. yd. container. The primitive campsite at Bluff View has no facilities except one 55-gallon container. Jam Up Cave primitive campsite can only be reached from the river. No facilities are provided at this location. Ebb and Flow Spring, Cardinal Acres and John Dixon Place are private scenic easement areas in the Park. One 6-cu. yd., two 55-gallon containers and one picnic table are located in the Bay Creek primitive camping area. Two 32-gallon containers are located in the Bluff Hole primitive campsite.

Alley Spring is the headquarters for the Jacks Fork District which consists of 25 regular campsites at Trails End Campground, 75 at Thorny, 30 at Swampy, 2 group campgrounds, and the concessionaire's operated gift shop and stand. Rangers' stations, staff residences and maintenance shop are also located in here.

The river cleaning work starts early in April and generally ends at the end of October. It takes 5 full days to clean the section of the river within this district. However, due to other work assignments, the river cleaning crew can work on the river only 4 days per week. The cleaning of the river is divided into five 8-hour work days as follows:

Buck Hollow to Blue Spring

Blue Spring to Rymer Ranch

Rymer Ranch to Bee Bluff

Bee Bluff to Alley Spring

Alley Spring to Eminence

The task of river cleaning includes pick-up of litter in the river, collection of refuse from containers in primitive campsites, campfires and left-overs by campers and canoe floaters, cleaning of containers, and occasional removal of logs from the river. The river cleaning John boat, attached on a trailer, with a crew is brought to the starting point each day by GSA rental truck and a driver. At the end of the day's work, the John boat, the crew and the collected refuse are taken back to the headquarters maintenance shop. The refuse, then, is transported by the private collector to his disposal site.

The collection of refuse from the campgrounds, picnic areas, rangers' stations, staff residences, maintenance area, concessionaire's operations is made daily by a 2-man crew with a GSA rental 1-ton stake body pick-up truck. Some campgrounds and picnic areas are picked up twice or three times a day during a heavy weekend or holiday. In this case, a second shift starts around 12:30 p.m. and normally the third shift will finish collection by 9:00 p.m. The majority of containers used in the Alley Spring area are of the 32-gallon size. Cleaning of containers is part of the collection crews' duty.

The locations and frequency of collection of the 6-cu. yd. containers are as described in Section II-C-1.

All refuse generated in this district has been disposed of in the Alley Spring dump. During the fall, 200 to 300 bags of leaves are collected and disposed of in the same dump.

3. Upper Current District

The Upper Current District stretches about 50 miles along the Current River from south of Montauk Springs to Jerktail Landing.

There are 3 major areas of solid waste generation. They are, from north to south, Akers Ferry, Pulltite Spring and Round Spring. The Akers Ferry was acquired by the NPS recently from the owner of Akers Ferry Resort, who still operates a store and limited camping facilities there. The campgrounds in Akers Ferry do not have a designated number of campsites nor fire places. Pit type toilet facilities are available. There is no camping fee charged to the campers. Even though NPS has not classified the campgrounds in this area, it appears to be, at least at the present time, more of the primitive type.

There are 50 regular campsites, one picnic area, 3 group campgrounds, staff residences, one canoe rental concessionaire and canteen machines in Pulltite Spring.

Round Spring has 65 regular campsites with a picnic area and 3 group campgrounds. There is also a concessionaire operating a canoe rental and soft drink stand.

Thirty two-gallon containers are used in most regular campground, staff residences, concessionaire operations and picnic areas. But, in remote areas such as primitive campsites along the Current River bank, 55-gallon containers are utilized for deposit of refuse. The locations and number of such containers are as summarized below:

Location	Number of 55-Gallon Containers
Parker Hollow	1
Erdman	1
Tanvat	1
Baptist Camp	1
Duckmouth Spring	1
Cave Spring	1
Lips	2
Current River Canoe Rental	2
Boyds Creek	1
Wide Ford	1
Mouth of Sinking Creek	2
Cars Landing	2
Upper Woods	1
Lower Woods	1
Mouth of Grassy	1
Williams Landing	1
Jerktail Landing	1

The complete cleaning of the river in this district requires four 4-hour days, from Montauk Springs to Cedar Grove, to Akers Ferry, to Pulltite Spring, then to Round Spring. The operation of river cleaning is basically the same as that in Jacks Fork District except a 2-man crew is used. The John boat is often left in the river for the next day's operation.

The refuse generated from all sources in Round Spring and Pulltite Spring is collected daily by a GSA rental 1-ton stake body pick-up truck operated by a 2-man crew. The waste from Pulltite Spring has been deposited directly in Pulltite dump. Whereas the refuse collected from Round Spring was loaded together with refuse from river cleaning in a NPS owned 5-cubic yard compactor which transported the collected refuse to the dump in Pulltite via Sinking Creek.

The refuse generated in Akers Ferry is collected by the concessionaire as described in Section II-C-1. The collected refuse is deposited in 4 6-cu. yd. containers provided by NPS. Collection has been made by the old Army surplus dump truck described in Section II-C-1.

There was a dump in Round Spring which was filled and not in use any more. The Pulltite dump is almost filled.

4. Cardareva District

Cardareva District is located in the middle section of the Current River between Jerktail Landing and north of Paint Rock Bluff. Also covered by this district is a section of the Jacks Fork River lying between Eminence and Two Rivers.

All campgrounds in this district are classified as "primitive" even though the Powder Mill campground has all the facilities of the regular campgrounds. There are 20 designated campsites, 4 group campgrounds, a visitor center, picnic area, concessionaire stand, floaters parking, staff residences, maintenance shop, etc. in the Powder Mill area. Two Rivers has 6 primitive campsites, a picnic area, canoe rental concessionaire and floaters

parking. Other primitive campsites are located mainly in Blue Spring, Shawnee, Log Yard and Paint Rock Bluff.

The three differenc types of refuse containers used in this district are summarized below:

Location	Number of 32-Gallon Containers	Number of 55-Gallon Containers	6-cu. yd. Containers
Jerktail Landing	-	2	1
Two Rivers	5	-	1
Goose Bay	-	-	1
Powder Mill	23	-	1
Log Yard	-	4	1
Paint Rock Bluff	-	-	1
Blue Spring	4	-	-
Total	32	6	6

It requires 4 days to clean the Current River in this district and another day to clean the Jacks Fork River from Eminence to Two Rivers. A 1/2-ton GSA rental truck and a driver are used to haul the John boat and the 2-man river cleaning crew back and forth from headquarters in Powder Mill to the river. The assigned river cleaning work and the operation is basically the same as that described in Section II-C-2 for the Jacks Fork District except only 50% of the litter collected from the river has been taken to the Powder Mill dump and the balance deposited in the nearby 6-cu. yd. containers.

The pick-ups from the campgrounds, picnic area, quarters, etc. in Powder Mill, Blue Spring, and Two Rivers are daily. Refuse generated in

Rocky Falls is collected 2 to 3 times per week. A 3/4 ton GSA rental truck and a 2-man crew perform this work. A day's operation begins pick-ups from Powder Mill sources to Blue Spring then to the dump. Returning from the dump, the truck and operators have gone to Two Rivers then to Rocky Falls and deposited the collected refuse at the dump.

The old Army surplus dump truck is stationed in Powder Mill. The dump truck is operated by a driver performing the dumping of all refuse deposited in the 6-cu. yd. containers distributed in various locations. The dump truck and the driver have normally carried an empty container on each trip since the truck can handle only one container per trip. The driver unloads the empty container then picks up the loaded container and drives to the dump, after unloading the truck and driver will go to the next pick-up point with the empty container.

5. Lower Current District

Lower Current District extends from Paint Rock Bluff to Hawes. Big Spring is the centroid of all activities in the district, which consists of 205 regular campsites with shower and toilet facilities, concessaionaire operated cabins, dining lodge and trailer court, staff residences, maintenance shop, ranger station, picnic areas, etc.

In addition to Big Spring activities, there are 2 minor camping areas in the district, namely Hawes and Cave Spring. Twelve primitive campsites, equipped with pit toilets, water hand pump, and a shelter are available to the public in Hawes campground and appears to have potential for future expansion. Very limited facilities are provided for Cave Spring.

There are no 6-cu. yd. containers in the district. The distribution of 32 and 55-gallon refuse containers in Lower Current District is as follows:

Location	Number of 32-Gallon Containers	Number of 55-Gallon Container
Big Spring	259	15
Radiford Tract	-	1
Club House Landing	-	1
Heathcock Landing	-	1
Upper Grubs Landing	-	2
Lower Grubs Landing	-	2
Cave Spring	2	-
Hawes Campground	13	-
Paint Rock Landing	-	1
Gravel Spring	-	1
Pyle Landing	-	4
Waymar	-	1
Total	274	29

The river cleaning is done by a 2-man crew operating 5 days per week. Occasionally, items such as mattresses, car seats, styrofoam are removed from the river.

Collection of waste from all sources in the Big Spring area has been made daily in the summer season by a 1-ton GSA rental stake body truck with a driver and a helper except for the refuse from staff residences which is picked up once a week.

The waste generated from Hawes campground has been picked up 3 times per week and deposited in the dump by a ranger with his assigned GSA rental truck. The refuse from Cave Spring was collected and deposited in the dump by the ranger.

The Big Spring dump was the only active dump in the district. Cover was applied once a week in the summer and twice during the winter season by NPS owned International front end loader.

6. Other Solid Wastes

Campfires are cleaned from fireplaces provided in most campgrounds and placed in refuse containers. This is a part of regular Park maintenance work.

The sludge from the pit toilets is pumped once or twice a year by the NPS owned pumper. The sludge is then buried in the ground.

Since there is no horse concessionaire in the Park, the Park does not have an animal manure disposal problem.

7. NPS Operated Solid Waste Management Costs

a. General - Since the foreman in each solid waste management district performs other Park assignments as well, only 40% of their time was charged to the solid waste management costs. An additional 10% was added to the total cost to cover administrative costs such as payroll, bookkeeping, secretary, etc.

The summer season is assumed to begin early in April and to end at the end of October, 30 weeks, or the equivalent of 1,200 working hours.

Since some GSA rental trucks are used for other assignments in

in the Park besides solid waste collection and disposal services, the depreciation and operating costs are based on the estimated mileage and time spent in actual waste management operation.

b. Jacks Fork District

River Cleaning		
1-man Crew* 960 hrs. @$3.00	$2,880	
Depreciation for John Boat, Motor, Trailer	190	
Driver to Transfer Crew and Boat 240 hrs. @$3.75	900	
Truck Depreciation for Boat Handling	350	
Sub-total		$ 4,320
Campgrounds, etc. Collection		
Drivers 840 hrs. @$3.75 = $3,150		
Laborers 840 hrs. @$3.00 = 2,520	5,670	
Truck Depreciation and Operating Costs @80% Usage Factor	880	
Sub-total		6,550
GSA Bags		460
40% of Maintenance Foreman's Time		4,150
Trench Excavation and Dump Operation		2,240
Total		$17,720

*One helper paid by OEO

c. Upper Current District

River Cleaning		
2-man Crew 960 hrs. @$3.00	$5,760	
Depreciation for John Boat, Motor, Trailer	190	
Driver to Transfer Crew and Boat 180 hrs. @$3.75	680	
Truck Depreciation for Boat Handling	310	
Sub-total		$ 6,940
Campgrounds, etc. Collection		
Drivers 2,220 hrs. @$3.75 = $8,330		
Laborers 1,200 hrs. @$3.00 = 3,600	11,930	
Truck Depreciation and Operating Costs	1,030	
Sub-total		12,960
GSA Plastic Bags		590
40% of Maintenance Foreman's Time		3,780
Trench Excavation and Dump Operation		2,240
Total		$26,510

d. Cardareva District

River Cleaning		
1-man Crew 1,200 hrs. @$3.00	$3,600	
Depreciation for John Boat, Motor, Trailer	190	
Driver to Transfer Crew and Boat 360 hrs. @$3.75	1,350	
Truck Depreciation for Boat Handling	380	
Sub-total		$ 5,520

Campgrounds, etc. Collection		
Drivers 660 hrs. @$3.75 = $4,050		
Laborers 660 hrs. @$3.00 = 1,800	$5,850	
Truck Depreciation and Operating Costs	1,000	
Sub-total		$ 6,850
Bulk Container System		
Dump Truck Depreciation and Operation Costs	2,100	
Container Depreciation and Maintenance	1,780	
Driver 150 days @$33.26/day	4,990	
Sub-total		8,870
GSA Bags		250
40% Maintenance Foreman's Time		3,860
Trench Excavation and Dump Operation		2,240
Total		$27,590

e. Lower Current District

River Cleaning		
1-man Crew* 1,200 hrs. @$3.00	$3,600	
Depreciation for John Boat, Motor, Trailer	190	
Driver to Transfer Crew and Boat	230	
Truck Depreciation for Boat Handling	400	
Sub-total		$ 4,420
Campgrounds, etc. Collection		
Drivers* 1,680 hrs. @$3.75	6,300	
Truck Depreciation and Operating Cost	1,120	
Sub-total		7,420

GSA Plastic Bags	$ 950
40% of Maintenance Foreman's Time	3,860
Trench Excavation and Dump Operation	2,750
Ranger Pick-up at Hawes Campground	3,250
Total	$22,650

*One helper paid by OEO

f. Summary of NPS Operated Solid Waste Management System Costs

Jacks Fork District	$ 17,720
Upper Current District	26,510
Cardareva District	27,590
Lower Current District	22,650
	$ 94,470
Add 10% Administrative Costs	9,440
Estimated Total Annual Cost	$103,910

D. Presently Operated Solid Waste Management System

1. General

The present system being utilized for solid waste management in the Park includes a contract with a private contractor and a somewhat different NPS collection system than was previously used when the engineers made their field survey.

On August 15, 1973, the Park entered into a contract with a private firm to provide 6-cu. yd. containers at locations designated by the Park and to collect contents of same and dispose of the refuse. The contractor is

guaranteed at least one 6-cu. yd. container of refuse per week for the period May 15 through September 15 from each of the four districts. The contractor is paid $36 for each 6-cu. yd. container collected, whether the container is full or not. At present the contractor is utilizing a land fill located near Doniphan, Missouri, in Ripley County for deposition of the Park's refuse.

The old Army surplus truck has been transferred from Powder Mill to Round Spring temporarily. This unit and its driver make a once-a-week trip to Akers Ferry to pick up the NPS 6-cu. yd. container located there. The container is hauled back to Round Spring for disposal by the private contractor. The present contract with the private contractor does not include furnishing of a 6-cu. yd. container and pick-up at Akers Ferry. Perhaps in the future, this may be included.

The Park has recently purchased three small compactor units similar to the 5-cu. yd. unit that has been in service for about 1 year, which are mounted on GSA 3/4-ton pick-up trucks. One of these units is assigned to each of the four districts to collect the refuse generated in its district from the 32 and 50-gallon containers and transport it to the contractor's 6-cu. yd. containers. Each truck has a driver and a helper. These three new small compactors replace the three 1-ton GSA low stake body trucks previously used.

The river collection system remains the same as described under II-C except the collections from the rivers are now deposited in the contractor's 6-cu. yd. containers.

2. Presently Operated Solid Waste Management Costs

The system has been in operation such a short time it is not possible to supply any figures as to actual costs, or its effectiveness. Based upon the estimates of generation of solid waste as developed in Section III, the probable annual costs are given below:

a.	Estimate of Private Contractor Cost		
	Contractor's bid price included in Solicitation, Offer and Award form dated June 25, 1973		$21,528
b.	Estimate of River Cleaning all Districts (See Pages II-17 thru II-19)		21,200
c.	Estimate of Collection Costs		
	(1) Jacks Fork District		
	Labor Costs	$6,210	
	Truck & Compactor Opr. & Maint. Cost	2,300	
	GSA Bags & Maint. Foreman's Time	2,540	
			11,050
	(2) Upper Current District		
	Labor Costs*	$7,990	
	Trucks* & Compactor Opr. & Maint. Cost	2,660	
	GSA Bags & Maint. Foreman's Time	2,480	
			13,130
	Sub-Total Carried Forward		$66,908

* Includes cost of operation of the old Army truck to Akers Ferry and return.

(3)	Cardareva District		
	Labor Costs	$6,210	
	Truck & Compactor Opr. & Maint. Cost	2,320	
	GSA Bags & Maint. Foreman's Time	2,180	
			$10,710
(4)	Lower Current District		
	Labor Costs*	$2,760	
	Truck & Compactor Opr. & Maint. Cost	1,060	
	GSA Bags & Maint. Foreman's Time	2,880	
	Ranger's Pick-up & Hawes	3,250	
			9,950
	Sub-Total		$87,568
	Add 10% for Admin. Costs		8,757
	Estimated Total Annual Cost		$96,325

* Assumes OEO will continue to pay for laborer on truck.

III. METHOD OF STUDY

III. METHOD OF STUDY

A. Random Sampling and Measurements

The determination of solid waste characteristics and quantitative generation is difficult due to the complex nature of interrelationship among factors such as seasonal activities, climate, facilities, administrative policies, etc. The classical approach would be the actual weighing and classifying of all solid waste generated from all sources in the park for the whole season. Obviously, this approach is impractical because investigation of this kind is often constrained by time and budget.

Statistical method is widely applied in modern science which is primarily based on probability of occurrence. One technique for predicting the characteristics and rate of generation of solid waste is called the random sampling method from which conclusions can be drawn about the measurements of composition as well as generation rate from randomly collected and measured samples. Statistical analysis is also made to determine the standard deviation.

A preliminary area survey was conducted by engineers in the period July 16 through July 20, 1973 to study the scheme of sampling and associated problems. The district foremen were consulted by the engineers during this period. The actual field sampling began on July 20 through July 23, 1973 with a total of 8 persons divided into 4 groups, one group at each district.

Random samples were obtained from each source area with background information such as visitor counts, number of meals served, pillow counts, number of campers, picnickers, etc.

The samples were individually weighed and then classified into 3 categories, namely food waste, other combustibles and non-combustibles. The quantity of sampled waste was divided by variate to determine the rate of generation. The summaries of sampling results for each district are presented in Table III-1 through Table III-4. Table III-5 shows the summary of waste characteristics and rate of generation for ONSR.

As mentioned previously, the summer activities generally start in early April, hit the peak in July and August, and then diminish at the end of October. Compilation of data obtained from Monthly Public Use Records (MPUR) established the histogram degree of monthly Park usage as shown in Figure III-1. Having distribution function determined, the quantitative generation of the seasonal and yearly generation can be calculated. The following table shows the present annual solid waste generation from each district and for the whole Park.

PRESENT ANNUAL ONSR SOLID WASTE GENERATION

District	Tons/Year
Jacks Fork	97.8
Upper Current	72.9
Cardareva	40.3
Lower Current	61.4
TOTAL	272.4 Tons/Year

The density of solid waste is a function of the waste composition and percentage fullness of waste in the storage container. A fully stuffed container

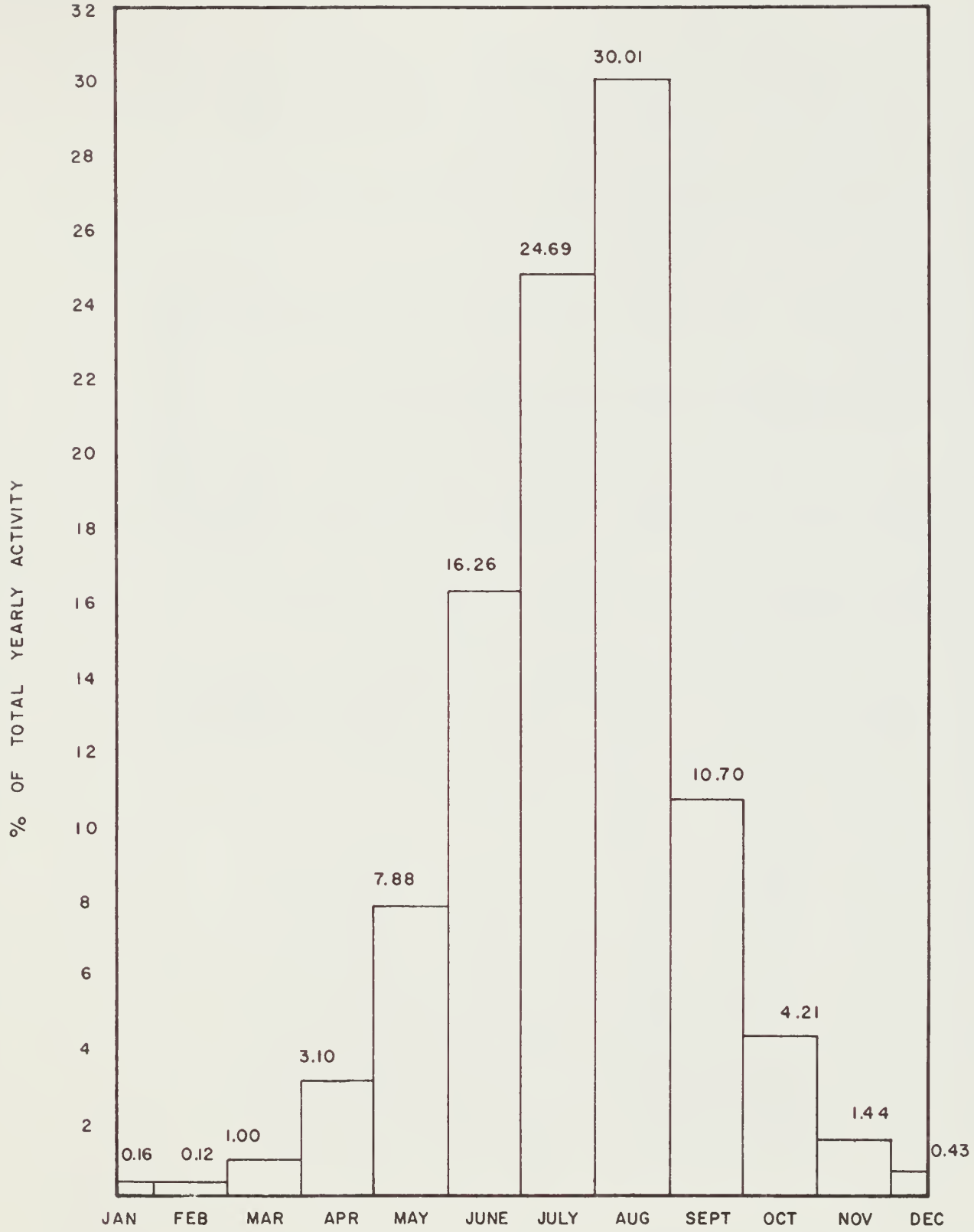

FIGURE III-1 DEGREE OF MONTHLY PARK USAGE

TABLE III-1

SUMMARY OF WASTE CHARACTERISTICS AND GENERATION

JACKS FORK DISTRICT

	Waste Composition			
	Food Waste #/Day	Other Combustibles #/Day	Non-Combustibles #/Day	Total #/Day
Campgrounds, Regular	260	104	155	519
Campgrounds, Primitive	99	50	61	210
Group Camps	9	7	10	26
Trailer Campgrounds	0	0	0	0
Picnic Areas	31	9	7	47
Concessionaire Op.	0.3	1.7	2	4
Staff Residences	17	20	18	55
Staff Operations	3	6	6	15
Roadsides/Visitor Center	2	7	11	20
River	3	21	22	46
Total	424	226	292	942

NOTE: Above figures are an average daily generation for the period from May 15 through September 15.

TABLE III-2

SUMMARY OF WASTE CHARACTERISTICS AND GENERATION

UPPER CURRENT DISTRICT

	Waste Composition			
	Food Waste #/Day	Other Combustibles #/Day	Non-Combustibles #/Day	Total #/Day
Campgrounds, Regular	90	45	111	246
Campgrounds, Primitive	35	32	101	168
Group Camps	43	10	16	69
Trailer Campgrounds	0	0	0	0
Picnic Areas	17	3	9	29
Concessionaire Op.	2	9	13	24
Staff Residences	29	27	20	76
Staff Operations	3	5	7	15
Roadsides/Visitor Center	3	4	14	21
River	8	19	39	66
Total	230	154	330	714

NOTE: Above figures are an average daily generation for the period from May 15 through September 15.

TABLE III-3

SUMMARY OF WASTE CHARACTERISTICS AND GENERATION

CARDAREVA DISTRICT

	Waste Composition			
	Food Waste #/Day	Other Combustibles #/Day	Non-Combustibles #/Day	Total #/Day
Campgrounds, Regular	16	4	20	40
Campgrounds, Primitive	63	28	106	197
Group Camps	0	0	0	0
Trailer Campgrounds	0	0	0	0
Picnic Areas	4	1	8	13
Concessionaire Op.	1	2	3	6
Staff Residences	13	13	20	46
Staff Operations	3	4	6	13
Roadsides/Visitor Center	3	11	29	43
River	6	19	41	66
Total	109	82	233	424

NOTE: Above figures are an average daily generation for the period from May 15 through September 15.

TABLE III-4

SUMMARY OF WASTE CHARACTERISTICS AND GENERATION

LOWER CURRENT DISTRICT

	Waste Composition			
	Food Waste #/Day	Other Combustibles #/Day	Non-Combustibles #/Day	Total #/Day
Campgrounds, Regular	59	12	38	109
Campgrounds, Primitive	43	34	49	126
Group Camps	12	7	11	30
Trailer Campgrounds	7	10	3	20
Picnic Areas	16	5	10	31
Concessionaire Op.	77	19	11	107
Staff Residences	27	21	28	76
Staff Operations	2	7	4	13
Roadsides/Visitor Center	8	14	17	39
River	8	24	34	66
Total	259	153	205	617

NOTE: Above figures are an average daily generation for the period from May 15 through September 15.

TABLE III-5

SUMMARY OF WASTE CHARACTERISTICS AND GENERATION

OZARK NATIONAL SCENIC RIVERWAYS

	Waste Composition			
	Food Waste #/Day	Other Combustibles #/Day	Non-Combustibles #/Day	Total #/Day
Campgrounds, Regular	425	165	324	914
Campgrounds, Primitive	240	144	317	701
Group Camps	64	24	37	125
Trailer Campgrounds	7	10	3	20
Picnic Areas	68	18	34	120
Concessionaire Op.	80	32	29	141
Staff Residences	86	81	86	253
Staff Operations	11	22	23	56
Roadsides/Visitor Center	16	36	71	123
River	25	83	136	244
Total	1,022	615	1,060	2,697

NOTE: Above figures are an average daily generation for the period from May 15 through September 15.

may have density double that of a container having only 50% of the same composition of waste. The results obtained from random sampling provided data for calculating the average density of solid waste generated in ONSR. It is, therefore, estimated that approximately 5,500 cubic yards of refuse will be generated within ONSR for 1973 or 275 tons of refuse.

B. Projection of Future Solid Waste Generation

Since 1969, visitor counts as well as other categorical park usage have been recorded in the MPUR. The visitor counts, a contributing factor to the waste generation, were calculated by rangers from traffic counts recorded by pneumatic recorders strategically placed along all major accesses, and the average people in a car. Due to the refined method of measuring the traffic count by the present chief ranger in ONSR, the visit counts dropped substantially to 276,619 for the first 5 months in 1973 from 871,687 in the same period in 1972. This, by no means, is an indication of a lesser degree of public usage in ONSR.

Other categorical usage data were compiled and secular trend was then established. Figure III-2 shows the computer-plotted regression analysis for ONSR overnight visits for the next 10 years. Using the least square line indicates an increase of 21% in park usage per year with 1971 as the base. It is also a general trend discovered in other National Parks and elsewhere that more waste is produced per capita. The estimated increase in generation per capita per year is about 4.5%.

The quantitative generation of solid waste within ONSR for the next 10 years is thus projected and shown in Figure III-3.

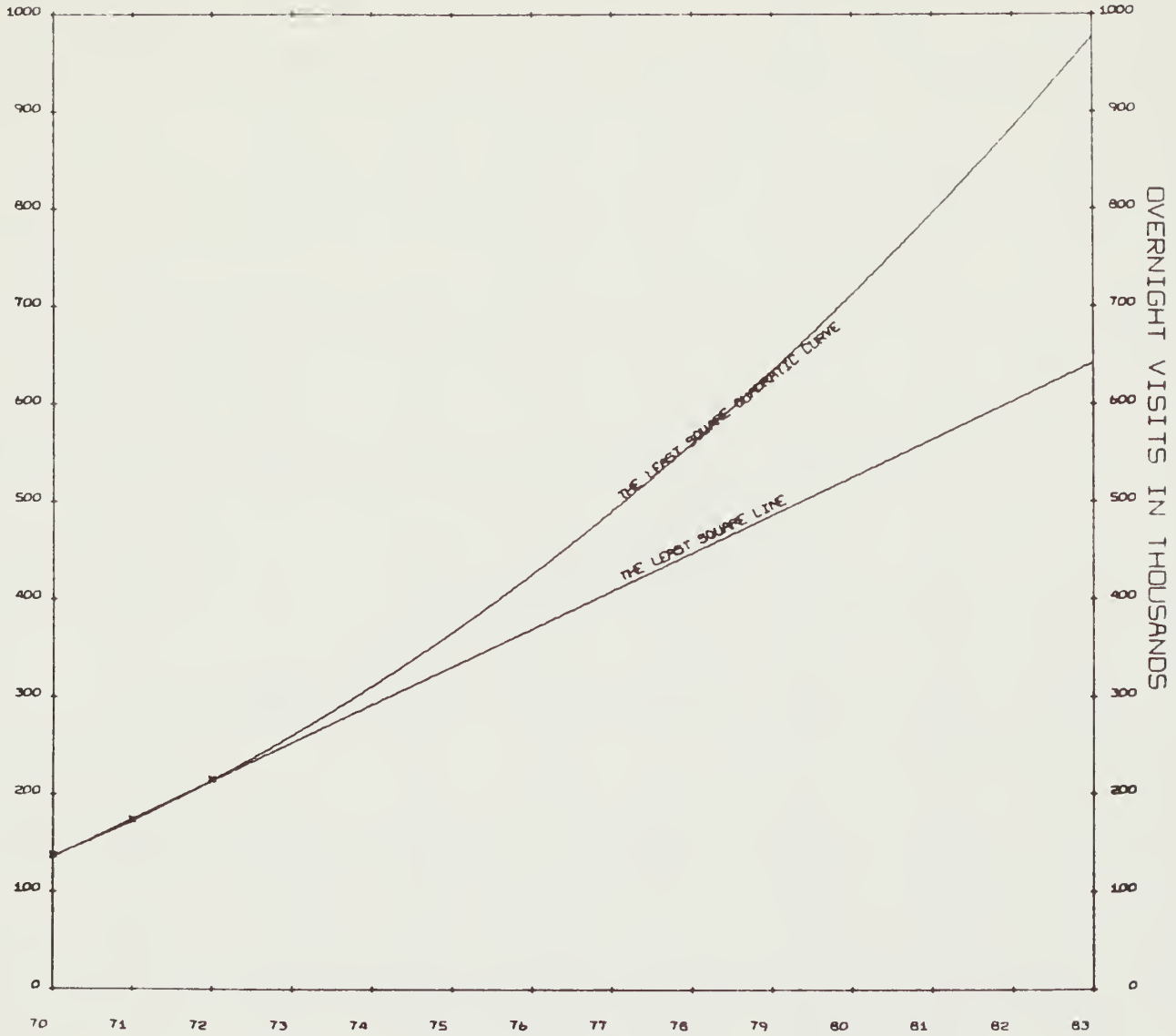

Fig. III-2 ONSR FUTURE OVERNIGHT VISITS PROJECTION

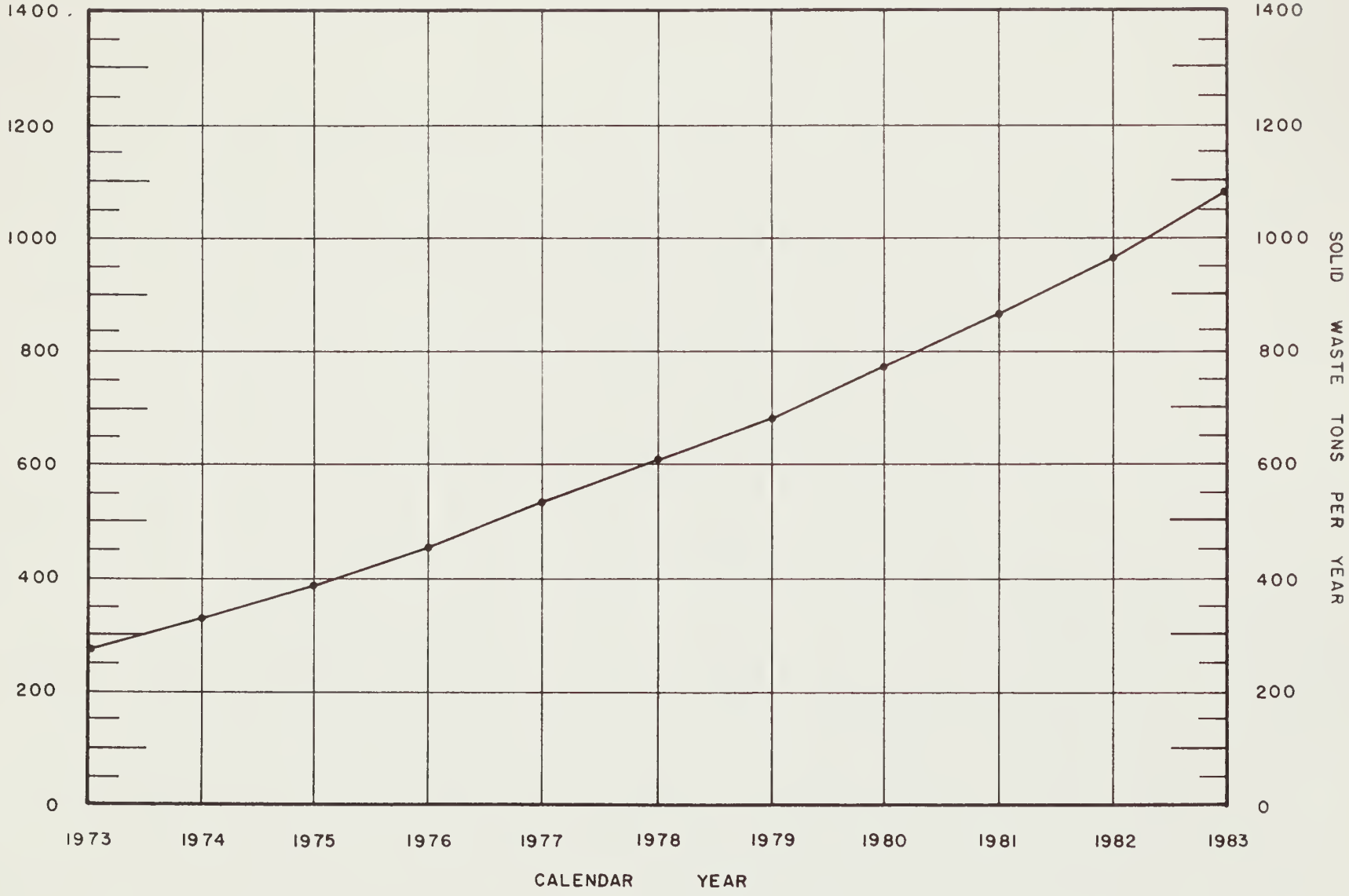

FIGURE III - 3 PROJECTED ONSR SOLID WASTE GENERATION

IV. ALTERNATIVE SOLID WASTE MANAGEMENT SYSTEMS

IV. ALTERNATIVE SOLID WASTE MANAGEMENT SYSTEMS

A. Acceptable Current Solid Waste Management Practices

1. Refuse Storage Containers

There are a wide variety of refuse containers available in the market ranging from household 20-gallon to 8 cubic yard. All commercially available containers are equipped with covers to protect from the weather and to avoid littering and insect and animal scavenging.

Selection of proper type and capacity of containers depends on quantity of refuse generated, frequency of collection service, the type of collection vehicles, and other considerations such as the wildlife in the area and the local climatological conditions.

2. Collection Systems and Transporting Vehicles

Basically, collection systems can be classified into 3 types - house-to-house municipal type collection, bulk container collection system, satellite vehicle collection system. Variations from these basic collection systems are the use of a transfer station, with and without compaction, and the overnight holding operation.

Collection vehicles associated with each collection system vary in capacity and principle of design and operation. Compactor trucks are primarily used by the municipal type of collection system. Compactor trucks with unloading mechanism are popular for the bulk container system. Tri-wheel vehicles are adopted in the satellite vehicle collection system which can be tied in with other systems, such as bulk container or transfer station, etc. Pick-up trucks or stake body trucks are convenient for collection of refuse

in Parks and other recreational areas provided refuse is properly confined in plastic bags and thus no litter or aesthetic problems are created.

The practical size of compactor or pick-up truck is determined from quantity of refuse, distance of travel, access road conditions and weight limits imposed by the states.

3. Disposals

The acceptable refuse disposal methods are numerous. However, they can be classified into five basic systems as follows:

Sanitary landfill

Thermal volume reduction - incineration

Recycling

Composting

Other thermal chemical processes

The sanitary landfill, by far, is the most economical method of disposing of solid waste if suitable land is available. The filling of refuse can be either area or trench method depending on the ground water and soil conditions, topography of site, and the quantity of refuse. The refuse can be disposed of directly in the landfill site or shredded prior to disposal. Ordinary sanitary landfill conforming to EPA and state requirement will cost $3.00 to $7.00 per ton. Approximately $5.00 per ton must be added to the landfill cost if refuse is shredded even though the cover requirements will be reduced due to the shredding. Thermal volume reduction or incineration burns the refuse in a combustion chamber. The modern municipal type incinerator is generally equipped with air pollution control

equipment such as an electrostatic precipitator or flue gas cleansing equipment (scrubber). The small package incinerator is provided with an afterburner section to reduce pollutant emissions. The residues from the thermal volume reduction process have to be disposed of in landfill. The cost of municipal incineration ranges from $10 to $15 per ton. The small package incinerator operation and maintenance costs between $15 to $50 per ton.

Recycling is a process to separate reusable materials from the bulk refuse. Ferrous materials can be separated from the mixed refuse by magnetic separator. The aluminum, paper, glass, etc. can be sorted by air classifier or centrifuge. A market has to be established for the recycled materials before the recycling process can be considered. Non-usable materials from the recycling process still have to be disposed of. The cost of recycling varies widely and can only be determined for each individual case.

Composting is biochemical degradation of refuse to produce humus-like material which can be disposed of in land as beneficial fertilizer. Composting has an unsuccessful history in the United States due to the fact that there is a very limited market for such a product. Odor and bulky storage required are other problems associated with the process.

There are numerous EPA sponsored pilot projects in the country. Pyrolysis, refuse as auxiliary fuel in a utility boiler, refuse as an energy source in electric generation, oxygen refuse gasifier, Torrax System, etc. are primarily designed to handle prototype plants of more than a thousand tons per day of refuse processing.

B. Evaluation of Present ONSR Solid Waste Management Practice

1. Refuse Storage Containers

The survey conducted by the engineers indicated an adequate number of containers are provided in each refuse generation area since there was no sign of refuse overflow from containers or litter problems in the Park.

The 32-gallon containers with lids and plastic liner are suitable for Park use in terms of capacity, maneuverability and sanitation. However, the 55-gallon containers have proven hazardous to the collection operation and unsanitary when covers are not provided. In many states, including Missouri, local ordinance has prohibited the use of the 55-gallon containers such as are used in the Park. The 6-cubic yard containers used in the Park, except those placed in Akers Ferry, are grossly oversized for the quantity of refuse generated. Two basic principles in the application of the bulk container system are:

a. Containers are to be placed in centroids of generation areas and to be easily accessible from all weather roadways.

b. Container capacity and distribution must be such that the collection operation, frequency of pick-up and distance of traveling are optimized.

The evaluation of the present ONSR bulk container system indicated

a. Inadequate frequency of pick-up - at least twice a week collections are required for the local weather condition.

b. Uneconomical in collection operation - duplication of dump truck traveling routes with each district's refuse collection vehicle.

2. Collection Equipment and Collection Frequencies

Transporting Vehicles

The pick-up trucks used in the Park are adequate and efficient in the collection operation. The quantity of refuse generated from each major source area does not seem to warrant the use of any compactor type truck. Especially for the contracted private disposal service the Park is presently utilizing, the compaction of refuse becomes meaningless when the refuse is transferred into bulk containers from a compactor truck.

The John boats used in the river cleaning are practical for this unique operation. Any other type of river cleaning equipment probably cannot be economically justified.

The present collection frequencies from regular campgrounds, picnic areas, staff residences, maintenance shops, concessions' operation, etc. are satisfactory. The pick-up frequency from some 6-cubic yard containers is less than once per week due to the lesser quantity of refuse generated. A minimum of twice a week collection from all sources should be maintained during the summer season.

Observation made by engineers shows that the rivers were well cleaned. This indicates that the frequency of river cleaning is adequate.

C. Alternative ONSR Waste Management Systems

1. Criteria of Establishing Alternative Systems

All the prospective alternative solid waste management systems for ONSR must meet the following basic principles:

a. Conform to the requirements set forth in the Federal Guidelines and that contained in Missouri Solid Waste Management Plan.

b. Prevent air, water and land pollution

c. Be practicable and economically justifiable

Based on the characteristics of solid waste shown in Section III, only 39% of the total refuse or 107 tons per year is non-combustible. The sampling results further indicated that there is limited metallic material in the non-combustible which is worthwhile for salvage.

A good majority of refuse still has to be disposed of by other means. In addition to the storage requirements, double handling of refuse, transportation to nearest dealer, the commercially available material separation equipment is not suitable for the quantity of refuse generated in the Park. Therefore, it can be concluded that recycling is an impractical and uneconomical alternative to the present ONSR solid waste management.

The characteristics of solid waste from ONSR also revealed that a large fraction of refuse is difficult to break down biologically. The combustibles are mostly paper which will compost slowly. The non-combustibles cannot be composted although they will chemically deteriorate. In view of such high seasonal generation, the slow composting process cannot be logically applied as an effective disposal method for the Park.

Other pilot processes, at the present time, have not received general acceptance since they are still in an experimental stage and general lack of operational experience as well as established owning and operation costs

for a prototype plant.

Since NPS has invested substantially in the solid waste storage containers, John boats, the 5-cubic yard compactors, etc., it is doubtful that a privately operated storage and collection system at ONSR will result in any significant savings for NPS. To secure better reliability and economic advantages for NPS, the NPS should continue to provide storage containers and operate the collection service. Therefore, a contracted private collection at ONSR will not be considered as a practical alternative system.

a. NPS Operated Collection and Incineration

Due to the geographical separation of refuse generation points, it is logical that each solid waste management district has an incinerator located near the maintenance shop. The additional capital investment stemming from multiple incinerator installation will, in the long run, be offset by the transportation cost of refuse to a centrally located plant. Since each incinerator will be located near the maintenance area, a full time incinerator operator is not required. However 3 man-hours per day are charged to the incineration operation. The residues from incineration are assumed to be disposed of in ground adjacent to the incinerator.

The collection of refuse as presently operated by NPS is not altered in any way by the incineration process. The estimated annual owning and operating costs for NPS operated collection and incineration are as follows:

Collection Operation Estimated Cost (Section II-D)	$ 66,040
4-Package Type Incinerator Units each with a small building - 10 year Depreciation	20,000
Supplemental Fuel Per Year	3,400
Labor, Maintenance and Utilities Annual Cost	32,800
Residue Disposal Annual Cost	1,400
Sub-Total	$123,640
10% Administration	12,360
Total Estimated Annual Cost	$136,000

b. NPS Operated Collection, Transfer Station and Landfill Operation

The geology in ONSR does not qualify for a successful operation of sanitary landfill. Therefore, any prospective landfill site must be located outside the Park's boundaries, logically near Eminence in Shannon County. The costs to operate and maintain more than one sanitary landfill would be prohibitive for the quantity of refuse generated. Since the distance between such a centrally located sanitary landfill and various refuse generation areas exceeds 25 miles, a small compaction unit at Big Spring, Powder Mill and Round Spring is required to reduce road trips to the landfill site.

It is assumed that NPS can either rent or purchase approximately 5 acres in the vicinity of Eminence and that one truck and driver can collect the compacted refuse from Big Spring, Powder Mill and Round Spring with the Alley Spring collector truck going direct to the landfill to dump.

The estimated annual owning and operating cost of this type of operation is as follows:

Collection Operation Estimated Cost (Section II-D)	$ 66,040
3-Compaction Units - Owning, Operation and Maintenance	12,000
Transport Truck and Driver Cost	23,250
Landfill - 5 Acres Rental @ $50	250
Bulldozer and Operator Cost	22,100
Sub-Total	$123,640
10% Administrative	12,360
Total Estimated Annual Cost	$136,000

If, after sufficient operating experience has been developed with the presently operated 5 cubic yard compactor units, it may be possible that these units could make a daily trip from say Powder Mill and Round Spring to the landfill site. Then only one compaction unit would be required at Big Spring with a smaller transport truck being utilized to make the trip to the landfill site. This would materially reduce the above estimated annual cost.

APPENDIX

CURVE FITTING-OZARK NATIONAL SCENIC RIVERWAYS OVERNIGHT VISITOR COUNT

QUADRATIC FUNCTION

CALCULATED COEFFICIENTS

A0= 0.0000000000E 00 A1= 0.3429450000E 05 A2= 0.2331500000E 04
XL= 0.7000000000E 02 YL= 0.1369650000E 06

WHERE Y - YL = A0 + A1 * (X - XL) + A2 * (X - XL) * * 2

	GIVEN		COMPUTED		
PT NO	X	Y	X	Y	DELTA Y
1	70.0000	136965.0001	70.0000	136965.0001	0.0000
2	71.0000	173591.0001	71.0000	173591.0001	0.0000
3	72.0000	214880.0001	72.0000	214880.0001	0.0000

STANDARD DEVIATION= 0.0000
CORRELATION COEFFICIENT= 1.0000

X	Y
70.0000	136965.0001
71.0000	173591.0001
72.0000	214880.0001
73.0000	260832.0001
74.0000	311447.0003
75.0000	366725.0003
76.0000	426666.0002
77.0000	491270.0003
78.0000	560537.0007
79.0000	634467.0004
80.0000	713060.0004
81.0000	796316.0007
82.0000	884235.0007
83.0000	976817.0004

CURVE FITTING-OZARK NATIONAL SCENIC RIVERWAYS OVERNIGHT VISITOR COUNT

LINEAR FUNCTION

CALCULATED COEFFICIENTS

A0=-0.777166667E 03 A1= 0.389575000E 05
XL= 0.700000000E 02 YL= 0.136965000E 06

WHERE Y - YL = A0 + A1 * (X - XL)

	GIVEN		COMPUTED		
PT NO	X	Y	X	Y	DELTA Y
1	70.0000	136965.0001	70.0000	136187.8335	777.1666
2	71.0000	173591.0001	71.0000	175145.3333	-1554.3332
3	72.0000	214880.0001	72.0000	214102.8335	777.1666

STANDARD DEVIATION= 1346.0920
CORRELATION COEFFICIENT= 0.9994

X	Y
70.0000	136187.8335
71.0000	175145.3333
72.0000	214102.8335
73.0000	253060.3334
74.0000	292017.8334
75.0000	330975.3336
76.0000	369932.8336
77.0000	408890.3337
78.0000	447847.8338
79.0000	486805.3338
80.0000	525762.8339
81.0000	564720.3339
82.0000	603677.8342
83.0000	642635.3342