

# Indiana Flood Control Projects and Their Influence on County Highway Planning

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## INTRODUCTION

Indiana's flood control and water resources program is making significant progress and, in so doing, involves in a direct way the road network of the state. At the same time, the highway programs, particularly the interstate and primary state road systems, exert a powerful influence upon the water programs.

## SCOPE OF PROGRAMS

Water is indispensable not only to life itself, but to agriculture, industry, public health, transportation, and for use as a landing place for our astronauts. Since it plays such a prominent role in every human activity, it is not surprising that the field of flood control and water resource planning and development is broad and complex, both from the technical standpoint and from the multiplicity of agencies and interests involved.

From the technical standpoint, the water resources planner is faced with the basic problems of geology, hydrology, hydraulics, construction methods and materials, and project economics. More importantly, he is confronted with the analysis of present and future needs, the translation of such needs into terms of project requirements and the coordination of the human, social, and material adjustments necessary to meet these requirements.

As an example of these latter problems, consider the fact that a given river basin may possess either present or foreseeable future needs in such areas as agricultural, municipal and industrial water supply, flood control, recreation, power, navigation, stream sanitation, and fish and wildlife. Hence the planning of a major reservoir in this state may involve the Corps of Engineers, the Federal Power Commission, the U. S. Bureau of Public Roads, the U. S. Forest Service, the U. S. Public Health Service, the U. S. Fish and Wildlife Service, the National Park Service, the Flood Control and Water Resources Commis-

sion, the State Conservation Department, the State Board of Health, the State Highway Commission; one or more county highway departments, planning commissions, municipalities, school districts; water, power, and telephone utilities; cemetery associations and, of course, a large number of private landowners.

This recital of uses, interests, and agencies merely serves to emphasize the dominant role which water plays in our modern society and to indicate some of the reasons why the planning and development of water projects is a complex and lengthy process.

## GENERAL TYPES OF WORKS

In view of the breadth and complexity of the subject, let us consider these water control projects and their implications with respect to highway planning by the three major classes of such works. These are local protection works, small watershed projects, and reservoirs. The small watershed classification is in reality comprised of one or more of the component elements of the other two classes, but is set apart because of certain distinguishing characteristics and by reason of its rapidly growing popularity in this state, as will be discussed subsequently.

### *Local Protection Works*

Considering first the general classification of works for local flood protection, it may be said that these consist of some one, or various combinations of, levees, floodwalls, and channel improvements, together with such appurtenant works as drainage structures, closure structures, pumping stations, and roadway ramps. Works of this character are generally designed to provide protection to a specific and relatively limited area, such as a municipality or a reach of contiguous agricultural bottom lands.

Among projects of this type may be cited the recently-completed channel improvements on Salamonie River at and near Portland in Jay County, channel improvements on White River, Fall Creek, and Eagle Creek at Indianapolis in Marion County, a forthcoming channel improvement project on Indian Creek at Corydon in Harrison County, the Levee Unit 5 project along the Wabash River in Gibson and Posey Counties, and the Mason J. Niblack Levee project in Knox and Sullivan Counties. Numerous other projects have, of course, been constructed throughout the state by both the federal government and local interests.

Local protection works do not, as a rule, exert such profound influences upon the road network as do reservoirs, for example, for the reason that they are generally limited in areal extent, do not constitute a barrier which is extremely costly to surmount, and do not result in

such drastic changes in traffic patterns. The effects of local protection projects on roads may be that of raising, lengthening, or underpinning an existing bridge, the construction of a new bridge and approaches to provide increased waterway area and improved alignment, relatively short road relocations necessitated by changes in channel alignment, or the construction of ramps to carry a road across a levee. These changes, of course, cost money and are important in that regard. In general, however, these local protection projects do not constitute any particular barrier to the future development and expansion of the county road system.

Works of this nature may be planned and constructed by counties, municipalities, special districts, the state, or agencies of the federal government. In the case of such work by local agencies, it is reasonable to assume that the fact that a particular local project is being planned is a matter of common local knowledge and hence that the county commissioners can be well informed as to the nature of the project and of its impact upon the road system and other matters within their jurisdiction. Having such information, they should be in a position to preserve and protect their interests.

While possessing the statutory authority to do so, the state has not as yet elected to engage in the direct construction of flood control works. Hence there is no need here to speculate as to just what policies might be employed with respect to the coordination of such projects with existing developments.

As herein defined, the only federal agency directly engaged in the planning and construction of local protection projects is the Corps of Engineers, working from district offices located in Louisville for that part of the state drained by the Wabash and Ohio Rivers, in Detroit for that part drained by the Maumee River, and in Chicago for that part drained by the Kankakee, Calumet, and St. Joseph Rivers.

I wish to take just a moment here to cite a few figures relative to this local protection program. We are accustomed to hearing such terms as "pork barrel" applied to flood control works, but I submit that here in Indiana, at least, the record shows otherwise.

To date, the Corps of Engineers has constructed four agricultural levee projects providing protection to 78,800 acres of land at a total cost of \$2,913,000. Since their construction, these four projects have prevented damages officially estimated at \$15,830,000, or 5.4 times their cost, and will continue to provide protection for many years to come.

Again, the Corps has completed the construction of seven urban protection projects involving levees and floodwalls at a total cost of

\$18,030,000. To date, these same projects have prevented damages estimated at \$24,500,000, or 1.36 times the construction cost. As in the case of the agricultural levee projects, the life of these protective works extends indefinitely into the future.

Two additional urban protection projects are under construction, involving Evansville and Vincennes, at a presently-estimated cost of \$21,600,000. Interestingly enough, these projects have already prevented damages of about \$11,900,000, even though not completed.

These data will suffice to show that soundly planned, carefully designed and well constructed flood control projects are an economic asset, not a "pork barrel" waste of public funds.

Federal policy with respect to local protection works is quite different from that for reservoirs. As we have already noted, local protection works are designed to provide protection to a specific area or locality and hence the project benefits generally accrue only to that particular area. In such case, federal policy requires a reasonably substantial local contribution toward the cost of the protective works. In general, this consists of the costs of the necessary lands and rights-of-way and the alteration or relocation of utilities, roads or other local improvements. In addition, local interests must hold and save the United States free from any damages resulting from the construction of the project and must maintain and operate the works after completion in a manner satisfactory to the Secretary of the Army.

With particular respect to roads, the federal government assumes only the cost of ramps, closure structures, or such other methods as may be employed to cross the line of protection, and that only within the limits of the project right-of-way. All other costs are borne by local interests.

In concluding this discussion of local protection works, it is desired to note again the fact that they do not as a general rule exert any profound effect upon the local road system. However, there is one effect on the road system that may result from the construction of levee projects protecting relatively large areas. This is the probable demand upon the county from the protected area for better roads since they are no longer liable to frequent washout or closure by reason of flooding. On the other hand, the savings in maintenance costs resulting from the elimination of flooding should permit some betterments from those funds alone.

#### *Small Watershed Projects*

As mentioned earlier, small watershed projects may involve such work as detention reservoirs, channel improvements, and levees. In addition, they include land treatment measures involving better land use

and management erosion control, and restoration or improvement of fertility.

These projects are initiated and carried out by local groups with technical and financial assistance from the Soil Conservation Service of the U. S. Department of Agriculture under the provisions of Public Law 566. Construction, operation, and maintenance are normally accomplished through the organization of Conservancy Districts pursuant to Indiana law.

Small watershed projects are limited in size to not more than 250,000 acres and hence may generally be considered as headwater or small tributary projects. They are primarily designed to provide benefits to the lands on which they are located and to prevent the frequent flooding of agricultural lands during the crop season, although they may be used to provide urban protection in some cases.

This program is relatively new in Indiana, but is proving to be extremely popular and developments are proceeding at a rapid pace. At the present time, three watershed projects are under construction, work plans have been completed for five projects, planning is in progress on five watersheds, and 34 watersheds are awaiting planning activity.

As in the case of local protection projects constructed by the Corps of Engineers, the alteration or relocation of roads necessitated by the small watershed projects is considered to be a local responsibility, to be carried out at local cost. The practice of the Soil Conservation Service is to contact the county commissioners or other responsible officials with respect to roads in the course of project planning and, as the planning enters final stages where the nature and extent of work is more definitely known, to negotiate agreements for the execution of the work by local interests.

To date, no project has been encountered where any particular influence has been exerted upon the county road system as a whole, nor does such appear likely to occur.

### *Reservoirs*

This is perhaps the phase of Indiana's flood control and water resources program in which you are most interested, not only because of the effect of reservoirs upon the road systems but because of their utility and popularity for many uses and purposes. The present status of the major reservoir programs in the state is as follows:

- (1) *Cagles Mill Reservoir*, located on Mill Creek in Owen and Putnam Counties, was completed in 1951 at a cost of \$4,108,000. It controls the runoff from 295 square miles of drainage area, has a maximum flood pool area of 4,840 acres, and has a total flood

storage capacity of 201,000 acre-feet, or 12.8 inches of runoff from the basin. The range in elevation from the permanent pool to the maximum pool is 68 feet. The estimated flood damages prevented by the reservoir since storage operations were started in 1952 amount to about \$5,800,000, or \$1,690,000 more than the cost of the project.

- (2) *Mansfield Reservoir*, located on Raccoon Creek in Parke and Putnam Counties, was completed in 1960 at a cost of \$7,540,000. It controls the runoff from 208 square miles of drainage area, has a maximum flood pool area of 3,900 acres, and has a total flood storage capacity of 116,655 acre-feet, equivalent to 10.5 inches of runoff from the basin. The range in elevation from the permanent pool to the maximum pool is 50 feet. As of January 1, 1962, flood control benefits from operation of the reservoir amounted to an estimated \$460,000.
- (3) *Monroe Reservoir*, located on Salt Creek in Monroe, Brown, and Jackson Counties, is currently under construction under a program of joint federal-state financing at a presently-estimated cost of \$13,350,000. The reservoir will control the runoff from a drainage area of 441 square miles.

This project is unique in Indiana in that it is a true multi-purpose reservoir, serving the primary project purposes of flood control and low flow augmentation on Salt Creek, East Fork of White River, and White River. These low flow releases will add to the values for domestic, municipal, and industrial water supply; improvement of water quality, and fish and wildlife. At the same time, the large pool area afforded by the conservation storage will provide excellent opportunities for water and water-related recreation.

The project is also unique with respect to its financing. Under the terms of the federal-state contract, the state will contribute a total of 54.1% of the cost of the project, representing the proportionate share of project costs allocated to conservation storage plus the capitalized cost of the state's share of future operation and maintenance expenses. The release, withdrawal, or other use of water from conservation storage will be under the sole control of the state.

The conservation pool will extend from elevation 515 to elevation 538, will have a volume of 159,000 acre-feet and a surface area, at elevation 538, of 10,700 acres. The flood pool will extend from elevation 538 to elevation 556, will have a volume of 258,000 acre-

feet or 11 inches of runoff, and a maximum surface area of 18,600 acres.

Some 1,700 acres of land will be utilized for ten proposed public access sites, in addition to facilities to be provided by the State Department of Conservation.

Completion of the reservoir project is scheduled for the fiscal year 1964-65.

- (4) *Salamonie Reservoir* is located on the Salamonie River near its mouth in Wabash and Huntington Counties, and was placed under construction in November 1961. It will control the runoff from 552 square miles of area. The reservoir will have a permanent pool at elevation 730 with a surface area of 976 acres, a summer pool at elevation 760 with a surface area of 3,268 acres, and a maximum flood pool at elevation 793 with a surface area of 9,340 acres. Flood storage capacity is 263,600 acre-feet, equivalent to 8.24 inches of runoff from the watershed. The range in elevation from permanent pool to maximum flood pool is 63 feet.
- (5) The *Mississinewa Reservoir* will be located on the Mississinewa River between its mouth and the City of Marion, in Miami, Wabash, and Grant Counties. It will control the runoff from 809 square miles of drainage area. The reservoir will have a permanent pool at elevation 712 with a surface area of 1,280 acres and a maximum flood pool at elevation 779 with a surface area of 12,830 acres. Consideration is being given to establishment of a summer pool at elevation 737, which would provide a surface area of 3,180 acres. Flood storage capacity is 345,100 acre-feet, or 8.54 inches of runoff from the basin. The range in elevation from the permanent pool to the maximum flood pool is 67 feet.

Initiation of construction is scheduled to begin with appropriate ground-breaking ceremonies in April of this year.

- (6) The *Huntington Reservoir* will be located on the Wabash River between Huntington and Bluffton in Huntington and Wells Counties and will control the runoff from an area of 708 square miles. The tentative maximum flood pool is at elevation 797, at which level it would have an area of 7,440 acres and a volume of 145,400 acre-feet, or approximately 4 inches of runoff. It is anticipated that a seasonal pool of about 900 acres will be provided. The range in elevation of the flood pool will be about 30 feet. It is hoped that construction will be undertaken during the next fiscal year.

- (7) The Corps of Engineers is in the process of making new studies of the *Brookville Reservoir*, authorized by Congress in 1938. This dam would be located on the East Fork of Whitewater River immediately upstream from the city of Brookville and the reservoir would be located in Franklin and Union Counties. The feasibility, capacity, and controlling pool elevation of the project can be determined only upon completion of the current studies.
- (8) Feasibility studies by the Corps of Engineers are well advanced on three other possible reservoirs in the upper Wabash River basin. These are the proposed *Big Pine Creek Reservoir* near Attica in Warren County, the *Wildcat Creek Reservoir* near Lafayette in Tippecanoe County, and the *Sugar Creek Reservoir* near Turkey Run State Park in Parke and Montgomery Counties. These three projects would control a total of about 1,800 square miles which, combined with the approximate 2,300 square miles controlled by the Mansfield and three Upper Wabash Reservoirs, would bring a total of about 4,100 square miles under control. This is some 51% of the Indiana portion of the Wabash River basin above Terre Haute, and 33.6% of the entire Wabash basin above the same point.
- (9) The Commission is engaged in studies of the feasibility of a major reservoir site on the Patoka River in DuBois, Crawford, and Orange Counties. It is expected that the Corps of Engineers will join in these studies later in the present year.

The reservoir program may be summarized at the present time as follows: two projects completed and in operation, two projects under construction, two projects scheduled for construction in the near future, one authorized project under review, and four projects in the feasibility study stage. Prior to completion of the Cagles Mill Reservoir in 1951, there was not a major flood control reservoir in the state.

## REGULATORY FUNCTIONS

No discussion of Indiana's flood control and water resources program would be complete without at least brief mention of the regulatory phase and associated activities, some of which should be of direct interest to road officials.

Pursuant to the provisions of the Indiana Flood Control Act, the construction of any works of any nature in a floodway must have the prior approval of the Commission. As might be expected, bridges are the type of structures most frequently involved.

In the exercise of these powers, the Commission staff is always available to the owners, state or local road officials, and their consultants to furnish technical information and assistance as it pertains to flood stages and waterway openings at any stage of planning and design. The Commission staff is engaged in a continuing program of setting high water marks on the rivers and streams of the state following major floods and establishing their elevation above sea level datum, of locating and determining the elevations of the stages of historic floods such as those of 1913, and of making special measurements of discharge at points of particular interest. In this connection, a total of some 20,500 high water marks have been established since 1954, of which about 11,000 have been referred to sea level datum.

In order to determine the elevations of these marks, it has been necessary to do extensive precise leveling, including the setting of a large number of permanent bench marks. The descriptions and elevations of these marks are available to all agencies and individuals who have need for such data. At the present time, such information is available for 62 counties.

## EFFECTS OF RESERVOIRS ON ROAD SYSTEMS

The construction of major flood control reservoirs such as those just described have rather widespread effects upon the local road systems, both immediate and long-range. These projects usually extend over a number of miles of streams, flood thousands of acres of area, and produce variations in water levels of as much as 70 feet. The crossing of such a reservoir with a roadway is normally a rather expensive project.

Before considering these effects, it is well to first discuss the several steps involved in the planning of a reservoir project by the Corps of Engineers. In general, these steps are as follows:

1. Local interests in a particular area or river valley who are interested in a solution to their flood problems petition their congressional representatives for a study by the Corps of Engineers.
2. Either the House or Senate Committee on Public Works may, by resolution, authorize the Corps of Engineers to make a survey of the area or basin.
3. Congress must appropriate the necessary funds for the survey.
4. Following congressional authorization and appropriation of funds, the Corps of Engineers proceeds with the necessary preliminary surveys and investigations to determine the nature and economic feasibility of remedial measures. Normally, the first step in these

investigations is the holding of a public hearing to obtain the views and desires of local interests.

5. Upon completion of the report and assuming a favorable finding, it is forwarded to the division office for review and approval, and thence to the Chief of Engineers.
6. The report is then transmitted to all federal agencies having any interest in the matter and to the governor of each affected state for review and comment. The report is then reviewed by the Board of Engineers for Rivers and Harbors and the Chief of Engineers, and forwarded to the Bureau of the Budget for coordination with the program of the administration.
7. Following the review of all these agencies, the report is transmitted to the Congress for consideration and possible authorization for construction.
8. After authorization, funds must be appropriated for final planning and the preparation of contract plans and specifications.
9. Funds are then appropriated for construction of the project.

While the length of time required from the initial step to the completion of the project will of course vary with the nature and magnitude of the work, it is safe to assume an average of about ten years. Hence there is both adequate time and opportunity for the exploration and resolution of problems concerning the road system.

It is a fact that the Corps of Engineers does not, as a rule, consult with local road officials during the preliminary, or survey report, stage, but rather draws upon its own investigations and experience and consults with the State Highway Commission to develop a generalized plan of road relocation and an estimate of cost. It should be emphasized here that the purpose of the survey report is to define the nature and extent of the flood problem, the amount of damages resulting therefrom, the nature and controlling elements of the most practicable solution, and the physical and economic feasibility thereof. Even though the survey report may be favorable, the Corps does not, and indeed cannot, consider that it has an official project until it has been approved by higher authority and authorized by Congress. Hence the failure to consult with local road officials during the survey report stage does not represent an attempt to by-pass their interests, but is done because of the lack of necessity for detailed planning at this stage and in the interest of conserving the time and expense of both the Corps and local agencies.

Now let us assume that a survey report has been made, that construction of a reservoir has been recommended, and that Congress has

authorized construction and appropriated funds for pre-construction planning.

It is only at this stage that there is an official project and it is here that definite project planning begins. In this phase, all prior studies of hydrology, hydraulics, foundation conditions, project purposes, storage requirements, and other factors are reviewed and expanded as necessary. The precise site of the dam and its appurtenant structures is determined and a decision reached as to the reservoir pool elevations to be used. The entire reservoir area is mapped so that the exact extent of the reservoir and its effect upon existing improvements can be definitely determined.

Planning is now at the point where the effects of the reservoir upon the road system are known and it is possible to consult with local interests in order to work out a plan for the revision of the road system. This plan usually involves the three elements of alteration, relocation, and abandonment.

Until March 1962, federal policy provided that all lands necessary for the construction, maintenance, and operation of the dam and its appurtenant structures were to be acquired in fee simple, together with all those reservoir lands which would be subject to flooding as often as once in five years, on the average, by the fluctuation of the flood control pool. For those reservoir lands lying above the five-year flood line, the policy was to acquire only a right to flood, with title remaining in the owners but subject to a restriction against any permanent buildings in the easement area. The Cagles Mill and Mansfield Reservoirs were constructed under this policy and the current land acquisition program for Monroe Reservoir is based upon the same principles.

The recently-stated (March 1962) policy does away with the concept of flood easements on reservoir lands, except in certain minor instances, and provides that all lands will be acquired in fee. The ensuing discussion is based upon this current policy.

The adjustment of the road system necessitated by the construction of a major reservoir presents so many possible variations, depending upon the circumstances of each particular case, as to prohibit a discussion of all possible developments. However, a consideration of general practice and policy will serve to illustrate the process.

Firstly, it is obvious that a considerable mileage of local roads will be located within the reservoir area where the title to all lands is acquired by the federal government. Since they no longer serve any useful purpose, the county is normally requested to officially abandon such roads. In such cases, the counties may, if they so desire, salvage

such items as bridges, culverts, guard-rails, traffic signs, etc., prior to the filling of the reservoir.

Secondly, there may be a number of local roads which are affected by the reservoir pool at one or more places where they cross an arm of the reservoir, but which are necessary to provide for local access to lands around the reservoir or to public access points on the reservoir. In such cases, the federal government, on the basis of an over-all agreement with county officials as to which roads should be maintained for such purposes, will either raise or relocate the affected portions of the road. This work by the federal government includes the acquisition of additional rights-of-way, if necessary, the preparation of plans, award of contracts, and supervision of construction. When completed, the work is turned over to the county for operation and maintenance. Such altered or relocated sections of roadway are constructed to current standards for the volume of traffic currently using that road. Should the county desire construction to a higher standard in anticipation of future traffic requirements, this may be done by an agreement by the county to assume the additional cost of construction to such higher standards.

Finally, it may be necessary and desirable, in order to prevent unreasonably large increases in travel, to provide one or more crossings of the reservoir for main county roads. In such cases, and again on the basis of an agreement with the county as to locations, the federal government will bear the entire expense of such crossings, returning the completed road to the county for operation and maintenance. These reservoir crossings are constructed not only to handle the volume of traffic currently using that road, but to handle the increased volume of traffic diverted to that crossing because of the abandonment of other roads.

This discussion of road systems has thus far been limited to the adjustments necessary to compensate for the construction of the reservoir. It is important to note that this is the only phase in which the federal government can engage in the local road program.

There is another aspect to this problem relating to the effect of reservoirs upon the county road system which will probably, in the long run, reflect more upon the overall road system and the county's finances than does the immediate adaptation of the road network to the reservoir. This influence is that of the additional volumes of traffic generated by the use of the reservoir and adjacent areas for such purposes as camping, picnicking, swimming, boating, fishing, and allied outdoor recreational uses. It can readily be visualized how that roads which are adequate to handle the present rural agricultural traffic volume

may be entirely inadequate to handle a large influx of visitors to the reservoir.

Projections as to the probable number of persons attracted to a reservoir and the resulting volume of traffic are admittedly subject to a wide range of error. Much more work needs to be done in this area in order to provide a better basis for making such estimates. It must be remembered, however, that the Cagles Mill Reservoir is the only such project in Indiana which has been in existence long enough to develop its potential in this regard.

The Commission has made limited studies of the number of visitors and volume of traffic at the Cagles Mill project and has recently made a tentative projection of these data to the Monroe Reservoir project near Bloomington. These will serve to illustrate the possible increases in traffic generated by the major reservoirs.

The study is based largely upon data collected in use surveys that have been made at Cagles Mill Reservoir. The data have been related to population distribution in Indiana and adjoining states as it affects Monroe Reservoir.

It has been found that about 60 miles is the limit that most people are willing to travel to visit the lake for one day; however, there are a few who may travel as far as 100 miles to reach the lake. The number who would be willing to travel more than 100 miles becomes so small that they have been neglected in our study.

The present planning for Monroe Reservoir is for facilities, such as picnic tables and boat launching ramps, that will be largely for the benefit of the person who will visit the lake for one day. Other facilities, such as hotels and camping grounds, are being considered but the plans are not advanced far enough to make determination of the number of people who will be staying at the lake for several days or for weeks. Consequently, our study is of the use by the day-visitor only. In any case, it is the day-visitors who will generate the most traffic around the lake.

The probable number of persons who will visit the lake has been determined by applying Use-Distance curves developed in the Cagles Mill survey to the population that provides the potential for reservoir use. The highway distance was determined to the population center of each county within 100 miles of the reservoir, and the population was taken from the 1960 census. The use, in per cent of population, was determined from the curve for each county for three classifications of use, Sundays and holidays, Saturdays, and week days. These percentage figures were converted to average daily attendance by applying

them to the 1960 census population. The season total attendance was then determined by multiplying the average daily attendance for each of the three classes by the number of Sundays and holidays, Saturdays, and week days in the season May 1 to September 30.

Two situations might be used to illustrate the methods of computation. The reservoir is 12 miles distant from the center of population of Lawrence County, Indiana, which had a population of 36,135 persons when the 1960 census was taken. The curve shows that on an average Sunday or holiday, 1.42 per cent of the population living 12 miles distance, or 513 persons from Lawrence County, would use the recreational facility. Another illustration shows the effect which large population centers some distance from the reservoir might have on attendance. The center of population of Marion County, Indiana, which had a 1960 population of 690,162 persons, is 58 miles from Monroe Reservoir. The curve indicates that on a Sunday or holiday, 0.15 per cent of the population living 58 miles distant would use the lake. This is about one-tenth of the percentage attendance determined for Lawrence County, but the 0.15 per cent when applied to the Marion County population becomes 1.035 persons, or twice the number of users determined for Lawrence County.

The estimated seasonal attendance at Monroe Reservoir based on the method of computation illustrated above is as follows:

Day Classification	Day per Season*	Average Daily Attendance	Seasonal Attendance
Sundays and holidays	25	4,737	118,425
Saturdays	21	1,665	34,965
Week days	107	1,145	122,515

Total persons per season 275,905

\* Season assumed is the five-month period, May 1 to September 30.

The figures given above are averages for the season and do not indicate the peak attendance that may be expected. Sundays in July and August will have larger attendance than during the other months and seasonal peaks may be expected in those months. The July 4th and July Sunday peaks may be expected to be from 2.0 to 2.5 times the average attendance. Consequently, Sunday attendance during July might range between 9,000 and 12,000 persons. During the early and late parts of the season the attendance figures would be correspondingly lower than the average.

Surveys have shown that the average number of persons expected to be transported to the lake is 3.8 per car. Consequently, for an attend-

ance of 12,000 persons nearly 3,200 automobiles could be expected. These figures could be larger or smaller depending upon the popularity of Monroe Reservoir as compared to Cagles Mill Reservoir.

The surveys have shown also that on week ends 8.8 per cent of the cars will tow boats to the lake. Consequently, about 275 boats could be expected on a peak day with an attendance of 12,000 persons.

How this traffic might be distributed around the lake is not known at this time. Its distribution will be determined by the popularity of the facilities that will be provided at the lake, the adequacy of the road network, and the means that may be taken to direct traffic to selected areas.

In connection with the Monroe project, the County Commissioners of Brown, Jackson, Lawrence, and Monroe Counties are working together to develop a joint plan for the routes which they consider necessary to tie into the existing state and federal system, to promote and maintain routes for local traffic, and to provide for the additional volume of traffic expected to be generated by the reservoir. Such a plan will enable all the local road officials to carry out their respective future road programs in the way designed to best serve the entire area. Such concerted action is to be commended and may well serve as a pattern for the counties involved in other reservoir projects.

There are many other phases of the impact of reservoirs on the local road systems which are beyond the scope of this paper. Among these may be mentioned the obvious fact that the reservoir lands acquired by the government are no longer subject to taxation, thereby reducing the county's revenues for road and bridge work. Again, the abandonment of those roads inundated by the reservoir reduces the funds received from the distribution of motor fuel taxes.

On the other hand, construction of a major reservoir invariably spurs the development of surrounding lands for residential and other purposes which result in a higher assessed valuation than rural farm lands. Such development, in time, may well result in an increase in the county's tax base over that prevailing before the construction of the reservoir. Further, it is a matter of common knowledge that perhaps the great majority of the local bridges over the streams whereon reservoirs may be constructed are at, or indeed already past, their economic life and require replacement to meet the needs of present-day traffic and that the bottom land roads which are frequently flooded require a disproportionate share of maintenance costs.

In closing, I would like to urge your serious consideration of the many local road problems arising from the reservoir program in this

state. You will find the Corps of Engineers to be sympathetic to your problems and to be cooperative to the full extent of their power. The Flood Control and Water Resources Commission, as the official representative of the state in the water resources program, stands ready to serve in every possible way in working toward a solution of all problems relating to the planning, construction, and operation of the entire program.