INTERIM REPORT

Submitted to the

Iowa Department of Transportation

Highway Division

and the

Iowa Highway Research Board

by

Systems Division, College of Engineering

The University of Iowa

Iowa City, Iowa 52242

A COMPUTER BASED INFORMATION SYSTEM FOR COUNTY EQUIPMENT COST RECORDS

HR-173

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A COMPUTER BASED INFORMATION SYSTEM FOR COUNTY EQUIPMENT COST RECORDS

1.0 INTRODUCTION

This report describes the work accomplished to date on research project HR-173, A Computer Based Information System for County Equipment Cost Records, and presents the initial design for this system. The specific topics discussed here are findings from the analysis of information needs, the system specifications developed from these findings, and the proposed system design based upon the system specifications. The initial system design will include tentative input designs for capturing input data, output designs to show the output formats and the items to be output for use in decision making, file design showing the organization of information to be kept on each piece of equipment in the computer data file, and general system design explaining how the entire system will operate.

The Steering Committee[1] appointed by Iowa Highway Research Board is asked to study this report, make appropriate suggestions, and give approval to the proposed design subject to any suggestions made. This approval will permit the designer to proceed promptly with the development of the computer program implementation phase of the design.

2.0 ANALYSIS OF INFORMATION NEEDS

In this section a report is made concerning our:

1. Study of the equipment cost record systems in a representative group of counties.

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[1]See Appendix A for Steering Committee members.

2. Study of the applicable Iowa Department of Transportation, Highway Division systems for equipment cost record collection, storage and use.
3. Review of applicable texts and other information relating to equipment costs and information systems.
4. Investigation of the computer facilities available at the Highway Division to determine the possibility of using these facilities for the operational phase.

These studies and investigations were made consistent with our original proposal [1] for this project.

The information obtained from each of these studies will now be discussed in detail.

2.1 STUDY OF EQUIPMENT COST RECORD SYSTEMS IN A REPRESENTATIVE GROUP OF COUNTIES

The investigators visited with county engineers or their representatives in nine selected counties. These counties were selected based upon advice of the Steering Committee and included counties in different parts of the state with varying population and geographical sizes. Two of these counties have already implemented computerized cost record keeping systems.

The counties and persons visited, and dates of the visits are shown below.

1.	Poweshiek County	M. O. Hansen	November 26, 1974
2.	Linn County	Bill Harrington	January 9, 1975
3.	Montgomery County	Cleo Smith	January 14, 1975
4.	Madison County	Tim Waddingham, Admin. Asst.	January 16, 1975

5.	Jasper County	Chuck Cabalka	January 16, 1975
6.	Warren County	Bob Sandy	January 21, 1975
7.	Boone County	Carl Schnoor	January 21, 1975
8.	Clayton County	Milt Johnson	January 28, 1975
9.	Black Hawk County	Paul Schwarting	March 18, 1975

Montgomery and Black Hawk counties have already developed computer based equipment cost accounting systems.

From our discussions we found that all these counties are collecting data on direct operating cost items to include fuel, oil, tires, grease, antifreeze, expendable parts (e.g., blades and filters), repair and overhaul parts, and maintenance and repair labor. Each county has its own forms for collecting these direct cost items as well as the number of miles or hours each piece of equipment was used during a given time period. Forms used for collecting cost data were obtained from each county as well as equipment inventory lists. Representative forms may be found in Appendix C.

Basically two ways are used to capture direct cost data for each piece of equipment. The first way is by the operator recording items on his time card or on other forms for specific cost items, e.g., a fuel ticket. The second way that the direct cost items are captured is by shop personnel recording cost items on shop maintenance and repair forms. Then, periodically, say monthly, the data on these forms are transferred to a summary form. Usually, there is one summary form for each piece of equipment, containing sufficient space for direct operating cost data for one year.

At the end of the year (calendar year in the counties visited) the direct operating costs are totaled. In five counties, a depreciation figure is also then recorded for the particular piece of equipment. In Jasper County, the depreciation amounts come

from detailed graphs of depreciation which have been developed for each piece of equipment. However, the other counties use less formal means of establishing depreciation charges. At any rate, the appropriate totals are then divided by the total number of hours or miles the equipment has been operated during the year. The result gives the annual cost per hour or mile for operating the equipment.

The resulting cost per hour or mile figures are being used in a number of different ways, to include establishing rental rates for entire classes of equipment (i.e., all motor graders, trucks, etc.), comparing operating costs for similar equipment made by different manufacturers, and determining which equipment to rebuild or trade due to high operating costs.

None of the counties appear to be including indirect costs in the cost per hour or cost per mile figures. Indirect costs are costs which cannot be directly attributed to a piece of equipment; such overhead costs must be allocated on an equitable basis to ensure that each piece of equipment assumes its fair share of these costs. Representative indirect costs include insurance, storage, supervisory and clerical overhead. Although some of these costs are more attributable to ownership than operation, they should, none-the-less, be included in the development of total cost per hour or cost per mile figures.

Another observation is that each county engineer visited appeared to be willing to adopt a uniform computer based system. County engineers in Black Hawk and Montgomery counties, which already have computer based systems, stated that the new system would undoubtedly duplicate some existing procedures, thereby adding some additional costs to their current operation. However, it appears that the added cost will be minimal.

Based upon equipment counts from the nine counties visited, it appears that there are about 9000 pieces of equipment state wide which should be reported upon once this system is operational. This number has been determined by including all self-propelled equipment and any other equipment with a list price over $5000. This is an average of about 90 pieces of equipment per county.

Operating the proposed system on an annual basis seemed to be most favorable to the county engineers visited. Most of the existing systems gather and report annual data. While it would be possible to make all reports on a monthly, quarterly, or semi-annual basis, the value of such added information does not appear to be in proportion to the added cost that would be incurred.

Finally, the additional output desired by the county engineers includes reporting average costs per hour or mile figures for a given class of equipment within each county, and for a representative district in which the county is located, as well as for the whole state. They also desire cost per hour or mile figures for equipment, subcategorized by manufacturer and age of the equipment.

2.2 STUDY OF APPLICABLE HIGHWAY DIVISION SYSTEMS

The investigators visited the Highway Division of the Iowa Department of Transportation on February 11, 1975, to study the Highway Division's system of equipment cost accounting. The Highway Division's A & B-F Equipment System and computer system were discussed with Mr. J. F. Hoag, Data Processing Director, and Mr. Kenneth L. Shafer, Systems Project Manager. The investigators also met with Mr. Stephen E. Roberts of the Steering Committee during this period.

Three main areas were investigated during these meetings. These included a study of the Highway Division's A Equipment Cost System, the Highway Division's computer hardware system and its potential for use with the system proposed here, and an attempt to find a contact point for entering the counties data into the Highway Division's Data Processing Department for computer processing. The Highway Division's computer system and Data Processing Department will be discussed in detail in Section 2.4.

We were interested in obtaining documentation of the Highway Division's A Equipment System because the A Equipment most nearly matches the type of equipment we are working with in this research study. The A Equipment System is a computerized billing, inventory, and accounting system which is used to keep track of all self-propelled equipment owned and operated by the Highway Division of the Iowa Department of Transportation. This system stores operating cost information for each piece of equipment for both the fiscal year and for the life of the equipment. Costs include operation charges, depreciation charges, fuel expense, parts, and labor. Total mileage or hours are also stored for the current year and for the life of the equipment. We spent several hours discussing this system with Mr. Shafer and obtained written documentation [9] of it.

Our further studies of the A Equipment System have indicated that while it is a most worthwhile system for state purposes, it is not directly applicable or adaptable to processing summary data in the form needed by county engineers. None-the-less, we have learned much from our study of this system and have incorporated many of its concepts into the design proposed here.

In our discussion with Mr. Hoag and Mr. Shafer, it was learned that while the Highway Division's Data Processing Department would be pleased to provide computer services for the proposed system, their group does not act as an initial entry point for input data from outside groups. Therefore, another initial entry point would be required to collect data from the various counties and turn it over to the Data Processing Department. We discussed this need with Mr. Roberts, and he suggested the Secondary Roads Department as a possibility. However, no decision has yet been made concerning this point.

2.3 REVIEW OF APPLICABLE TEXTS AND MANUFACTURERS INFORMATION

Equipment costs refer to the over-all cost entailed in providing and utilizing the services of equipment. These costs may be classified several ways. Some of these classifications are: a) operating and ownership costs, b) variable and fixed costs, and c) direct and indirect costs [5]. The elements making up total equipment costs fall into various general categories depending on the classification system used. For example, one cost element is fuel. The cost of fuel is an operating cost under classification a), a variable cost under b), and a direct cost under c). A review of literature applicable to county equipment cost record keeping [2,8], has shown that the most appropriate and common way to classify costs is to use the direct and indirect cost system. Another important part of over-all equipment cost, in addition to direct and indirect costs, is depreciation. A discussion of these three cost factors taken from the NACE Action Guide Series [8] follows.

"Direct cost is composed of two parts, repair and operating cost. Repair cost means the cost of parts and materials installed or consumed in repairing or overhauling equipment, together with the labor expended in these operations. Also included are the costs of services performed by commerical shops. Operating cost means the cost of supplies consumed in operating and servicing equipment, including servicing obtained from commerical services. It includes the cost of consequential amounts of labor involved in servicing, other than that of operators on duty with the equipment. The following are typical operating cost items: fuel, lubricants, grease, tires and tubes, tire repairing, and expendable accessories (spark plugs, batteries, fan belts, etc.).

Indirect costs are those not identified with any particular unit or equipment, thus requiring prorating costs to all equipment benefited. Following are typical examples of indirect costs:

1. Salaries and expenses of supervisory employees not directly employed in servicing or repairing equipment.
2. Clerical salaries of employees engaged in accounting and preparing reports for equipment.
3. Shop storage and miscellaneous costs of an overhead nature relating to the care and handling of equipment, such as:

a) Utilities.

b) Office and shop building depreciation, rental and maintenance.

c) Depreciation of shop equipment.

d) Replacement of expendable shop tools.

e) Office supplies.

f) Salary of shop foreman or superintendent.

g) Moving equipment.

h) Equipment Insurance

Depreciation is the measure of the declining value of property due to age and wear. It is normally based on the original cost of the equipment including erection, attachments, and transportation, less the estimated salvage value at the time the equipment is retired from service. This is the depreciation base. Thus a unit costing $14,000 less an estimated salvage value of $2,000 at replacement time would have a depreciation base of $12,000. . . . .

The depreciated value (purchase price less accumulated depreciation) of a unit of equipment will seldom equal the actual secondhand market value of the particular unit. The age, amount of use and mechanical con-

dition will determine the resale or trade-in value, which may be greater or less than the depreciated or book value."

Iowa law apparently prohibits the use of revolving funds [2] in accounting procedures for county-owned equipment. Therefore a separate fund cannot receive depreciation charges from each job performed. This has been interpreted by county engineers as implying that depreciation figures should not be included in determining rental rates for costing out jobs. They should be included, however, for internal control purposes such as determinations affecting equipment replacement and purchase of new equipment.

When this system was originally proposed, it was thought that extensive studies of equipment manufacturers information would be needed for determining such things as equipment classifications. However, the A Equipment System and reference [4] obviated the need for a detailed study of equipment manufacturers materials.

2.4 INVESTIGATION OF COMPUTER FACILITIES AVAILABLE

At the start of this study it was felt that the Highway Division's computer facility would be an ideal one on which to operate the information system for county equipment cost records. Our subsequent studies have shown that this is indeed the case.

The Highway Division's computer is an IBM 370/145. The IBM S/370 is the newest line from IBM and the 145 is a medium sized model within the S/370 line. This system has 1 million bytes (positions for storing characters) of storage in the main computer memory. This computer operates under a system which makes it look to users as if there are 16 million bytes of main memory available. This is more than adequate for our intended use.

Some of the peripherals attached to the 370/145 include an IBM 3300 magnetic disk, six magnetic tape drives for reading and writing data from and to magnetic tapes, a punched card reader, a line printer which produces the printed output, and approximately 25 remote terminals. The main computer and peripheral gear are compatible with the computer system at the University of Iowa on which the computer programs for the equipment cost accounting system are being developed.

Moreover, a working relationship already exists between the counties and the Highway Division with their analysts, programmers and computer personnel already attuned to county road and equipment needs. In addition, formal assurance has been received from Mr. Howard Gunnerson (see Appendix B) that their data processing services are available for this purpose.

The computer programming languages available for use on this system include COBOL and PL/1. The A Equipment System is written in COBOL, mainly because its development began before PL/1 was widely used or available. However, it is our intention to use the PL/1 language when writing the computer programs for the new system being developed. PL/1 is a powerful language with data handling and manipulation capabilities even stronger than COBOL's and its computational capabilities are unmatched in commonly available general purpose languages.

An estimate has been made of anticipated data processing operational costs. The maximum cost for one hour of computer central processing time is about $175. It would probably take no more than one hour of such time each time the county equipment cost system is run. The major cost would probably be the cost of keypunching, that is, punching cards suitable for entering the data into the computer

from the forms submitted on each piece of equipment from each county. The cost for keypunchers is about $4.00 per hour. If this system is run on an annual basis it may take 200 hours of keypunching time. Other costs include cards, magnetic tapes, and continuous form paper (the paper the output is printed on), and postage. With all counties taking part on an annual basis, and costs allocated equally to all counties, the estimated cost per county is approximately $20 per year. This does not include the costs of data collection and preparation on the county level prior to submitting summaries to the data processing facility.

3.0 GENERAL SYSTEM SPECIFICATIONS

This section documents and summarizes the developmental work accomplished to date. It is the end result of the system study subphase of the application development process. The system study has focused on the determination of the new system's objectives and the development of the input-output processing system specifications.

3.1 SYSTEM DESCRIPTION-EXISTING SYSTEMS[2]

There is at the present time no uniform state-wide system for analyzing county equipment costs. A minority of the counties have implemented systems for equipment cost records. The existing systems are all different. Most of the data collected is on direct cost items; however, a few counties include depreciation figures. There is little uniformity among direct cost elements collected and depre-

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[2] See Section 2.1 also.

ciation methods used. Most of the counties with existing systems use manual or machine bookkeeping and accounting methods; however, several counties have recently implemented computer data processing systems. While the present systems determine cost per hour or cost per mile figures for individual pieces of equipment, these figures are not available by equipment class, manufacturer, or age. Few counties have maintained historical records of equipment costs.

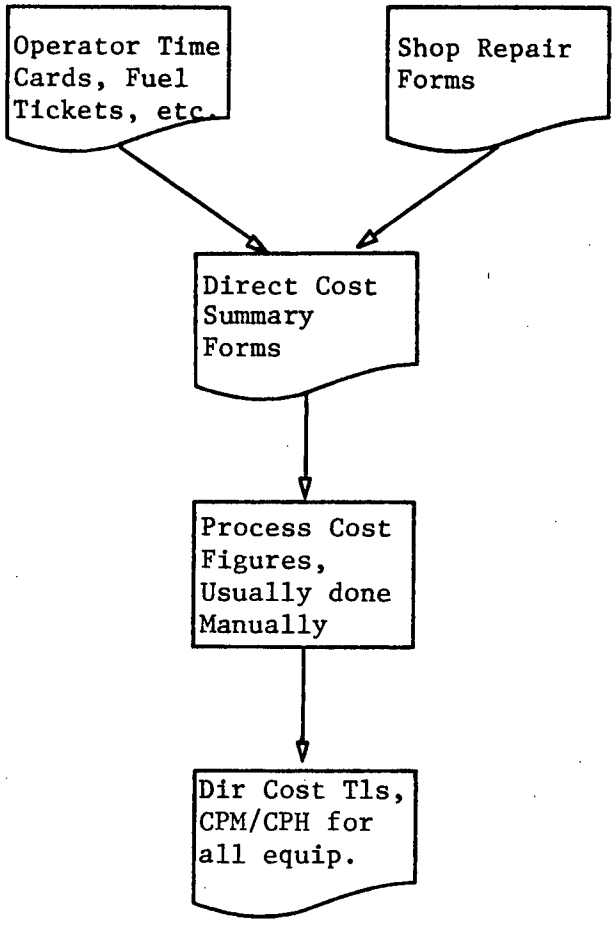
3.2 OBJECTIVES OF THE NEW SYSTEM

The primary objective of the computer based information system for county equipment cost records is to provide a uniform system in all counties for gathering, storing, processing, and using data and information on equipment costs.

To achieve this objective the system should have the capability of specifying and gathering all appropriate direct, indirect, and depreciation costs; establishing and maintaining an equipment cost data base containing general information on all applicable equipment owned by the counties, and historical cost information on that equipment; and providing output in neat, readable form which will aid county engineers in making new equipment purchases and establishing equipment rental rates. In addition the proposed system should have the side benefit of serving as an equipment inventory list for classes of equipment maintained by the system.

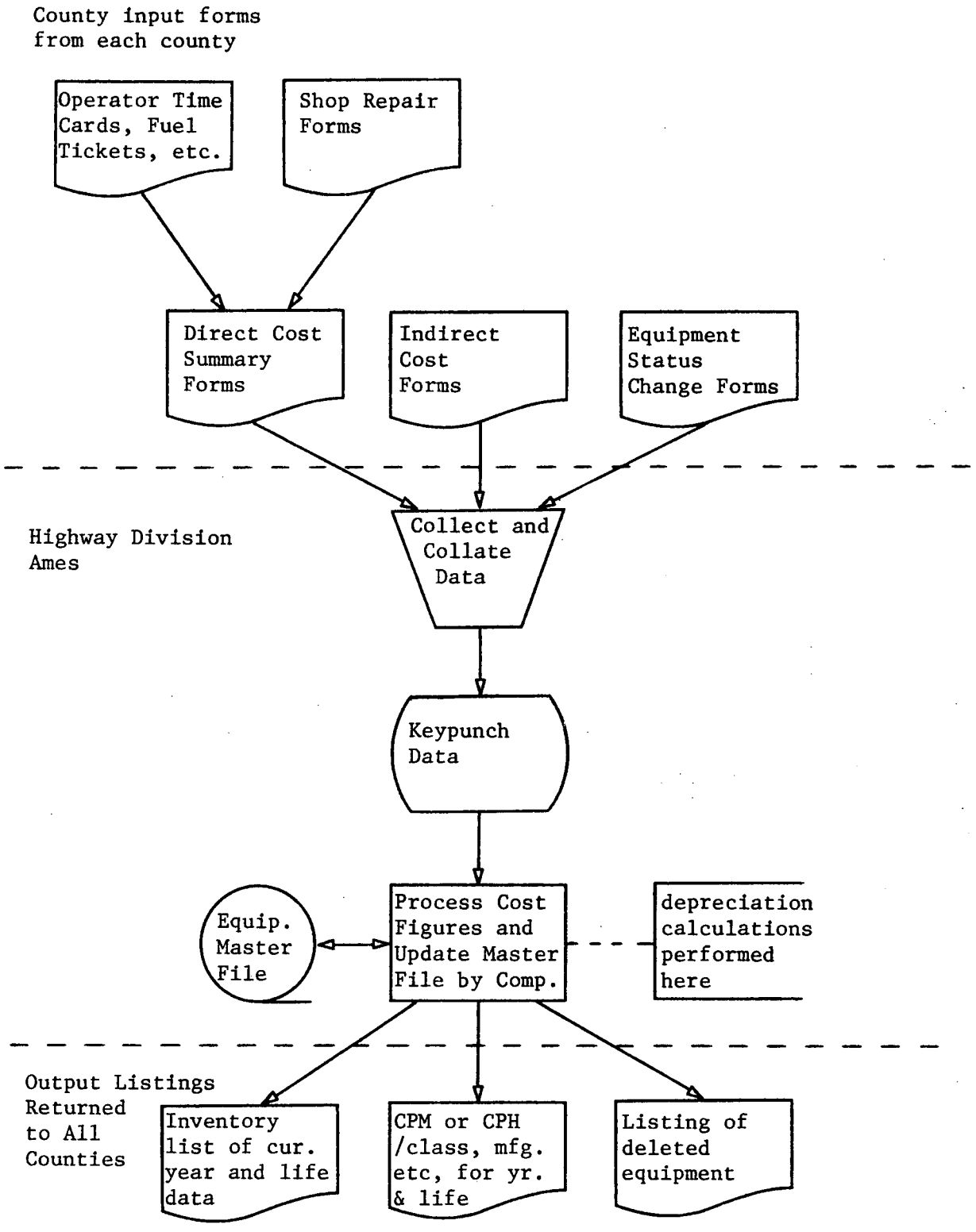
3.3 GENERAL FLOWCHARTS

This section of this report presents a flowchart comparison of a typical existing manual equipment cost system with that of the proposed system. A typical existing system is shown on the following page.



Each existing system we studied handled only direct costs for equipment owned by that county with little or no summary capability; moreover, no regular capability for exchange of information exists between counties.

The proposed system is designed to incorporate indirect costs and depreciation information as well as that pertaining to direct costs, for all counties in the state, and to provide appropriate summary data and reports. Flow of information for the proposed system is shown in the following diagram.



The operation of the system and particular information gathered will be discussed subsequently in this report.

3.4 INPUT/OUTPUT REQUIREMENTS

Three input forms are required for entering data from each county into the data processing system. They are the Direct Cost Summary Forms, the Indirect Cost Form, and Equipment Status Change Form. The Direct Cost Summary Forms will contain the periodic (most probably annual) direct cost summaries on each piece of equipment from each county. The Indirect Cost Form will contain all the indirect equipment costs for the period. The Equipment Status Change Form will be used to enter new equipment into the data base, change or correct data items on a piece of equipment already in the data base, or to delete a piece of equipment from the data base. The items included on each of these three input forms are shown in Figures 1, 2, and 3.

Figures 4, 5, 6, 7, and 8 give examples of the three basic outputs from the system: 1) an inventory listing of all equipment by county (Figure 4); 2) a listing of calculated cost per hour or mile for each individual piece of equipment and class, by county (Figure 5), average cost per hour or mile for each class of equipment by county, district, and state (Figure 6), and an average cost per hour or mile for each class of equipment by manufacturer and age (Figure 7); and 3) a listing of equipment being deleted from the equipment master file (Figure 8). These outputs will be produced by the information system and returned to each county by the appropriate contact group in the Highway Division.

3.5 FILE CONSIDERATIONS

The Equipment Master File will contain each of the fields shown below. There will be one record, each containing all these fields,

Figure 1. Direct Cost Summary Form

(one card per piece of equipment)

Card Columns Required		
3	1.	County Number
8	2.	Equipment Number
4	3.	Date - month, year
6	4.	Fuel Cost
5	5.	Lubricant Cost
4	6.	Antifreeze Cost
6	7.	Tire & Tube Cost
6	8.	Expendable Parts Cost (e.g., teeth, blades, filters, etc.)
6	9.	Labor Cost for Maintenance, Repair, and Overhaul
6	10.	Repair Parts Cost
5	11.	Mileage or Hours for This Reporting Period
4	12.	Down Time - Hours
2	13.	No. of Times Repaired
65		

Figure 2. Indirect Cost Form

(one card per county)

Card Columns Required		
3	1.	County Number
7	2.	Salaries and Expenses of Supervisory Employees Not Directly Employed in Servicing or Repairing Equipment
7	3.	Salaries of Clerical Employees Engaged in Accounting and Preparing Reports for Equipment
	4.	Shop Storage and Miscellaneous Overhead Costs Relating to Equipment Care and Handling
7		a) Utilities
7		b) Shop and Office Building Depreciation, Maintenance, and/or Rental
6		c) Depreciation of Shop Equipment
6		d) Replacement Cost of Expendable Shop Tools
6		e) Office Supplies
7		f) Costs of Moving Equipment
7		g) Equipment Insurance
7		h) Mobile Radio Equipment
70		

Figure 3. Equipment Status Change Form

(three cards per piece of equipment)

Card Columns Required		
3	1.	County Number
2	2.	District
8	3.	Equipment Number
2	4.	Class Code
2	5.	Year Equipment Manufactured
3	6.	Manufacturer Code Number
2	7.	Number of Cylinders in Engine
1	8.	Type of Fuel Burned in Engine - Gasoline or Diesel Fuel
8	9.	Original Purchase Cost (before trade-in)
7	10.	Salvage Value
16	11.	Class Description
14	12.	Make and Model Description of Equipment
14	13.	Manufacturer's Serial Number
14	14.	Engine Make and Model Description
2	15.	Engine Manufacturer Code
12	16.	Company Purchased From (Dealer)
6	17.	Date Purchased M/D/Y
3	18.	Wheelbase in Inches
1	19.	Transmission Type
1	20.	Sold, Junked, or Traded Code
6	21.	Date Sold, Junked, or Traded M/D/Y

Figure 3. cont.

Card Columns Required	
8	22. Book Value Amount
6	23. Miles/Hour-Life
7	24. Fuel Cost-Life
6	25. Lubricants Cost-Life
6	26. Tires and Tubes Cost-Life
6	27. Expendable Parts-Life
5	28. Antifreeze Cost-Life
7	29. Parts Cost-Life
7	30. Labor Cost-Life
3	31. Rated Horsepower
188	

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Figure 4.

Inventory List of Equipment In Each County

JOHNSON COUNTY

1975 EQUIPMENT INVENTORY LIST

EQUIPMENT NUMBER	MAKE & MODEL	MANUFACTURER	YEAR	SERIAL NUMBER	PURCHASE COST	BOOK VALUE	PURCHASE DATE	DEALER	DISPOSAL DATE	SOLD,TRADED JUNKED CODE
		CYL FUEL TRAN TYPE	WHB INS HP	ENGINE MAKE AND MODEL						
EQUIPMENT CLASS - MEDIUM DTY TRUCK										
T-37	CHEVY CS-60	CHEVROLET	1968	T37695348	9300.30	4000.00	10-24-69	G.WHITE CHEV	03-12-75	T
		8 G A	172 285	CHEV 427 CI						
T-38	FORD F-600	FORD	1973	3687UXW431	10400.45	9600.87	6-13-73	L.LANCE FORD		
		8 D S	185 301	CUMMINS 555 CI						
EQUIPMENT CLASS - HVY DTY TRUCK										
T-29										
T-47										

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Figure 5.

DOCUMENTALIST Cost Per Mile or Hour-By County, By Class, By Piece of Equipment - ne Output for Direct Costs, One Output for All Operating Costs (Formats of Yearly and Life Figures are Similar)

JOHNSON COUNTY

1974 EQUIPMENT DIRECT OPERATING COSTS

EQUIPMENT NUMBER	MAKE & MODEL	MILES/ HOURS	FUEL	LUBRICANTS	ANTI FREEZE	TIRES	EXPENDABLE REPAIR PARTS	REPAIR PARTS	REPAIR LABOR	TOTAL DIRECT COSTS	DIRECT CPM/ CPH
EQUIPMENT CLASS - HVY DTY MOTOR GRADER											
383	CAT 120	1353	1246.35	87.40	21.13	.00	513.51	312.51	245.00	2426.37	1.793
393	GALION T-500l	1098	1831.63	60.09	17.95	200.00	287.39	273.00	175.00	2845.06	2.591
⋮											
CLASS TOTALS											
EQUIPMENT CLASS - LGT DTY CRAWL. TRACTOR											
⋮											
CLASS TOTALS											
⋮											
GRAND TOTALS FOR 1974											

JOHNSON COUNTY

1974 EQUIPMENT OPERATING COSTS

EQUIPMENT NUMBER	MAKE & MODEL	MILES/ HOURS	DOWN TIME	TIMES REPAIRED	TOTAL DIRECT COSTS	TOTAL INDIRECT COSTS	DEPRECIATION	TOTAL COST	DIRECT CPM/CPH	DIRECT + INDIRECT CPM/CHP	DEPREC + DIR + INDIR CPM/CPH
EQUIPMENT CLASS - HVY DTY MOTOR GRADER											
383	CAT 120	1353	73	1	2426.37	500.00	2086.00	5012.37	1.793	2.163	3.705
393	GALION T-500L	1098	98	3	3845.06	413.13	1275.00	4533.19	2.591	2.967	4.128
⋮											
CLASS TOTALS											
EQUIPMENT CLASS - LGT DTY CRAWL.TRACTR											
⋮											
CLASS TOTALS											
⋮											
GRAND TOTALS											

DATE _____

DOCUMENTALIST _____ Figure 6. _____

ost Per Mile or Hour By Equipment Class, County, District, and State

1974 EQUIPMENT OPERATING COSTS

COST PER MILE OR HOUR BY EQUIPMENT CLASS, DISTRICT, AND COUNTY

COUNTY CODE	COUNTY NAME	COST MI/HR	NUMBER OF VEHICLES
EQUIPMENT CLASS - PASSENGER CAR - STANDARD SIZE			
DISTRICT 1			
052	JOHNSON	__.__	___
092	WASHINGTON	__.__	___
	.	__.__	___
	.		
	.		
	AVERAGE FOR DISTRICT 1	__.__	___
DISTRICT 2			
001	ADAIR	__.__	___
013	CALHOUN	__.__	___
078	POTTAWATTAMIE		
	.		
	.		
	.		
	AVERAGE FOR DISTRICT 2	__.__	___
DISTRICT 3			
	AVERAGE FOR DISTRICT 9	__.__	___
AVERAGE COST FOR STATE		__.__	___

Figure 7.

Cost Per Mile or Hour By Equipment Class, Manufacturer, and Age

1974 EQUIPMENT OPERATING COSTS

COST PER MILE OR HOUR BY EQUIPMENT CLASS, MANUFACTURER, AND AGE

MANUFACTURER NUMBER	AGE	COST MI/HR
EQUIPMENT CLASS - PASSENGER CAR - STANDARD SIZE		
CHEVROLET-		
3	0- 3	__.__
21	4- 6	__.__
1	7- 9	__.__
1	10-12	__.__
1	OVER 12	
FORD-		
10	0- 3	__.__
2	OVER 12	__.__
AMERICAN MOTORS-		
1	0- 3	__.__
EQUIPMENT CLASS - PASSENGER CAR - COMPACT		
AMERICAN MOTORS-		
2	0- 3	__.__
2	7- 9	__.__
2	OVER 12	__.__
EQUIPMENT CLASS - STATION WAGON		

DATE

OR DOCUMENTALIST

Figure 8.
Equipment Disposal List, by County

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JOHNSON COUNTY

LIST OF EQUIPMENT DISPOSED OF IN 1974

EQUIPMENT NUMBER	MAKE & MODEL	TOTAL MILES/ HOURS	TOTAL DIRECT COSTS	DISPOSAL DATE	DISPOSAL METHOD
EQUIPMENT CLASS - HVY DTY MOTOR GRADER					
416	GALION T600	23720	41263.63	07-23-74	TRADED
433	CAT 12E	21633	33567.89	10-01-74	SOLD

for each of the estimated 9000 pieces of equipment to be included in the Equipment Master File. The Equipment Master File will be stored on magnetic tape. It is planned that the magnetic tape will be stored in the tape library of the Highway Division's Data Processing Department.

Equipment Master File

Record Layout

Field No.	Positions from	to	Characters	Field Name
1	1	3	3	County no. (could be expanded for cities)
2	4	5	2	District no.
3	6	13	8	Equipment no.
4	14	15	2	Class Code
5	16	17	2	Year equipment manufactured
6	18	20	3	Manufacturer Code Number
7	21	22	2	Engine Manufacturer Code
8	23	24	2	Number of Cylinders in Engine
9	25	25	1	Type of Fuel - gas or diesel
10	26	26	1	Transmission Code
11	27	34	8	Original Purchase Amount
12	35	42	8	Salvage Value
13	43	50	8	Book Value Amount
14	51	57	7	Depreciation Rate
15	58	63	6	Miles/Hours - Current Year
16	64	70	7	Fuel Cost - Current Year
17	71	75	5	Lubricant Cost - Current Year
18	76	81	6	Tires & Tubes Cost - Current Year
19	82	87	6	Expendable Parts Cost - Current Year
20	88	92	5	Antifreeze Cost - Current Year
21	93	99	7	Parts Cost - Current Year
22	100	106	7	Labor Cost - Current Year
23	107	113	7	Indirect Cost - Current Year
24	114	119	6	Miles/Hours - Life
25	120	126	7	Fuel Cost - Life
26	127	132	6	Lubricants Cost - Life
27	133	138	6	Tires & Tubes Cost - Life
28	139	144	6	Expendable Parts Cost - Life
29	145	149	5	Antifreeze Cost - Life
30	150	156	7	Parts Cost - Life
31	157	163	7	Labor Cost - Life
32	164	183	20	Class Description

Field No.	Positions from	to	Characters	Field Name
33	184	197	14	Make & Model Description of Equipment
34	198	211	14	Manufacturer's Serial Number
35	212	225	14	Engine Make and Model Description
36	226	237	12	Company Purchased From (Dealer)
37	238	243	6	Date Purchased - Month/Day/Year
38	244	249	6	Date Sold, Traded or Junked - M/D/Y
39	250	250	1	Sold(S), Traded(T), Junked(J) Code
40	251	253	3	Wheelbase in inches
41	254	256	3	Down time in hours - Current Year
42	257	259	3	Down time in hours - Life
43	260	261	2	Number of times repaired - Current Year
44	262	264	3	Number of times repaired - Life
45	265	267	3	Rated H.P.
46	268	300	33	Blank
			300	

3.6 VOLUMES OF DATA AND OTHER SPECIFICS

1. The equipment to be included in the data base is all self-propelled equipment and all other equipment having a list price over $5,000.
2. An average of 90 pieces of such equipment per county is expected, or about 9000 pieces of equipment in the entire data base.
3. About fifteen to twenty change in equipment status reports are expected from each county per year.
4. Cost data are to be gathered daily in each county. For convenience monthly summaries should be prepared prior to preparing the annual input data summary which will be submitted for computer data processing in January of each year.
5. The system's output listings produced by the information system will be returned to each county in February of each year.

3.7 COMPLEMENTARY SYSTEMS

The computer programs to be developed for the proposed system will not directly be a part of any other existing system. However, the computer programs will produce an updated yearly equipment inventory listing by county from the Equipment Master File. This inventory listing (Figure 4) will be provided to each county along with the other output from the system.

3.8 ESTIMATED OPERATIONAL COSTS

The following estimates are based upon participation by all 99 counties, an estimated data base of 9000 pieces of equipment, and computer processing being done once a year at the Highway Division's Data Processing Department.

1. Data Processing Costs - Computer time, keypunching and verification, cards, computer output paper, magnetic tapes, and postage - Twenty dollars ($20) per county per year. See Section 2.4.
2. Clerical salaries of employees in each county engaged in preparing input forms for submission to data processing - $600 to $1000 per county per year. This estimate is based upon two days per month spent in collecting, sorting, and transcribing equipment cost data from their original forms to the summary forms.
3. Input forms - $200 to $500 dollars per county per year.

3.9 OTHER GROUND RULES

The proposed system is being designed such that the total number of pieces of equipment in the Equipment Master File could increase by

100% and still be handled easily by the computer hardware. However, any large increase in the data base will somewhat increase the turnaround time from the submission of the input forms to the data processing service until receipt of computer output. This would occur mainly because the majority of the data processing time is spent in keypunching and verification and because county data processing requests are considered to be of lower priority than state needs within the Highway Division's Data Processing Department.

The Equipment Master File is being designed so that some blank space is being left in each record. This will allow additional data to be stored on each piece of equipment, if this is desired in the future. Approximately 30 blank spaces will be included in each record. Adding data items to each record sometime in the future, however, would require some modification of the computer programs used to process the records.

Although the system being designed is viewed as an annual one, if a decision is made to run it more often, it must be recognized that the data processing cost projections of Section 3.8 will increase approximately linearly with the number of runs made and that the probability of slower turnaround time increases because of the added burden on the keypunch staff.

The proposed system is oriented toward use by all counties in the state. However, the county code has been designed with an allowance for expansion. This would allow cities to enter their equipment into the equipment data base and to receive the same type of outputs as received by the counties.

4.0 PROPOSED SYSTEM DESIGN

The design phase consists of such design considerations as output design, input design, file design, and the general system design. Items presented in the sections which follow include the proposed design of input and output formats; suggestions for capturing (initially recording) input data; data file organization, access method, and storage medium choices; detailed system flowcharts; proposed design of coding systems for equipment classification; and plans for handling equipment depreciation and indirect costs.

4.1 INPUT AND OUTPUT FORMATS

Input Formats

As mentioned previously, three input forms will be needed to input data into the data processing system. They are the Direct Cost Summary Form, the Indirect Cost Form, and the Equipment Status Change Form. Figures 1, 2, and 3 of Section 3.4 presented data items included on each of these forms. The designs which follow attempt to make completion of the forms easy while also making them easy to process.

Direct Cost Summary Form

The Direct Cost Summary Form contains a dollar total of all the direct cost items, the hours or miles operated, the down time, and the number of times repaired during the time period. Two design alternatives are presented. The first alternative, Figure 9, uses one form per piece of equipment. The second alternative, Figure 10, calls for placing the data of 15 pieces of equipment on one form. Both forms have been designed for ease of completion and keypunching.

Figure 9. Direct Cost Summary Form

Alternative 1

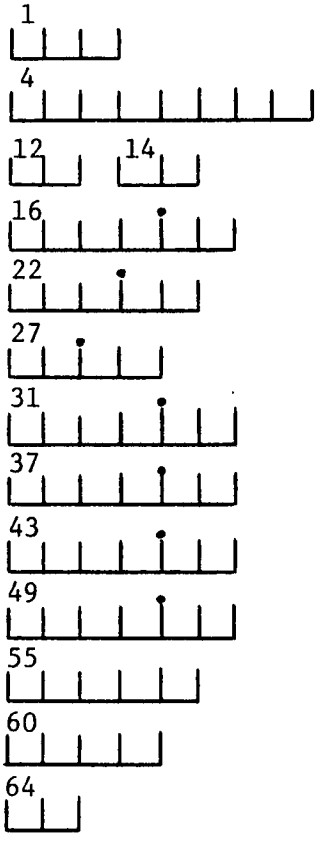
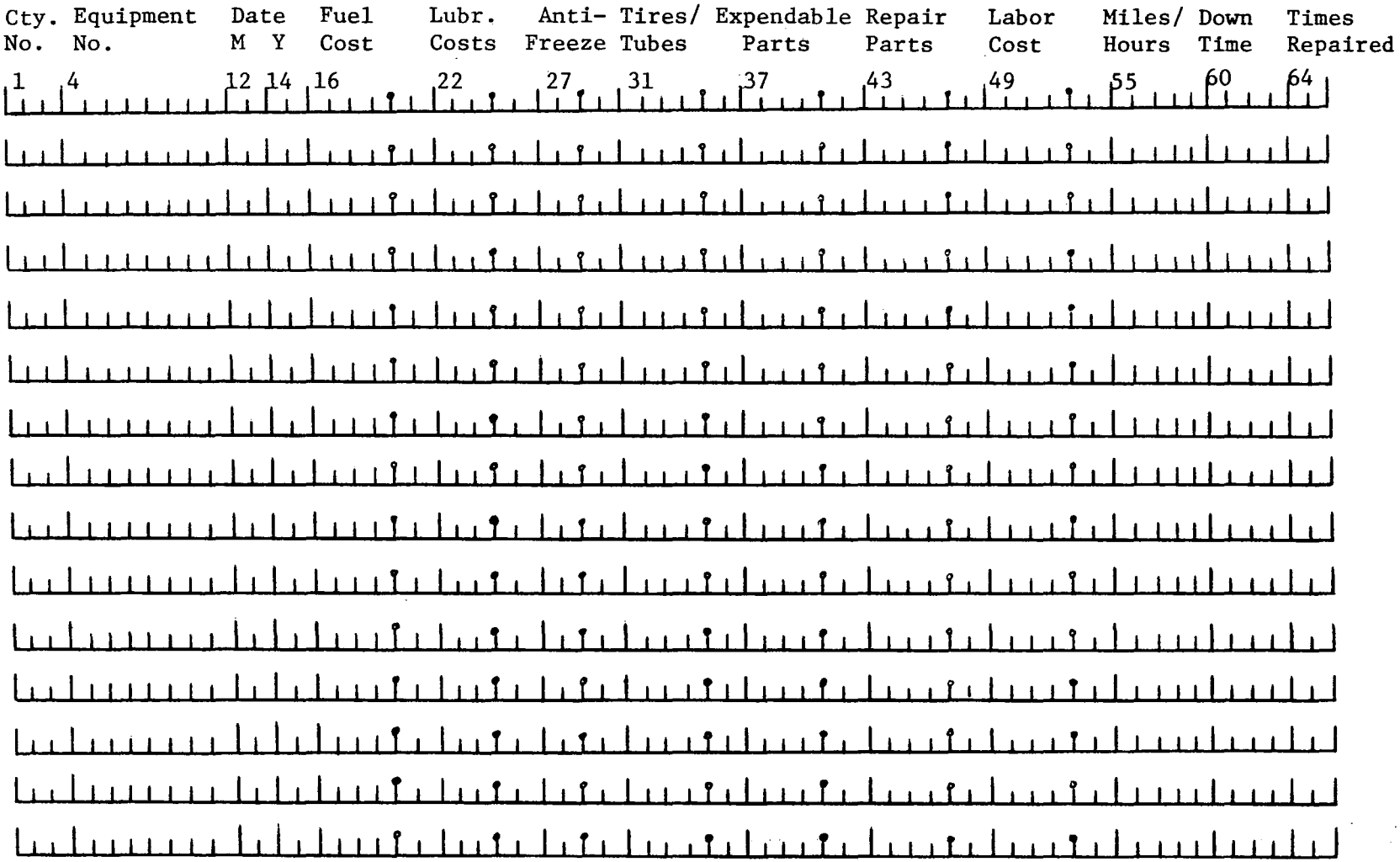


Figure 10. Direct Cost Summary Form

Alternative 2



A decision on which form to implement is needed; however, either form will work with the planned design.

In comparing the two alternatives, there are several trade-offs which should be recognized. Alternative 1 would have fewer coding and keypunching errors because it is easier to read and understand. However, the volume of these type forms is great because one form is needed for each piece of equipment. Alternative 2, will decrease the volume of Direct Cost Summary Forms needed by a factor of 15 over Alternative 1, but is not as readable and would not be as easy to fill out. With either alternative design, one card would be punched for each piece of equipment. We prefer the use of Alternative 2.

Indirect Cost Form

The Indirect Cost Form contains all of a county's indirect equipment costs for the time period just completed. There will be just one form per county. It is recognized that indirect costs will be more difficult than direct costs to determine accurately, however, they are a part of the total equipment cost and should be included in cost per hour or cost per mile calculations. Figure 11 shows the proposed Indirect Cost Form.

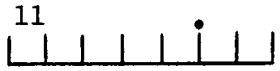
Following the annual submission of the Indirect Cost Form the total indirect equipment cost for a county will be allocated by the computer to each piece of equipment in that county's equipment inventory. It is proposed that the portion of the total indirect cost allocated to each piece of equipment be calculated as follows [2]:

1. Find the total indirect equipment cost for a county by adding individual cost components shown on the Indirect Cost Form.

Figure 11. Indirect Cost Form

County Number

Salaries and expenses of supervisory employees not directly employed in servicing or repairing equipment

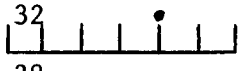


Salaries of clerical employees engaged in accounting and preparing reports for equipment

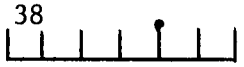
Shop storage and miscellaneous overhead costs relating to equipment care and handling

a) Utilities

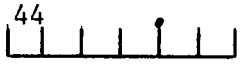
b) Shop and office building depreciation, maintenance, and/or rental



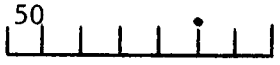
c) Depreciation of shop equipment



d) Replacement cost of expendable shop tools

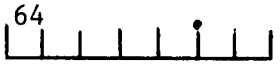


e) Office supplies



f) Cost of moving equipment

g) Equipment insurance



h) Mobile radio equipment

2. Divide the total in Step 1 by the total current book value (original cost depreciated to date) of all equipment in that county's inventory.
3. For each piece of equipment, multiply the result of Step 2 by the current value of each piece of equipment. This gives an indirect cost for each piece of equipment.

Equipment Status Change Form

The Equipment Status Change Form will be used for a variety of functions. It will be used to enter the data on new equipment into the data base. It will be used to change or correct data items already in the data base which may have been entered incorrectly the previous time period. It will also be used to delete from the data base equipment which has been sold, junked, or traded during the previous time period. It is planned to use one form for each addition, deletion, or change. Three punched cards can result from each of these forms. The proposed design is shown in Figure 12.

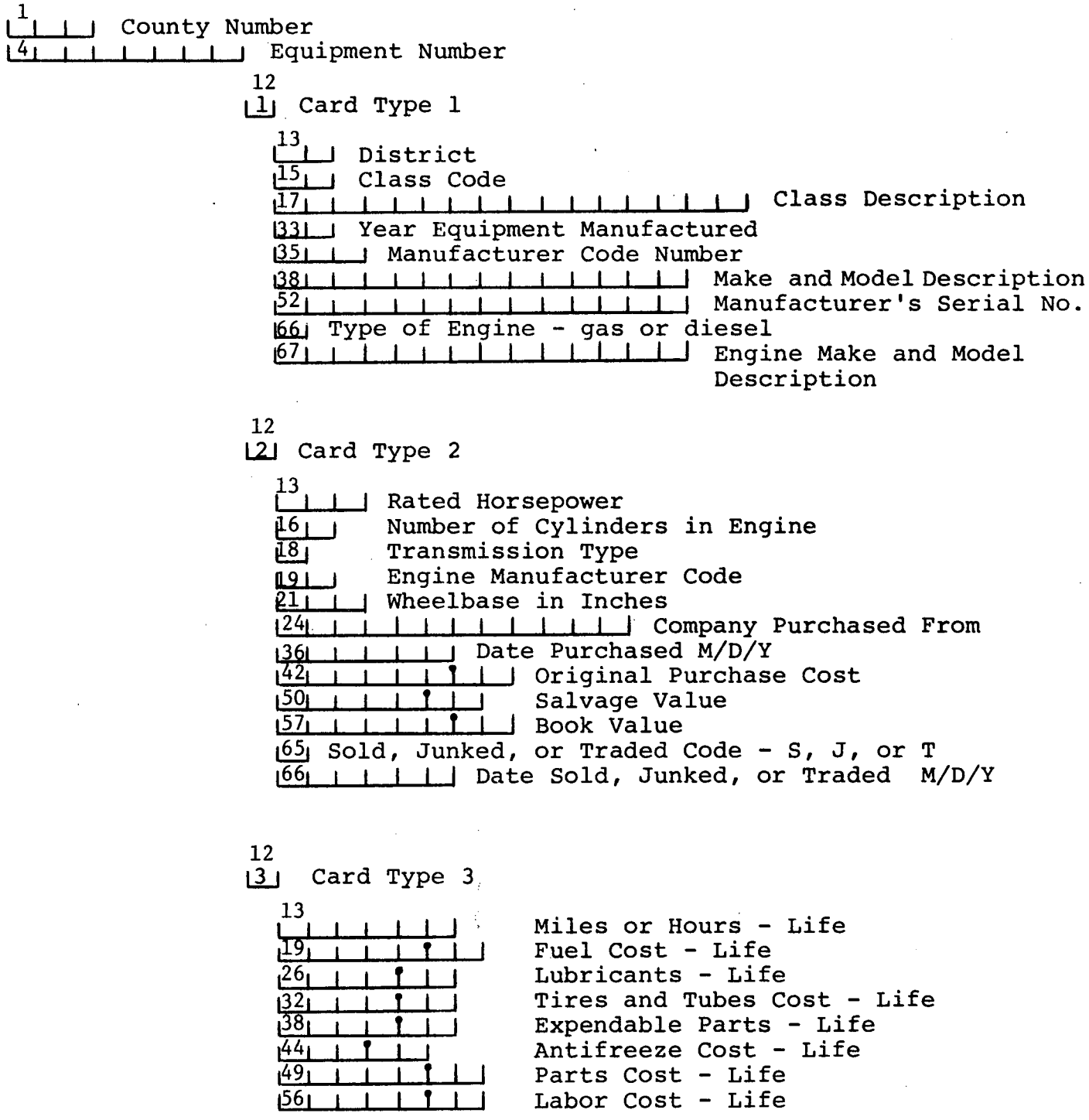
Output Formats

The designs for the output formats were presented in Section 3.4 in Figures 4 through 8. It is projected that the total amount of printed output to be returned to each county will be approximately 200 pages each year presuming annual runs. The majority of this output, about three-fourths, will come from the output shown in Figure 6.

4.2 COLLECTING DIRECT COST INPUT DATA

To be successful, this new system must provide a way to collect direct cost data accurately and easily. All repairs and supplies must be charged to a particular unit of equipment as they are fur-

Figure 12. Equipment Status Change Form



nished. Several forms are appropriate for capturing these charges, they are: 1) a county repair order form, 2) a daily report of fuel and lubricants supplied, 3) a daily operators time and equipment report, and 4) a monthly summary form. It is our understanding, however, that the design decisions on the type of forms mentioned above will be made by the Bookkeeping Committee of the Iowa Highway Research Board, and that the detailed design of these forms is not directly a part of this research project. See Appendix C for examples of forms which could be adopted with minor alterations. Several are from References [2] and [8]. The remainder are currently being used in different Iowa counties.

Whatever design is chosen for the above forms care must be taken to capture the data items needed for the Direct Cost Summary Form. A review of those items is given here to insure proper collection:

1. Each form must provide space for the equipment or machine number - all equipment within each county must have a unique identification number.
2. Each form must have spaces to contain the date; when these forms are used for a period of time, space must be allowed for the beginning and ending date.
3. Space must be given for recording quantities of fuel, lubricants (crankcase oil, transmission oil, grease), and antifreeze. Space may be allowed for the cost of these items, or the cost may be calculated from current rates when a transfer is made to the monthly summary form.
4. Space must be allowed for recording the cost of tires and tubes.

5. Space must be allowed for recording the cost of expendable parts such as teeth, blades, filters, sparkplugs, ignition points, belts, batteries, etc. It would be a good idea to provide space to list these items also when their cost is charged to a piece of equipment.
6. Space must be allowed for listing repair part items and their cost.
7. Space must be allowed for listing repair and maintenance labor costs.
8. Space must be allowed to list the current odometer or hour meter reading. The net mileage or hours can then be calculated for the summary form by finding the difference between the reading at the beginning of the period and that at the end of the period.
9. Space should also be allowed to keep track of down time in hours, that is, the working time in hours a piece of equipment is not operational.
10. Space should also be allowed to keep track of the number of times each piece of equipment required repairs during the time period.
11. It appears appropriate to allow space for several other items which could be used for internal county control. Some of these are operator's name, mechanic's name, project worked on, location of project within county, and operation codes to charge projects to.

4.3 DATA FILE DESIGN

The design of the equipment data file consists of record layout, a choice of file organization, the choice of a method by which

to access the file, and choosing the medium on which to store the file. The record layout design is given in Section 3.5.

Sequential organization has been chosen as the type of file organization. File organization refers to how records are actually arranged on the file. It is the physical structure of the file. Sequential organization exists when the physical and logical organization of the file are the same. For example, consider the logical organization of our equipment master file to be first, all the equipment from Adair County in order by their equipment number, followed by all the equipment from Adams County in sequence by their equipment number, and so on. If we had each of the equipment records on punched cards in the same sequence as the logical organization, we have an actual physical sequential organization. Although we are not using punched cards for the master file, the same analogy holds for magnetic tape or magnetic disk.

Sequential organization is the most widely used file organization. It is the easiest to understand, and is applicable to all media (punched cards, magnetic tape, magnetic disk, etc.) used in data processing. However, when a file is organized sequentially it can only be accessed sequentially. Access refers to how records are written to a file or retrieved from it. With sequential access, the file is read, one record at a time from the beginning of the file to the end or until the desired record is read.

The justification for choosing sequential file organization and access is as follows. The file will be read and updated infrequently, probably only once a year, but when it is read, all the records in the whole file will be read. Since all the records must be updated, it is simplest from a computer programming viewpoint to just start

from the beginning of the file and read each record sequentially. Sequential organization is the recommended file organization when the frequency of use of the file is low, but the percentage of the file used is high, which is the case here. Also, by using sequential organization the size and possible growth of the file will pose no problems.

The file medium chosen for the equipment master file is magnetic tape. The entire equipment master file will fit easily on one reel of tape. Magnetic tape is inexpensive, offers fairly good protection for the file (a backup copy of the file can be stored somewhere else), can be easily transferred from one data processing site to another, can be used with various brands of computer hardware, can be read fairly rapidly by the computer, and is being used by the Highway Division's A-Equipment System. Backup systems for the master file will be discussed in our final report.

4.4 SYSTEM FLOWCHARTS

The system flowcharts shown in Figures 13, 14, 15, 16, and 17 were developed from the general flowchart of the proposed system given in Section 3.3. These flowcharts show a more detailed flow of data and information and provide an expanded concept of the processing functions which will take place.

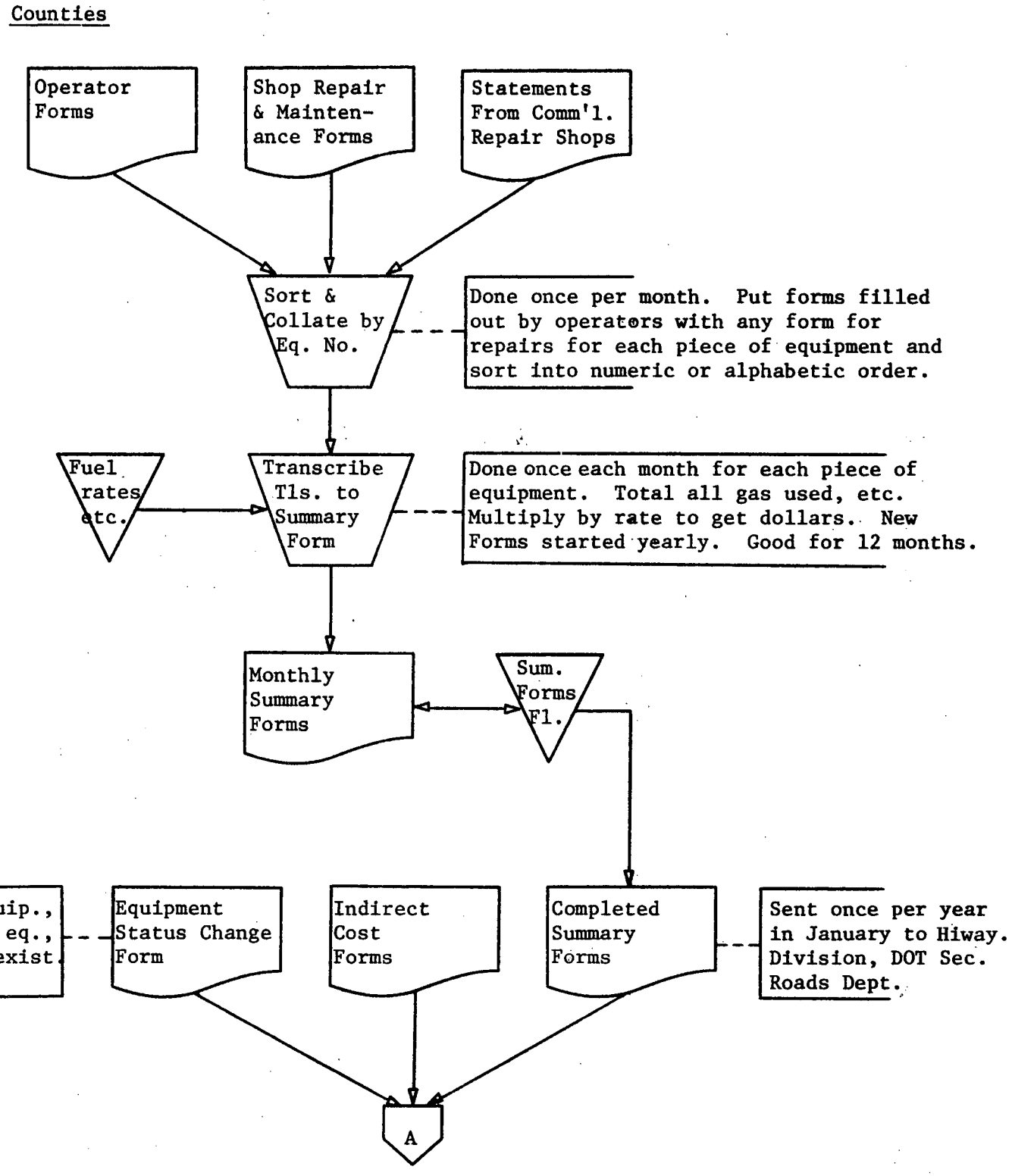
4.5 CODING SYSTEMS

A number of coding systems have been designed to aid in the complete classification of all pieces of equipment. Codes have been designed for the following:

Figure 13.

System Flowchart

Page 1



To Secondary Roads Department
Highway Division
Page 2

Figure 14.

System Flowchart

Page 2

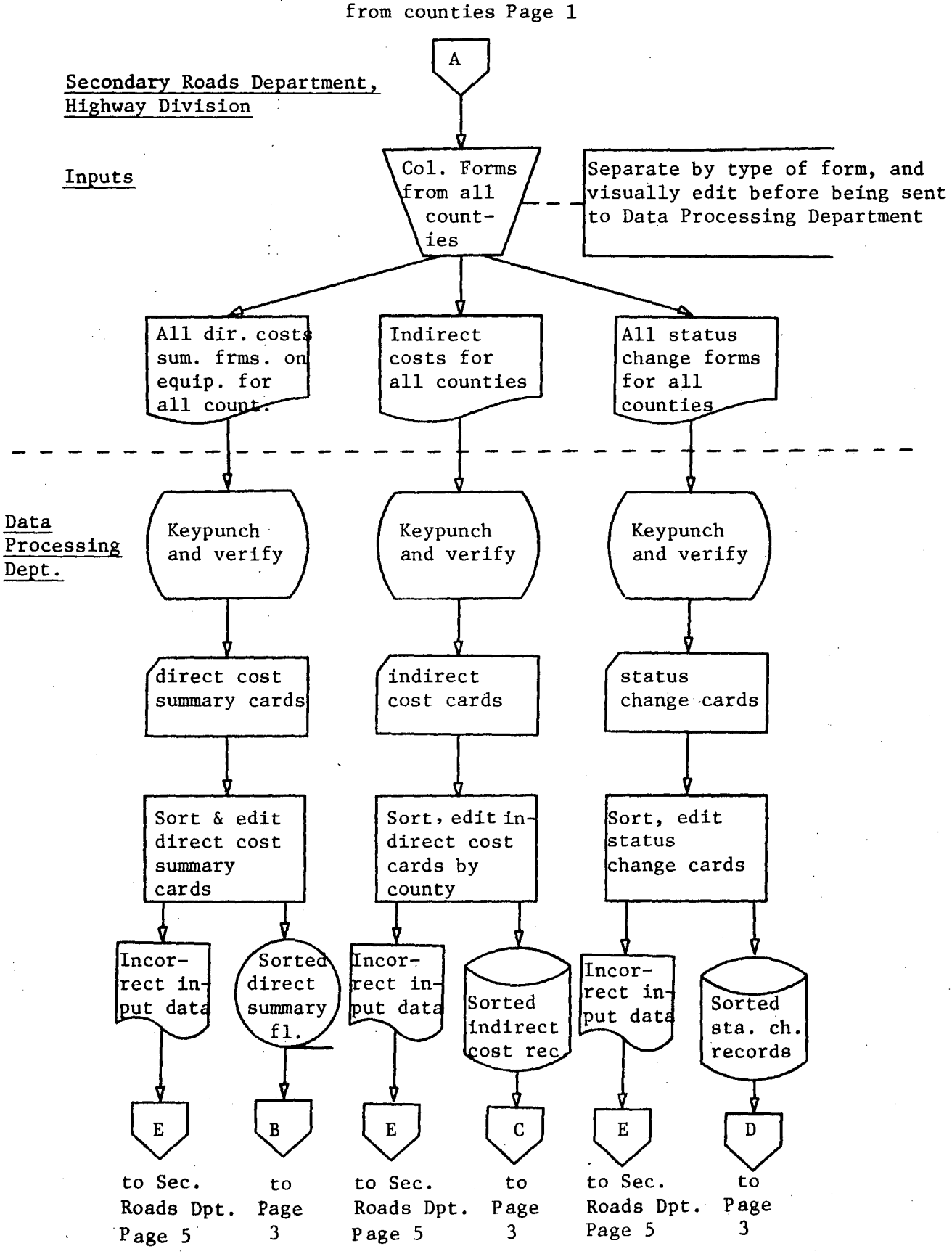


Figure 15.

System Flowchart

Page 3

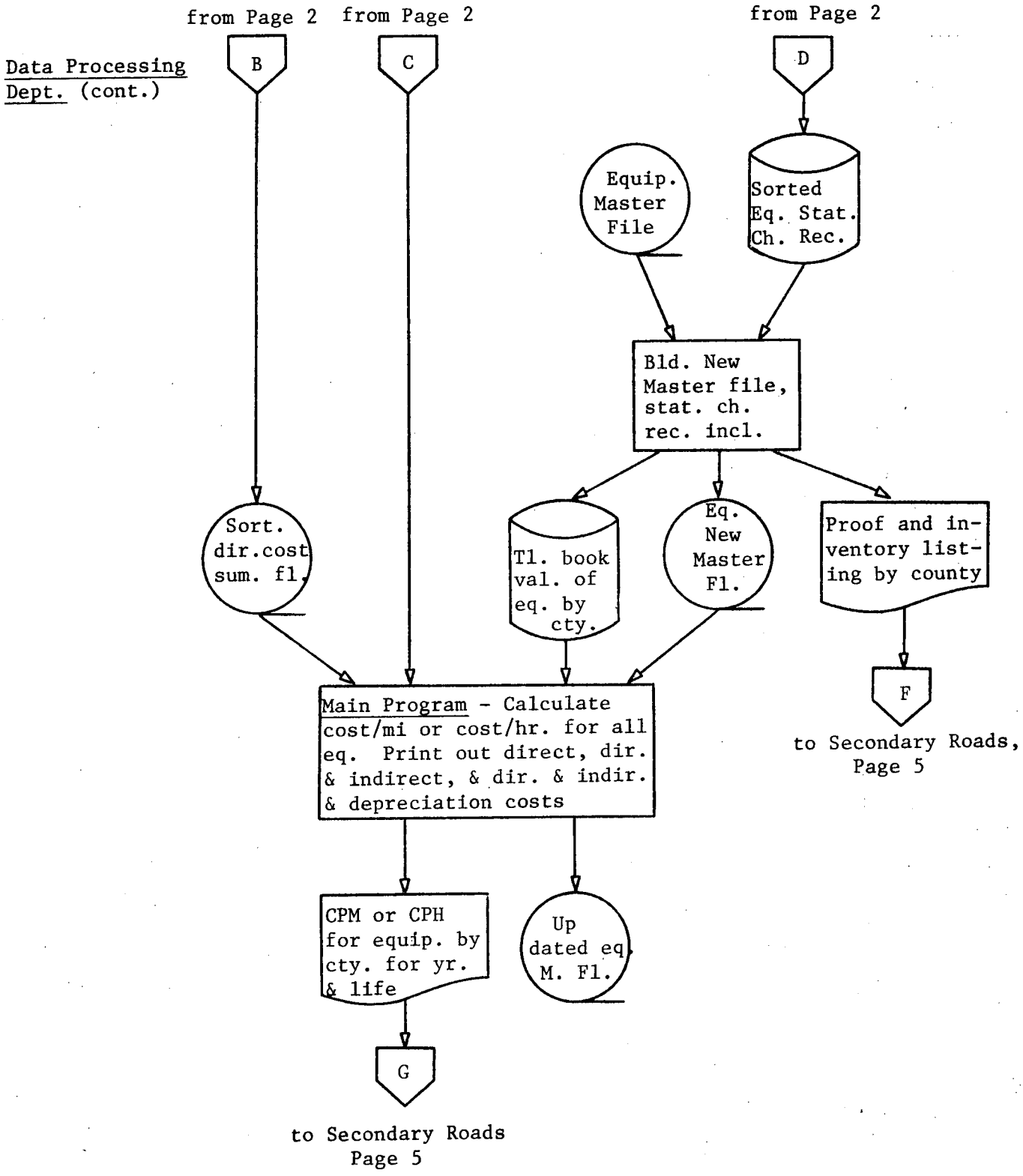


Figure 16.

System Flowchart

Page 4

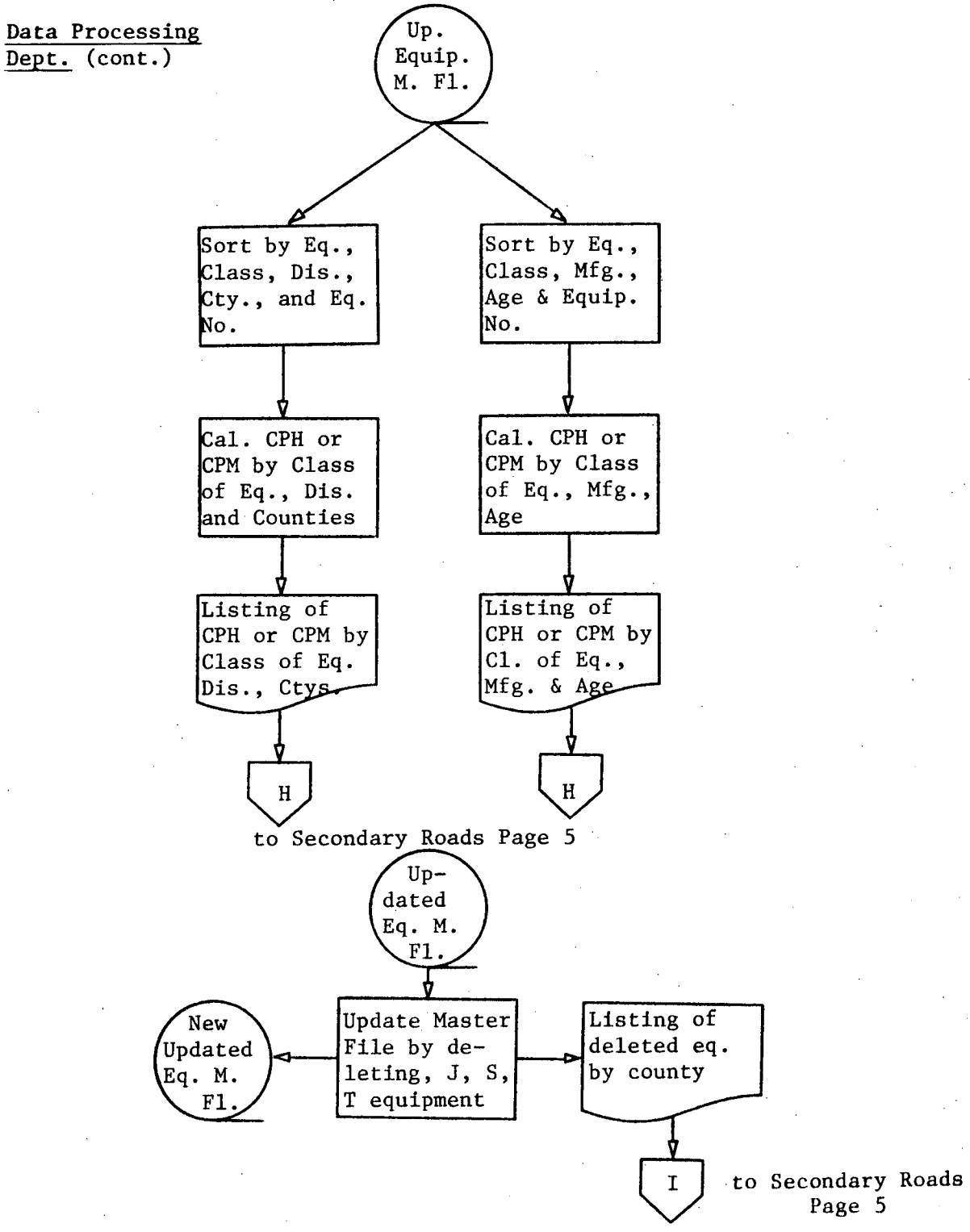


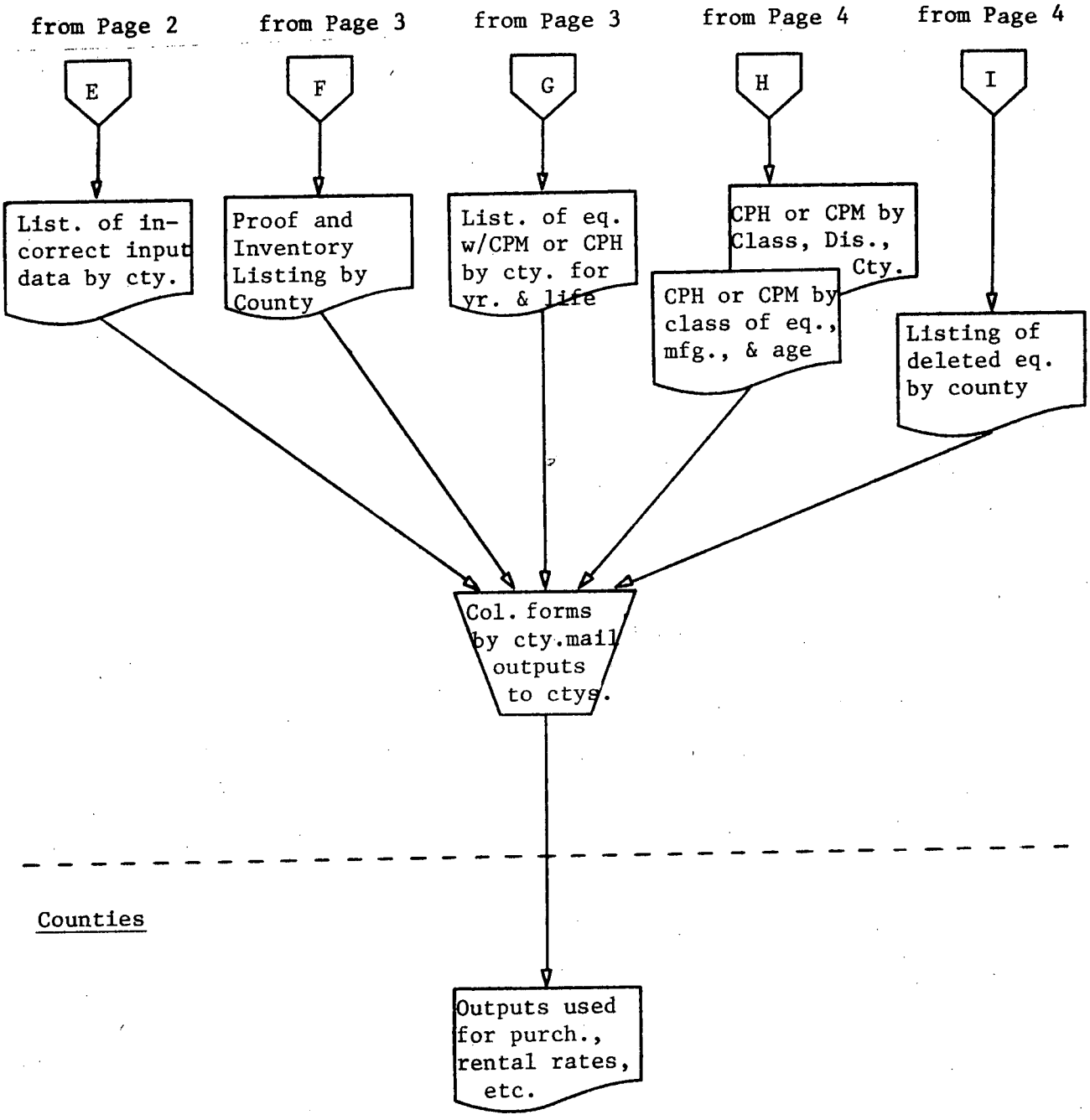
Figure 17.

System Flowchart

Secondary Roads Dept.

Outputs

Page 5



1. Counties
2. Equipment Classes
3. Equipment Manufacturers
4. Engine Manufacturers
5. Transmission Code
6. Districts of the State
7. Number of Cylinders in the Engine
8. Fuel Burned
9. Disposal Code

Each will be explained in the following paragraphs.

The code chosen for the county code is the well known method of alphabetizing the counties and numbering them in ascending order. This is shown in Figure 18. Note a three digit code is shown to allow for expansion if some cities use this system in the future.

The code chosen for equipment classification is shown in Figure 19. This classification is a modified form of the class code used in the Highway Division's A Equipment System. The equipment with codes 01 through 16 will yield cost per mile figures. The rest will yield cost per hour figures.

A list of equipment manufacturers and codes is given in Figure 20. If the list is incomplete, names of additional manufacturers will be added in the final design.

A list of engine manufacturers and codes is given in Figure 21. This list should also be checked for completeness.

The transmission code chosen is simply an A for automatic transmissions, and an S for standard transmissions.

It is planned to divide the state into a number of districts so counties can make cost comparisons with counties in the same geo-

Figure 18. County Codes

001	Adair	051	Jefferson
002	Adams	052	Johnson
003	Allamakee	053	Jones
004	Appanoose	054	Keokuk
005	Audubon	055	Kossuth
006	Benton	056	Lee
007	Black Hawk	057	Linn
008	Boone	058	Louisa
009	Bremer	059	Lucas
010	Buchanan	060	Lyon
011	Buena Vista	061	Madison
012	Butler	062	Mahaska
013	Calhoun	063	Marion
014	Carroll	064	Marshall
015	Cass	065	Mills
016	Cedar	066	Mitchell
017	Cerro Gordo	067	Monona
018	Cherokee	068	Monroe
019	Chickasaw	069	Montgomery
020	Clarke	070	Muscatine
021	Clay	071	O'Brien
022	Clayton	072	Osceola
023	Clinton	073	Page
024	Crawford	074	Palo Alto
025	Dallas	075	Plymouth
026	Davis	076	Pocahontas
027	Decatur	077	Polk
028	Delaware	078	Pottawattamie
029	Des Moines	079	Poweshiek
030	Dickinson	080	Ringgold
031	Dubuque	081	Sac
032	Emmet	082	Scott
033	Fayette	083	Shelby
034	Floyd	084	Sioux
035	Franklin	085	Story
036	Fremont	086	Tama
037	Greene	087	Taylor
038	Grundy	088	Union
039	Guthrie	089	Van Buren
040	Hamilton	090	Wapello
041	Hancock	091	Warren
042	Hardin	092	Washington
043	Harrison	093	Wayne
044	Henry	094	Webster
045	Howard	095	Winnebago
046	Humboldt	096	Winneshiek
047	Ida	097	Woodbury
048	Iowa	098	Worth
049	Jackson	099	Wright
050	Jasper	100-999	cities

Figure 19.

Equipment Class Codes and Descriptions

Code	Description
01	Passenger Car - standard size
02	Passenger Car - compact
03	Station Wagon - car
04	1/4-Ton Pickup
05	1/2-Ton Pickup
06	3/4-Ton Pickup
07	1-Ton Pickup
08	4 WD Pickup
09	Crew Cab Pickup
10	Panel - truck, van or station wagon type truck (Suburban, travelalls, etc.)
11	Bus
12	Light Duty Truck under 23,000 G.V.W. (single axle)
13	Medium Duty Truck 23,000 to 27,000 G.V.W. (single axle)
14	Heavy Duty Truck 27,000 to 34,000 G.V.W. (single axle)
15	Extra Heavy Duty Truck 34,000 to 46,000 G.V.W. (single or tandem axle)
16	Extra Super Heavy Duty Truck over 46,000 G.V.W. (tandem axle or off road)
20	Light Duty Motor Grader 50-75 H.P.
21	Medium Duty Motor Grader 76-125 H.P.
22	Heavy Duty Motor Grader 126-175 H.P.
23	Extra Heavy Duty Motor Grader over 175 H.P.
24	Light Duty Crawler Tractor 26-50 H.P.
25	Medium Duty Crawler Tractor 51-100 H.P.
26	Heavy Duty Crawler Tractor over 100 H.P.
27	Light Duty Wheeled Tractor 10-25 H.P.
28	Medium Duty Wheeled Tractor 26-50 H.P.
29	Heavy Duty Wheeled Tractor 26-50 H.P.
30	Backhoe, fixed or telescoping boom (crawler or truck mounted)
31	Dragline
32	Tractor w/sickle mower (specially made only for mowing)
33	Tractor w/rotary mower (specially made only for mowing)
34	Light Duty Rotary Snow Plow
35	Medium Duty Rotary Snow Plow
36	Heavy Duty Rotary Snow Plow
37	Light Duty Loader (less than 2 yds.)
38	Medium Duty Loader (2-5 yds.)
39	Heavy Duty Loader (over 5 yds.)

Figure 19. (cont.)

Code	Description
40	Wheeled Tractor w/loader and backhoe
41	Light Duty Crawler Tractor with backhoe
42	Force Feed Loader
43	Sweeper self-propelled
44	Pickup Sweeper
45	Roller 2-4 ton self-propelled
46	Roller 5-7 ton self-propelled
47	Roller, over 7 ton self-propelled
48	Mixers, Pulverizers self-propelled
49	Scraper capacity 10-25 ton self-propelled
50	Scraper capacity 26-40 ton self-propelled
51	Scraper capacity over 40 ton self-propelled
52	Scraper capacity 10-20 ton tractor-drawn
53	Scraper capacity 21-30 ton tractor-drawn
54	Scraper capacity over 30 ton tractor-drawn
99	Other

Figure 20.

Manufacturer Names and Codes

Code	Name
001	Adams
002	Allis-Chalmers
003	American
004	American Motors
005	Athey
006	Austin-Western
007	Autocar
008	Bantam
009	Baughman
010	Bay City
011	Brockway
012	Bros
013	Bucyrus-Erie
014	Buffalo-Bomag
015	Buffalo-Springfield
016	Case
017	Caterpillar
018	Champion
019	Chevrolet
020	Chrysler
021	Clark
022	Cleaver-Brooks
023	CMI
024	Am. Cole
025	H. Cole
026	Coleman
027	Crane Carrier
028	Datsun
029	Davey
030	Davis
031	John Deere
032	Diamond-Reo
033	Dodge
034	Drott
035	Dyna-Pac
036	Essick
037	Euclid
038	Falcon
039	Federal
040	Ferguson
041	Fiat-Allis
042	Ford
043	Fruehauf
044	FWD
045	Galion
046	Gardner-Denver
047	General Electric

Figure 20. (cont.)

Code	Name
048	GMC
049	Gradall
050	Grove
051	Hancock
052	Harnischfeger
053	Hein-Werner
054	Hendrickson
055	Henry
056	Hopto
057	Hough
058	Huber-Warco
059	Hy-Dynamic
060	Hy-Hoe
061	Hyster
062	Ingersoll-Rand
063	Ingram
064	Insley
065	International Harvester
066	Jaeger
067	JCB
068	Jeep
069	Kenworth
070	Kinney
071	Klauer
072	Koehring
073	Komatsu
074	LeRoi
075	Liebherr America
076	Lima
077	Link-Belt
078	Little Giant
079	Long
080	Lorain
081	Lull
082	Mack
083	Manitowoc
084	Marmon-Harrington
085	Massey-Ferguson
086	Melroe
087	Michigan
088	Minneapolis-Moline
089	M-R-S
090	Napco
091	Northwest
092	Oliver
093	Oshkosh
094	Owatonna
095	P & H
096	Parsons

Figure 20. (cont.)

Code	Name
097	Peterbilt
098	Pettibone Mulliken
099	Pierce Bear
100	Plymouth
101	Poclain
102	Porta-Air
103	RayGo
104	Reo
105	Rexnord (Rex)
106	Rosco
107	Sargent
108	Schield Bantam
109	Scharamm
110	Scoopmobile
111	Seaman
112	Shawanee
113	Silent H & C
114	Smith
115	Snowking
116	Studebaker
117	Sullivan
118	Tampo
119	Terex
120	Thew-Lorain
121	Thomas
122	Thrun
123	Toyota
124	Trojan
125	Twinpactor
126	Unit
127	V-con
128	Wabco
129	Waldon
130	Warner & Swasey
131	Westinghouse
132	White
133	Worthington
134	Yale
135	Young
999	Other

Figure 21.

Engine Manufacturers and Codes

Code	Name
1	Alco
2	Allis-Chalmers
3	American Motors
4	B & S
5	Case
6	Caterpiller
7	Chevrolet
8	Chrysler
9	Continental
10	Cummins
11	Deutz
12	Fiat
13	Ford
14	General Motors-Detroit Diesel
15	GMC
16	Hatz
17	Hercules
18	International Harvester
19	John Deere
20	Kohler
21	Komatsu
22	Leyland
23	Mack
24	Mercedes Benz
25	Murphy
26	Nissan
27	Oliver
28	Onan
29	Perkins
30	Saab Scandia
31	TCI
32	Waukesha
33	White
34	Wisconsin
99	Other

graphical part of the state. No final design has been made on the arrangement or number of districts. However, six possible district arrangements are presented in Figures 22, 23, 24, 25, 26, and 27. The Steering Committee should select one of these six or suggest some other arrangement. The district arrangement shown in Figure 25 is favored by the investigators.

The number of cylinders in the engine will be recorded in the equipment data base. The code will simply be the number of cylinders (2, 4, 6, 8, 12).

The type of fuel used in the engine of each piece of equipment will be recorded. The letter G will be used for a gasoline engine, and a D for a diesel engine.

A disposal code will be used to show why equipment is being dropped from the data base. The planned code is J for Junked, S for Sold, and T for traded.

4.6 EQUIPMENT DEPRECIATION

It is planned to include depreciation calculations in the computer programs being written for this system. Initial planning is oriented toward using the straight line depreciation method, mainly because of its ease of understanding and implementation. It is planned to establish a useful lifetime for each equipment class over which to completely depreciate the equipment.

Figure 28 presents three sources of useful lifetimes for depreciation purposes for the various equipment classes. The Highway Division's lifetimes were taken from those used in the A Equipment System [9]. The Forke Brothers Blue Book [6] figures were determined by analyzing the age of used heavy equipment sold by Forke Brothers.

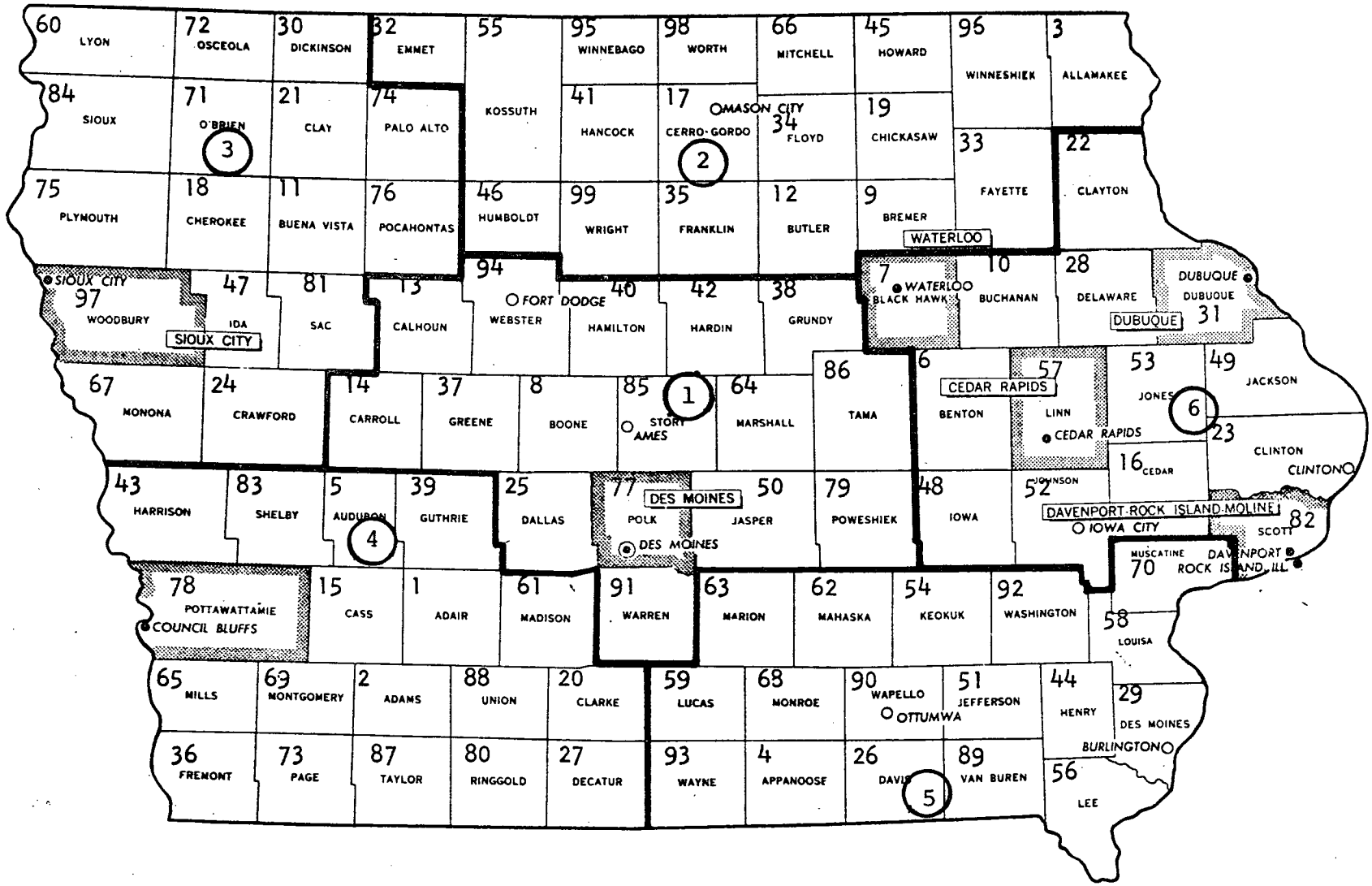


Figure 22.

6 Highway Division Districts

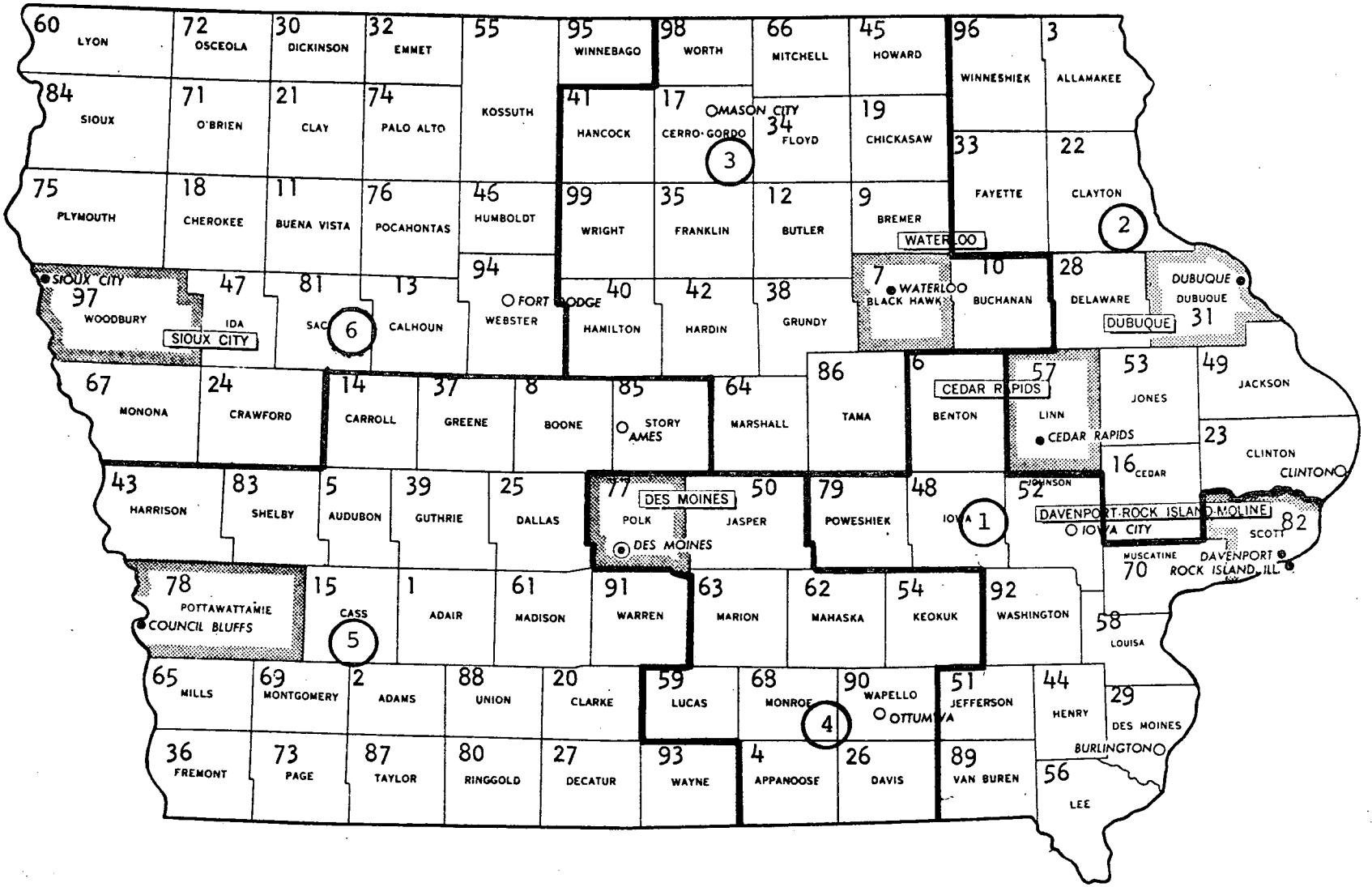


Figure 23.

6 Iowa Congressional Districts

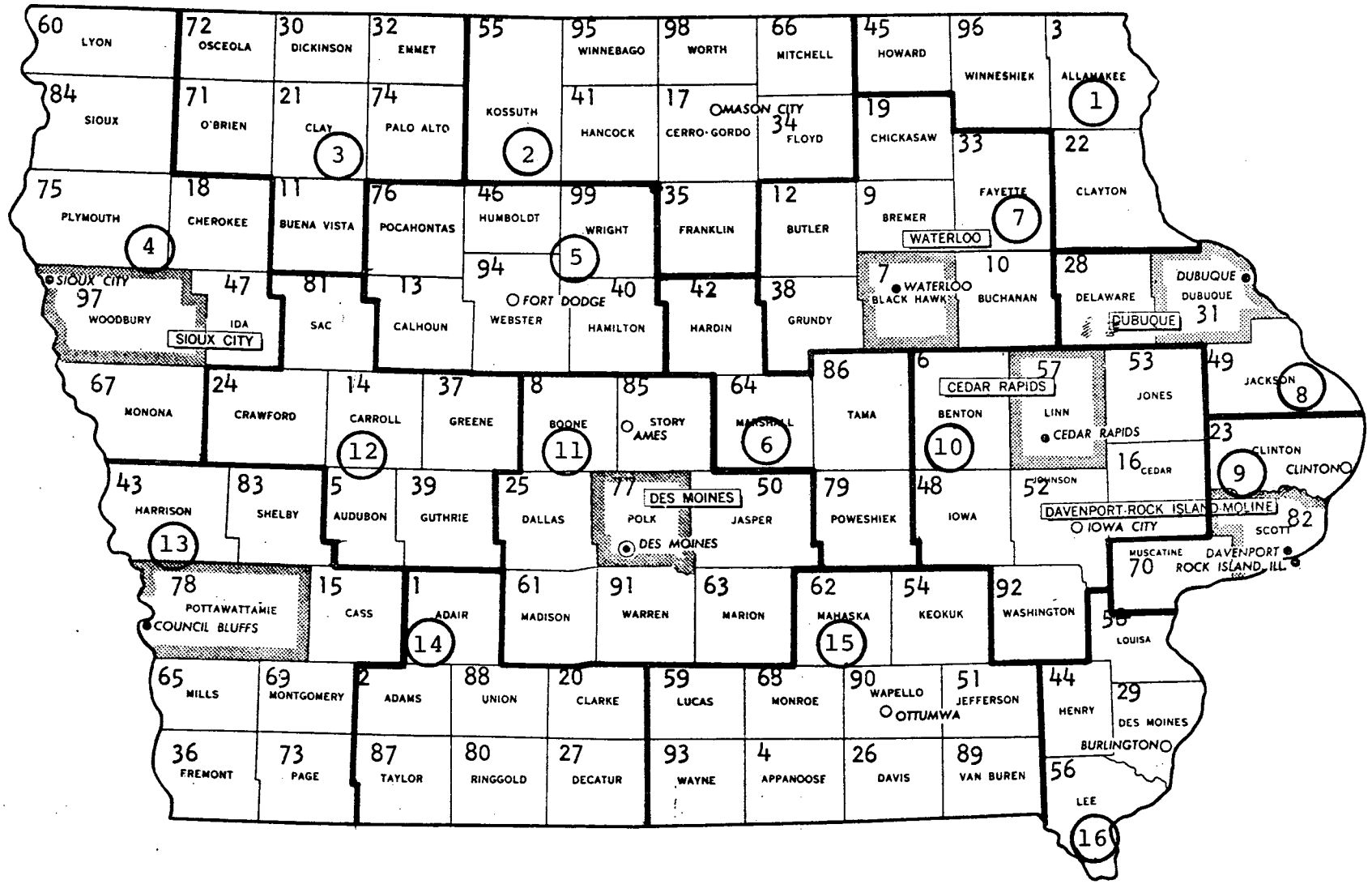


Figure 24.

16 Multi-County Areas Recommended by the Office for Planning and Programming

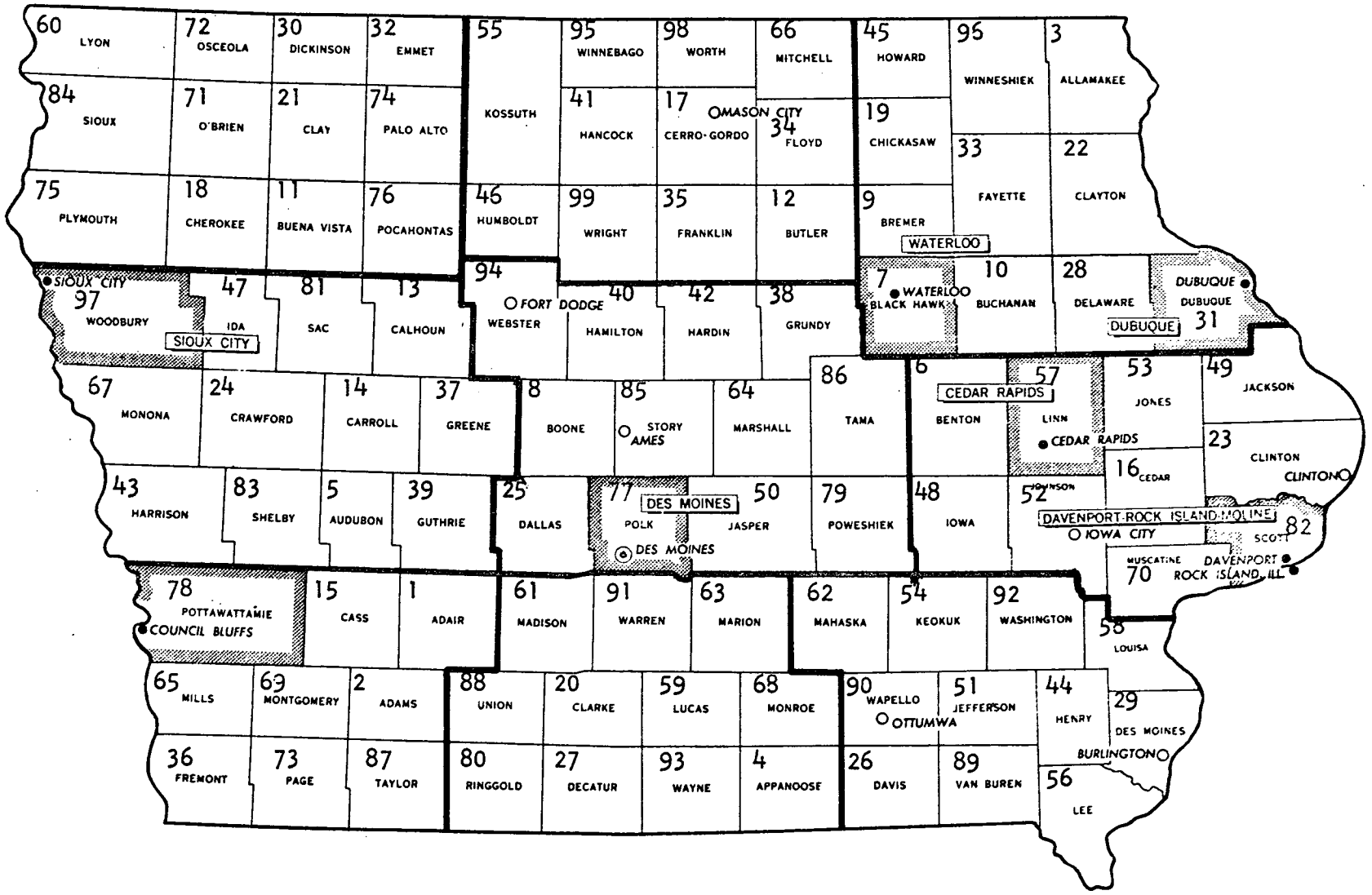


Figure 25.

9 Crop Reporting Districts

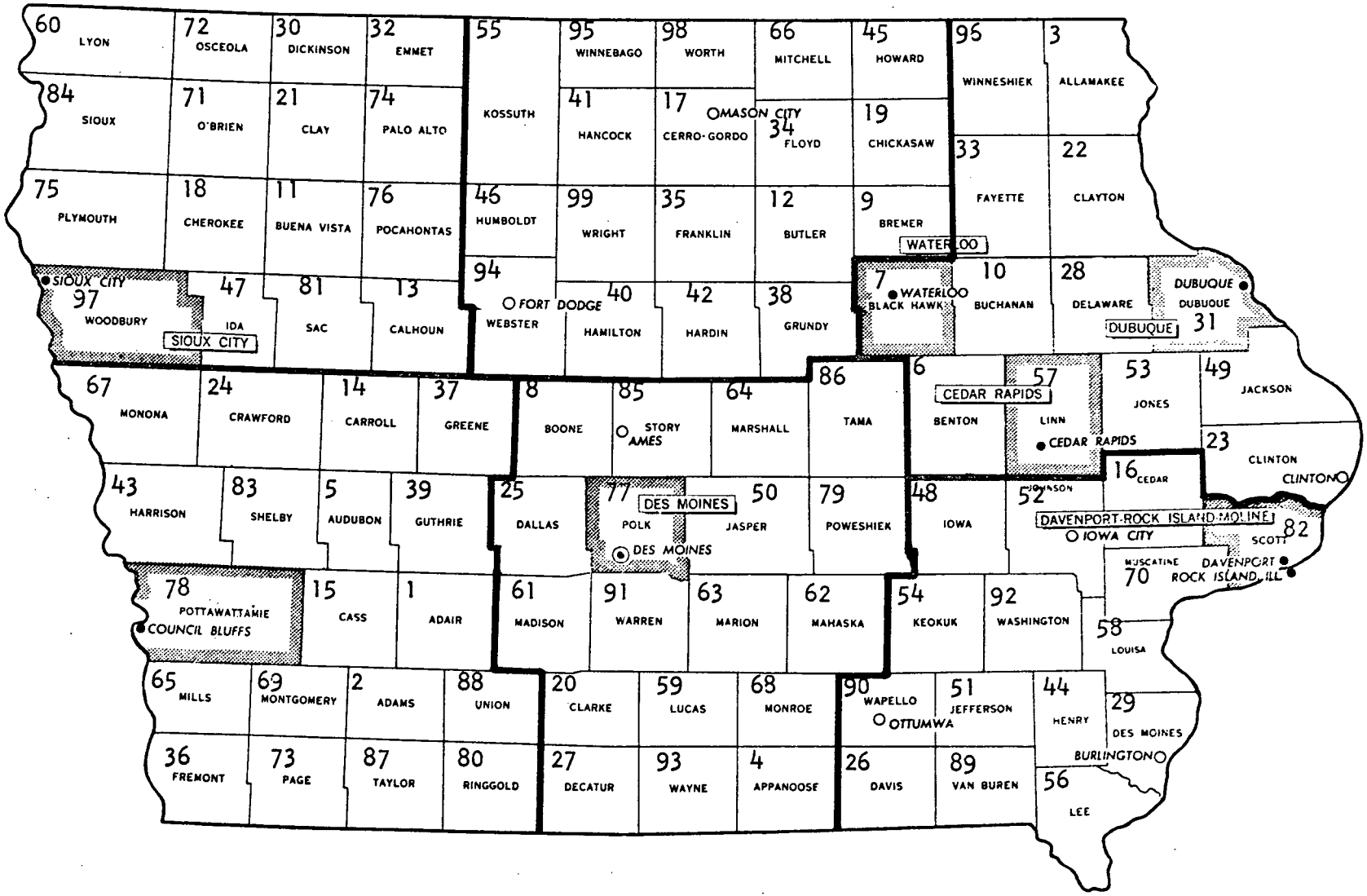


Figure 26.

Department of Health Regions Served By Regional Nurse Supervisors

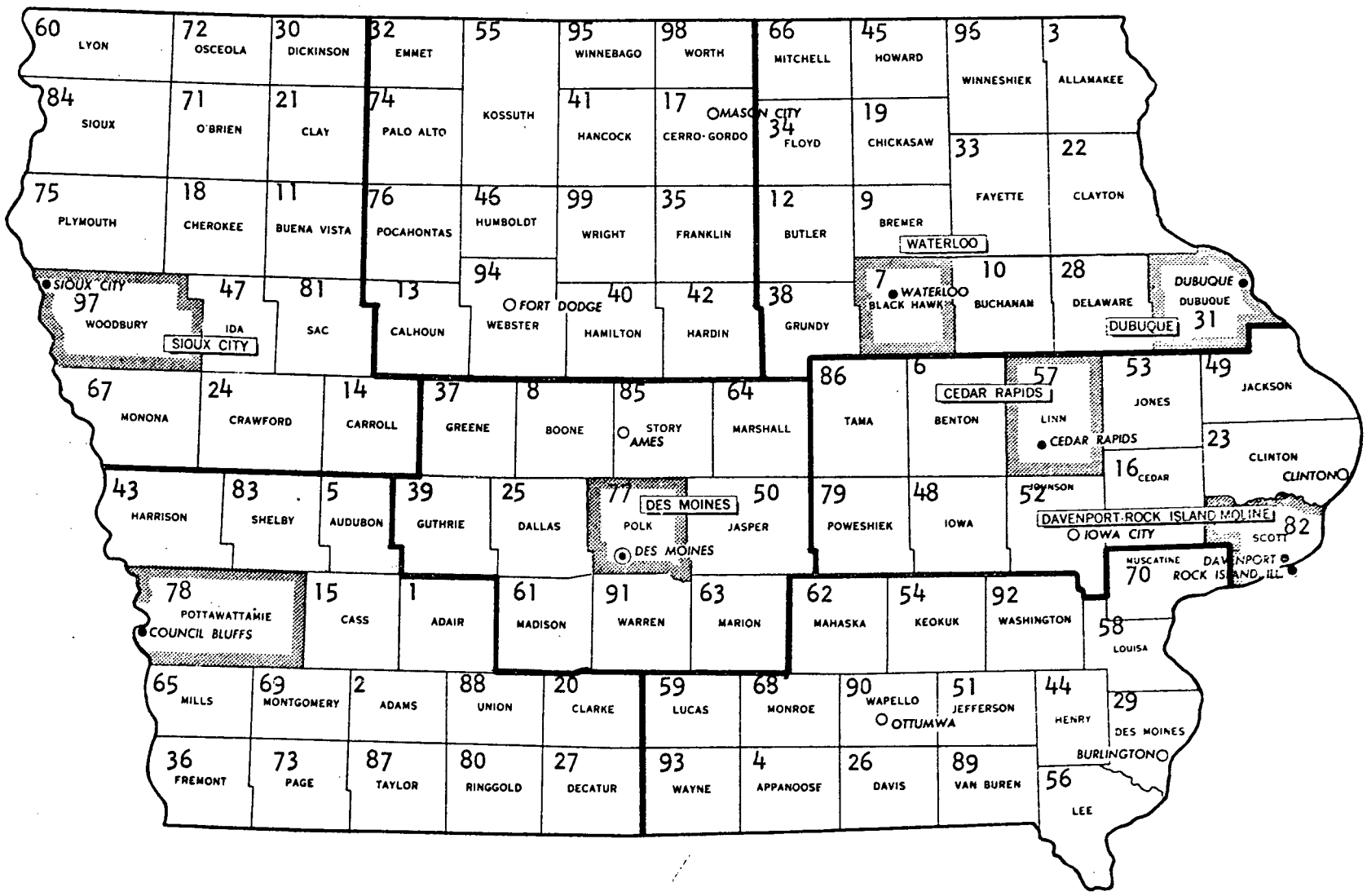


Figure 27. Conservation Commission Outdoor Recreation Regions

Figure 28.

Depreciation Figures

Class Code	Description	Number of Years over which to depreciate		
		Highway Division	Forke Bros. Blue Book	Public Works Nov. 74
01	Passenger Car-std. size	5		
02	Passenger Car-compact	5		
03	Station Wagon-car	5		
04	1/4-Ton Pickup	5		
05	1/2-Ton Pickup	7		
06	3/4-Ton Pickup	7		
07	1-Ton Pickup	7		
08	4 WD Pickup	5		
09	Crew Cab Pickup	7		
10	Panel Truck, Van or Station Wagon Type Truck	7		
11	Bus	8		
12	Light Duty Truck up to 23,000 GVW (single axle)	5		
13	Medium Duty Truck 23,000 to 27,000 GVW (single axle)	8		
14	Heavy Duty Truck 29,000 to 34,000 GVW (single axle)	10	10	
15	Extra Heavy Duty Truck 34,000 to 46,000 GVW (single or tandem axle)	10	10	
16	Extra Super Heavy Duty Truck over 46,000 GVW (tandem)	10	10	
20	Light Duty Motor Grader 50-75 HP	10	16	11
21	Medium Duty Motor Grader 76-125 HP	10	16	11
22	Heavy Duty Motor Grader 126-175 HP	10	16	11
23	Extra Heavy Duty Motor Grader over 175 HP	10	16	11
24	Light Duty Crawler Tractor 26-50 HP	5	15-17	11

Figure 2ᵢ (cont.)

Class Code	Description	Number of Years over which to depreciate		
		Highway Division	Forke Bros. Blue Book	Public Works Nov. 74
25	Medium Duty Crawler Tractor 51-100 HP	8	15-17	11
26	Heavy Duty Crawler Tractor over 100 HP	8	15-17	11
27	Light Duty Wheeled Tractor 10-25 HP	10		9
28	Medium Duty Wheeled Tractor 26-50 HP	10		9
29	Heavy Duty Wheeled Tractor over 51 HP	10		9
30	Backhoe, fixed or telescoping boom	10	18-20	10
31	Dragline	10	18-20	13
32	Tractor w/sickle mower	5		
33	Tractor w/rotary mower	5		
34	Light Duty Rotary Snow Plow	10		
35	Medium Duty Rotary Snow Plow	10		
36	Heavy Duty Rotary Snow Plow	10		
37	Light Duty Loader (less than 2 yds)	8	13-14	8½
38	Medium Duty Loader (2-5 yds)	8	13-14	8½
39	Heavy Duty Loader (over 5 yds)	8	13-14	8½
40	Wheeled Tractor w/loader and backhoe	10	8-10	10
41	Light Duty Crawler Tractor with backhoe	5	8-10	10
42	Force Feed Loader	10		
43	Sweeper self-propelled	10		
44	Pickup Sweeper	10		8½
45	Roller 2-4 ton self-propelled	5	18	11
46	Roller 5-7 ton self-propelled	10	18	11
47	Roller over 7 ton self-propelled	10	18	11
48	Mixers, Pulverizers self-propelled	8		
49	Scraper 10-25 ton self-propelled	10	12	
50	Scraper 26-40 ton self-propelled	10	12	
51	Scraper over 40 ton self-propelled	10	12	
52	Scraper 10-20 ton tractor-drawn	10	12	
53	Scraper 21-30 ton tractor-drawn	10	12	
54	Scraper over 30 ton tractor-drawn	10	12	

The Public Works [7] figures were given in the November, 1974 issue. One figure for each equipment class must be selected by the Steering Committee before final computer program design can be accomplished.

The original cost of the equipment less any salvage value will be divided by the useful life to arrive at a yearly (or other period) depreciation cost. This cost will be included in the total equipment cost for the time period. Book value will be updated each time period by subtracting the depreciation cost for each time period from the book value of the previous period.

It is planned to provide output figures of cost per hour or cost per mile both including depreciation cost and without including depreciation cost.

5.0 SUMMARY

This report has presented ways and means of collecting direct costs, indirect costs, and depreciation charges for county equipment. It has also presented a proposed design for processing this data into appropriate output useful for decision making. Outputs include proposed tabulations by county, district, and state levels as well as classifications by manufacturers and age of equipment.

Throughout the report an attempt has been made to explicitly point out items requiring decisions by the Steering Committee. The content of this report should be discussed at an early meeting of the investigators and the Steering Committee.

6.0 REFERENCES

1. A Computer Based Information System For County Equipment Cost Records, Research Proposal, Systems Division, College of Engineering, The University of Iowa, October 25, 1974

2. Benson Associates, Consulting Engineers, An Improved System of Bookkeeping and Accounting for Iowa County Highway Departments, Ames, Iowa, Project No. HR129, Iowa State Highway Commission, Iowa Highway Research Board, 1967

3. Coombs, William, E., Construction Accounting and Financial Management, New York, McGraw-Hill Book Company, Inc., 1958

4. Construction Methods and Equipment, "Specs for your files," New York, McGraw-Hill, Inc., 1974

5. Dudick, T. S. and F. I. Ravenscroft, Development of Uniform Procedures for Establishing Construction Equipment Rental Rates, Washington, D.C., Highway Research Board, 1966

6. Forke Brothers, publishers, Blue Book of Current Market Prices of Used Heavy Construction Equipment, Lincoln, Nebraska, Forke Brothers, 1974

7. "Highway Equipment Ownership and Management", Public Works, City, County, and State, Vol. 105, No. 11, November 1974, 48-52

8. National Association of County Engineers, Cost Records and Budgets, Volume II of Action Guide Series, National Association of Counties Research Foundation, 1972

9. Shafer, Kenneth L., A and B-F Equipment System, Data Processing Systems Manual, Ames, Iowa, Data Processing Department, Iowa State Highway Commission, 1970

Appendix A.

Research Project

HR-173

A Computer Based Information System For County Equipment Cost Records

Steering Committee

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Research Department
Iowa Department of Transportation, Highway Division
Ames, Iowa 50010
Phone 515-296-1195

Iowa 66 a place to grow

THE IOWA STATE HIGHWAY COMMISSION

· 515-296-1101 · AMES, IOWA 50010

H. E. GUNNERSON
Director – Chief Engineer

D. E. McLEAN
Deputy Director
Deputy Chief Engineer

November 25, 1974

REFER TO: 350

Mr. Bob G. Sandy, President
Iowa County Engineer's Association
County Engineer's Office
Indianola, IA 50125

Dear Bob:

The counties may use the Iowa State Highway Commission's data processing services for the County Highway Equipment cost accounting system that is being developed if you wish.

The services will be provided on a reimbursement basis and with the understanding that there may be times that there will be delays because other priority items are being processed.

If there are any questions related to programming, feel free to contact J.F. Hoag, P.E., Data Processing Director.

Very truly yours,

Howard E. Gunnerson
Director - Chief Engineer

HEG:lsc
cc: J.F. Hoag

COUNTY HIGHWAY DEPARTMENT REPAIR ORDER

Date In _____ 19____

Date Out _____ 19____

Mileage _____

EQUIPMENT NO. _____ Make _____ Driver _____

MECHANIC (Initials)	DESCRIPTION OF WORK	DATE	LABOR HRS.	LABOR AMOUNT

REASON FOR DELAY IN REPAIR			QTY.	COST
(1) Awaiting Parts		Total Labor		
(2) Other Repair Work		Total Parts		
(3) Inadequate Tools		Grease		
(4) Emergency Service Call(s)		Oil		
(5) Other (Specify)		TOTAL COST		

PARTS USED

QTY.	DESCRIPTION	PRICE
	Battery	
	Blades	
	Points	
	Spark Plugs	
	Tires	
	Tubes	

Released by _____

From NACE Action Guide Series, Vol. II, Cost Records & Budgets

DAILY GAS AND OIL REPORT

Garage _____

HIGHWAY DEPARTMENT

_____ County,

Date _____

By _____

DAILY GAS & OIL REPORT

INVENTORY

STOCK	GAS.-GALS.		DIESEL GALS.	MOTOR OILS--(QUARTS)						KERO. GALS.	ANTI-FREEZE	AMT.	
	Hi-Test	Reg.		10	20	30	40	Hoist Oil	Grease				
PREVIOUS													
RECEIVED													
TOTAL													
DISTRIBUTED													
BALANCE													

DISTRIBUTION

EQUIPMENT NUMBER	GAS.-GALS.		DIESEL GALS.	MOTOR OILS--(QUARTS)						KERO. GALS.	ANTI-FREEZE	AMT.	
	Hi-Test	Reg.		10	20	30	40	Hoist Oil	Grease				
TOTAL													

METER READINGS

PRESENT													
PREVIOUS													
DISTRIBUTED													

DAILY REPORT

_____ County Highway Department Daily Report Date _____ 19 __

EQUIPMENT SUPPLIES						MILEAGE OR HOURS		
Equip. No.	Diesel or Gas (Gal.)	Oil (Qts.)	Grease (Lbs.)	OTHER DESCRIPTION	OTHER Quantity	Speedometer or Hours Meter Start	Speedometer or Hours Meter End	Hours or Miles Run

WORK DATA			MATERIALS HAULED					LOCATION OF WORK
HRS.	OPERATION	NO. OF UNITS	LOADS	YDS.	TONS	KIND	FROM	

TIME				
Worked	Wait Time	Service Equip.	Repair Equip.	TOTAL

Attach all weigh bills, sales tickets, etc. Place remarks on reverse side.

_____
SIGNATURE

(Reverse Side of Report)

Remarks: _____

Materials and Other Supplies Used:

Repairs and Service:

Eq. No.	Time	Description

From NACE Action Guide Series, Vol. II, Cost Records & Budgets

MONTHLY EQUIPMENT LOG RECORD

MONTHLY OPERATION RECORD

Month MAY

Year

DATE (a)	OPERATOR (b)	SPEEDOMETER READING (c)	HRS. (d)	OPERATING EXPENSES: FUEL Type (e)	FUEL Gallons (f)	FUEL Cost (g)	OIL Quarts (h)	OIL Cost (i)	TIRES-TUBES COST (j)	MAINT. EXPENSES: MISCELLANEOUS (k)	MAINT. EXPENSES: REPAIR COST (l)	MAINT. EXPENSES: OTHER SERVICES (m)	STORAGE COST (n)	REMARKS (o)
1	CEB	27526	8	GAS	20		1							
4	CEB	27570	8											
5	CEB	27663	8	GAS	24									
6	CEB													
7	CEB													
8	CEB													
11	JAR	27834		GAS	20		1			3.75				FAN BELT – P.O. 507
30	JAR	28501	8											GREASE JOB *
TOTAL			176	GAS	139	*	3	*						TOTAL EXPENSES

Monthly operating data for equipment log to be kept with equipment. Totals are transferred to perforated tear-out sheet, which is then forwarded to the headquarters office.

* COSTS FURNISHED IN OFFICE

From NACE Action Guide Series, Vol. II, Cost Records & Budgets

MONTHLY SUMMARY FROM EQUIPMENT LOG

MONTHLY OPERATION SUMMARY		Month 19
a. Bureau Identification No. (if any)		5-22
b. License Plate No.		11507
c. Headquartered: BELFAST	Division or region: PLAINS	
d. Speedometer reading end of current month		28501
e. Total mileage current month		975
OPERATING COSTS		
a. Fuel Gallons	Gasoline	139
	Other	
Cost	Gasoline	(22.24) *
	Other	
b. Oil Quarts		3
Cost		(.90) *
Lubrication cost		(1.50) *
c. Tires and tubes cost		26.10
d. Other expenses		
e. Total operating costs		50.74
MAINTENANCE COSTS		
a. Repair cost		
b. Other expenses		FAN BELT 1.75
c. Total maintenance cost		1.75
d. Storage cost		
Total expenses		56.49
Signature		Date

Perforated tear-out sheet from equipment log showing totals from figure 2-4.

* COSTS INSERTED IN OFFICE

EQUIPMENT EXPENSE AND EARNINGS REPORT

Current month May 19____

EQUIP. NO.	DESCRIPTION		REPAIR PARTS	GAS-OIL-SUPPLIES	LABOR	OVERHEAD	DEPRECIATION	TOTAL EXPENSE	RENTAL EARNED	GAIN OR LOSS
0512	5 ton truck – (trade name)	(A)	15 06	36 72	23 01	12 78	124 00	211 57	226 55	14 98Cr
		(B)	3 56	41 82	10 58	11 39	147 00	214 35	202 05	12 30Dr
		(C)	18 62	78 54	33 59	24 17	271 00	425 92	428 60	2 68Cr
0523	5 ton truck – (trade name)									
0712	(trade name) Tractor									
1502	Shovel – 1/4 yd – (trade name)									

(A) Current month
(B) Prior months this year
(C) Total year-to-date

NOTE: Entries on this form may be handwritten, typed, or on data processing equipment.

From NACE Action Guide Series, Vol. II, Cost Records & Budgets

ANNUAL EQUIPMENT COST RECORD

Description	Code	Year mfg.	Operated		Equipment operation cost											
					Fuel				Oil				Greasing	Tires, tubes	Cleaning	Accessories
			Miles	Hours	Gals.	Total cost	Per mile	Per hour	Qts.	Total cost	Per mile	Per hour				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)

(Continuation of sheet above)

From _____, 19____

To _____, 19____

				Repair costs					Other costs		Annual costs			Performance	
Other	Subtotal operation cost	Operation cost		Labor	Parts	Subtotal repair costs	Repair cost		Indirect expense	Depreciation charge	Total cost all items (7-28)	Average cost		Rental earned	Gain or loss (+ or −)
		Per mile	Per hour				Per mile	Per hour				Per mile	Per hour		
(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)

From NACE Action Guide Series, Vol. II, Cost Records & Budgets

_____ COUNTY

DEPARTMENT OF HIGHWAYS

EQUIPMENT CONTROL RECORD

DEPT. EQUIP. NO. _____

MANUFACTURERS NO. _____

MAKE OF EQUIPMENT | KIND OF EQUIPMENT

BODY STYLE, CAPACITY OR SIZE | MODEL NUMBER

PURCHASED FROM | ADDRESS

PURCHASE ORDER NO. | DATE PURCHASED | DELIVERY DATE

DEPT. EQUIP. NO. _____

COST _____ TRADE IN ALLOWANCE _____ NET COST _____

SALVAGED ( ) OR SOLD TO | ADDRESS

DATE | PURCHASE ORDER NO.

AMOUNT REALIZED | APPLIED TO PURCHASE OF DEPARTMENT EQUIPMENT NO.

DESCRIPTION | ATTACHMENTS

ENGINE CHANGES

MONTH	YEAR	NEW NO.
X X	X X	

YEAR	MILES	HOURS	OPERATING COSTS								REPAIRS		DEPRECIATION	TOTAL ALL COST	RENTAL EARNED	GAIN OR LOSS
			FUEL		OIL		GREASING	TIRES TUBES	CLEANING	ACCESSORIES	LABOR	PARTS				
			GALS	COST	QTS	COST										

OVERHAUL RECORD

DATE	SERVICE ORDER NO.	ESTIMATED COST	ACTUAL COST

SUMMARY OF OPERATIONS

YEAR	DAYS IN SERVICE	DAYS UNDER REPAIR	DAYS NOT USED

INSPECTION RECORD

DATE INSPECTED	INSPECTED BY	FINDINGS

From NACE Action Guide Series, Vol. II, Cost Records & Budgets

DAILY TIME AND EQUIPMENT REPORT

_____ County Highway Department Daily Report Date _____ 19____

EQUIPMENT SUPPLIES						MILEAGE OR HOURS		
Equip. No.	Diesel or Gas (Gal.)	Oil (Qts.)	Grease (Lbs.)	OTHER DESCRIPTION	QUANTITY	SPEEDOMETER OR HOUR METER START	SPEEDOMETER OR HOUR METER END	HOURS OR MILES RUN

WORK DATA			MATERIALS HAULED					LOCATION OF WORK
HRS.	OPERATION	NO. OF UNITS	LOADS	YDS.	TONS	KIND	FROM	

TIME				
Worked	Wait Time	Service Equip.	Repair Equip.	Total

Attach all weigh bills, sales tickets, etc. Place remarks on reverse side.

_____
Signature

Remarks: _____

_____

_____

Materials and Other Supplies Used:

_____

From An Improved System of Bookkeeping and Accounting for Iowa County Highway Departments

INSTRUCTIONS

This field report is designed to more easily report time of men and machines; where & what is done; for charging to the proper accounts. Fill in your card carefully and clearly, using numbers to describe what you are doing. File your card promptly at the end of each reporting period. If you are in doubt about how to list something, ask your superior or the bookkeeper. This form is for Construction only.

OBJECT CODE

114 Regular pay (salaried)
115 Regular pay (hourly)
120 Overtime pay
123 Vacation leave
124 Sick leave
125 Holiday leave
126 Jury leave
127 Military leave
128 Bad weather
129 Equipment breakdown
130 Meetings & training
131 Other paid time

FUNCTION - OPERATION

100 ENGINEERING

110 Preliminary Engineering
- 111 Field engineering
- 112 Office engineering
- 113 Material tests
- 114 Test borings
- 115 Traffic & speed studies
- 117 Plans, specs & estimates
- 118 Aerial surveys
- 119 Other costs

120 Right of Way
- 123 Appraisers; salaries & expense
- 125 ROW Agents; salaries & expense
- 129 Economic studies; surveys
- 149 Other costs

150 Construction Engineering
- 151 Field engineering & layout
- 152 Office engineering
- 154 Material tests & inspection
- 155 Estimates; progress & final
- 156 Inspection; quantity measurement

200 CONSTRUCTION-ROADWAY

210 Roadway earthwork & grading
- 211 Clearing & grubbing
- 212 Excavation
- 213 Overhaul
- 214 Finishing, subgrade preparation
- 215 Right-of-way fences
- 217 Moving buildings & structures
- 219 Subbase materials
- 221 Wetting, rolling & compacting
- 223 Detours & traffic services during construction
- 229 Other costs

230 Drainage & structures (roadway)
- 231 Structure excavation
- 232 Structure backfill
- 233 Corrugated metal culvert pipe
- 234 Concrete culvert pipe
- 235 Storm sewers
- 236 Vitrified clay pipe & tile
- 237 Removal of old structures

240 Drainage & structures (sidedrain)
- 241 Structure excavation
- 242 Structure backfill
- 243 Corrugated metal pipe
- 244 Concrete pipe
- 245 Slope drain
- 246 Vitrified clay pipe & tile
- 247 Removal of old structures

250 General
- 251 Formed concrete & masonry
- 252 Reinforcing steel
- 253 Structural steel
- 254 Riprap
- 255 Slope paving
- 256 Subdrains
- 257 Curb & gutter
- 258 Treated timber
- 259 Other costs

260 Roadway base & surface
- 261 Crushed rock surfacing
- 262 Gravel surfacing
- 263 Bituminous treatment
- 265 Bituminous road-mix
- 267 Bituminous plant-mix
- 269 Asphalt concrete
- 271 Portland cement concrete
- 273 Overhaul
- 275 Wetting, rolling & compacting

280 Roadside development
- 281 Removing & replacing top
- 283 Initial seeding
- 284 Sodding
- 285 Shouldering
- 286 Erosion control

290 Miscellaneous construction
- 291 Right of Way markers

300 CONSTRUCTION-STRUCTURES

310 Structure excavation
- 311 Channel excavation
- 312 Unclassified excavation
- 313 Rock excavation
- 314 Special backfill mat'l.

320 Foundations
- 321 Piling, timber
- 322 Piling, steel
- 323 Piling, concrete
- 324 Load tests
- 325 Concrete
- 326 Reinf. steel

330 Structure & superstructure
- 331 Concrete
- 332 Reinf. steel
- 333 Structural steel
- 334 Railing

350 New traffic service facilities
- 351 Signs
- 352 Signals
- 353 Striping, marking
- 354 Guard rails
- 355 Highway lighting
- 356 Channelization

EMPLOYEE NAME	NO.	POSITION	HOURS	RATE	EARNED	RD.-BR. BLDG-EQ. PROJ. NO.	SECTION	FUNCTION OPERATION	OBJECT CODE	EQUIPMENT NO.	EQUIPMENT HRS.	MO. DAY YR. RENTAL	TOTAL

APPROVED

CERTIFIED

FOREMAN

INSTRUCTIONS

This field report is designed to more easily report time of men and machines; where & what is done; for charging to the proper accounts. Fill in your card carefully and clearly, using numbers to describe what you are doing. File your card promptly at the end of each reporting period. If you are in doubt about how to list something, ask your superior or the bookkeeper.

OBJECT CODE

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124 Sick leave
125 Holiday leave
126 Jury leave
127 Military leave
128 Bad weather
129 Equipment breakdown
130 Meetings & training
131 Other paid time

FUNCTION-OPERATION

100 ENGINEERING

110 Preliminary Engineering
- 111 Field engineering
- 112 Office engineering
- 113 Material tests
- 114 Test borings
- 115 Traffic & speed studies
- 117 Plans, specs & estimates
- 118 Aerial surveys
- 119 Other costs

120 Right of Way
- 123 Appraisers; salaries & expense
- 125 ROW Agents; salaries & expense
- 129 Economic studies; surveys
- 149 Other costs

150 Construction Engineering
- 151 Field engineering & layout
- 152 Office engineering
- 154 Material tests & inspection
- 155 Estimates; progress & final
- 156 Inspection; quantity measurement
- 159 Other costs

400 MAINTENANCE

410 Routine roadway surface operations
- 411 Patching - asphalt concrete
- 412 Patching - Bit. S.T.
- 413 Patching - PCConcrete
- 414 Joint and crack filling
- 415 Stone and gravel replacement
- 416 Blading
- 417 Dust palliatives
- 419 Other costs

420 Special roadway surface operations
- 421 Mud jacking and undersealing
- 423 Plant-mix seal (-1¼)
- 424 Scarifying and remixing
- 425 Bit.treatment(inv.penetration)
- 426 Resurfacing (bit.sand seal)
- 427 Protection & traffic handling during above operations
- 429 Other costs

440 Shoulders and side approaches
- 441 Patching
- 442 Reseeding and resodding
- 443 Bituminous resealing
- 444 Replacing in kind
- 445 Reshaping
- 449 Other costs

460 Roadside and drainage
- 461 Erosion and washouts
- 462 Drainage channels & structures
- 463 Cleaning ditches
- 464 Clean & repair catch basins
- 465 Walls, cribbing & riprap
- 466 Trees, shrubs & planting
- 467 Mowing & weed control
- 468 Reseeding & resodding
- 479 Other costs

480 Structures: Repairing & Maintaining
- 481 Storm sewers
- 482 Sanitary sewers
- 484 Cattle pass
- 488 Viaducts
- 490 Dams
- 491 Underpasses
- 492 Overpasses
- 494 Bridges
- 499 Other costs

500 TRAFFIC SERVICES

510 Snow and ice control
- 511 Snow removal
- 512 Snow fence; erection & removal
- 513 Sanding icy surfaces
- 514 Application of chemicals
- 515 Ice removal
- 516 Opening inlets & channels
- 529 Other costs

530 Traffic control, service facilities
- 531 Painting, striping & markings
  Repairing, maintaining:
- 532 Signal equipment
- 533 Traffic signs
- 534 Guard rails
- 535 Right-of-way fences
- 538 Highway lighting system
- 549 Pedestrian facilities
- 550 Rest & picnic areas
- 553 Detours (not on construction)
- 559 Other costs

600 DISASTERS

Assign numbers as needed.

650 INDIRECT EXPENSE

651 Field maintenance supervision
652 Field maintenance engineering
653 Complaint investigation
654 Special

From An Improved System of Bookkeeping and Accounting for Iowa County Highway Departments

8924

JASPER COUNTY SHOP

QTY.	PART NO.	DESCRIPTION	PRICE			
1	5S 8	Gsk				24
1	9F-8594	Gsk				26
2	1B1-699	Kit	14	21	28	42
OUTSIDE REPAIRS						
1	Radiator	repair			145	00
ACCES. NO.	TIRES, TUBES, AND ACCESSORIES					
2	55484	Filter	1	17	2	34
		TOTAL ACCESSORIES			31	26

Not Responsible For Loss or Damage to Cars or Articles Left in Cars in Case of Fire, Theft or Any Other Cause Beyond Our Control.

427

NAME: Caterpillar DATE: 12-16-74 A.M. P.M.

ADDRESS PHONE

YEAR AND MAKE	TYPE OR MODEL	MOTOR NO.	SERIAL NO.	CUST. ORDER NO.
	D7-4			

SPEEDOMETER	LICENSE	PROMISED A.M. P.M.	PHONE WHEN READY YES ☐ NO ☐	ORDER WRITTEN BY
11715 hrs.				

OPER. NO.	LUBRICATE ☐ CHANGE OIL ☐ FLUSH TRANS. ☑ FLUSH DIFF. ☐ WASH ☐ POLISH ☐		
	Seals & gaskets needed.		
	Radiator leaks.		
	Service complete #30 oil		
	Bob - 14hrs -	67	20
	Dale - 4hrs -	18	64
	Mick 8hrs -	33	44

				F. S.		
	Gals. Gas @			Total Labor	119	28
7 gal	Qts. Oil @ 2.20	15	40	Body Work		
	Qts. Trans. Fluid @			Total Parts	31	26
	Lbs. Grease @			Accessories		
	Total	15	40	Tires and Tubes		
				Gas, Oil, Grease, Trans. Fld.	15	40
				Outside Repairs	145	00
				Tax		
				Total Amt.	310	94

I hereby authorize the above repair work to be done along with the necessary material, and hereby grant you and/or your employees permission to operate the car, truck or vehicle herein described on streets, highways or elsewhere for the purpose of testing and/or inspection. An express mechanic's lien is hereby acknowledged on above car, truck or vehicle to secure the amount of repairs thereto.

X

77

POWESHIEK COUNTY TIME CARD

NAME MACHINE HOURS BEGINNING _____ END _____ YEAR _____

MO.	DAY	HOURS	RATE	EARNED	LOCATION / PROJECT	OPERATION	EQUIP. NO.	HRS. Mi.	FUEL	OIL	GREASE

OPERATION CODING:

300 SERIES – CONSTRUCTION
320 – Bridges
330 – Roadway Culverts
331 – Pipe Culverts
332 – Box Culverts
350 – Roadway Construction
351 – Clearing & Grubbing
352 – Excavation & Entrances
360 – Surfaces
361 – Granular
367 – P.C. Concrete
380 – Roadside Construction
382 – Erosion
384 – Erosion Control
386 – Tile Lines
390 – Traffic Controls
391 – Signs
393 – Pavement Markings
394 – Guardrail

400 SERIES – MAINTENANCE
420 – Bridges
430 – Culverts
431 – Pipe Culverts
432 – Box Culverts
450 – Roadway Maintenance
451 – Blading Granular
452 – Blading Earth
453 – Ditching
460 – Surface Maintenance
461 – Granular
462 – Stabilized Granular
463 – Dust Palliative
464 – Seal Coat
466 – Asphalt Concrete
467 – P.C. Concrete

480 – Roadside Maintenance
481 – Ditch Cleaning
482 – Shoulders
483 – Erosion Control
484 – Entrances
485 – Tile Lines
490 – Road Clearing
491 – Brush Cutting
492 – Spraying
493 – Mowing

500 SERIES – TRAFFIC SERV.
520 – Snow & Ice Control
521 – Plowing & Spreading
522 – Plowing & Blading
523 – Chemical & Abrasive Spreading
590 – Traffic Control
591 – Signs
593 – Pavement Markings
594 – Guardrails

600 SERIES – EQUIPMENT & EQUIPMENT OPER.
620 – Equip. Repair & Serv.
621 – Parts
622 – County Labor
624 – Servicing Equipment
625 – Safety
650 – Sundry

900 SERIES – HOLDING ACCOUNT
901 – FICA & IPERS
902 – Insurance
903 – Vacation Leave
904 – Sick Leave w/Pay
905 – Paid Holidays
907 – Inclement Weather
908 – Safety

MATERIALS USED OR RECEIVED (LIST)

WARREN COUNTY WEEKLY TIME CARD --- PATROL OPERATORS

NAME _____ MACHINE HOURS BEGINNING _____ END _____ YEAR _____

MO.	DAY	HOURS	RATE	EARNED	LOCATION / PROJECT	OPERATION	EQUIP. NO.	HRS / MI	FUEL	OIL	GREASE

I certify that this is an exact record of the hours I have worked during the week specified above.

CONSTRUCTION:
213 Inspection
310 Right Of Way
312 Fence
320 Bridges
330 Culverts
331 Pipe Culv.
332 Box Culv.
350 Rdwy. Constr.
351 Clear & Grub
352 Excavation
353 Entrance
359 Misc.
360 Surfaces
361 Granular
362 Stabilized Gran.
364 Bit. Seal Coat
367 P.C. Conc.
380 Roadside Constr.
382 Erosion Control (Row)
383 Shoulder Grading
384 Erosion Control (Structures)
386 Tile Lines
389 Misc.
390 Traffic Controls
391 Signs
393 Pvmt. Markings
394 Guard Rail

OPERATION CODING:
MAINTENANCE
420 Bridges
430 Culverts
431 Pipe Culv.
432 Box Culv.
450 Roadway Maint.
451 Blading, Gran.
452 Blading, Earth
453 Ditching
454 Repair Slides, Washouts
459 Misc.
460 Surface Maint.
461 Granular
463 Dust Palliative
464 Seal Coat
467 P.C.Conc.
480 Roadside Maint.
481 Ditch Cleaning
482 Shoulders
483 Erosion Control
484 Entrances
485 Tile Lines
486 Storm Sewers
489 Misc.
490 Road Clearing
491 Brush Cutting
492 Spraying
493 Mowing
499 Misc.
520 Snow & Ice Control
521 Plowing & Spreading
522 Plow & Blade Only
523 Chem. & Abrasives (Spread)
524 Chem. & Abrasives (Material)
525 Snow Fence
529 Misc.
590 Traffic Controls
591 Signs
593 Pvmt. Markings
594 Guard Rail
599 Other
620 Equipment Repair
622 County Labor
624 Service Equip.
650 Sundry
653 Labor & Building & Ground Maintenance

Warren County

Make _____ Year _____ Operator _____

Hours or Miles, January 1, _____ Hours or Miles, December 31, _____

MONTH	REPAIRS		MAINT LABOR	LABOR IN FIELD	GASOLINE		DIESEL FUEL		OIL		GREASE		ANTIFREEZE		MISC ITEMS Chains, Batteries, Tires, etc.	TOTAL COST
	Parts	Labor			Gal.	Cost	Gal	Cost	Qts.	Cost	Lbs.	Cost	Qts.	Cost		
January																
February																
March																
April																
May																
June																
July																
August																
Sept.																
Oct.																
Nov.																
Dec.																
TOTALS																

Warre: County

EQUIPMENT MAINTENANCE RECORD MONTH YEAR _____

Operator _____ Machine No. _____ Miles or Hours 1st of Month _____ Miles or Hours End of Month _____

Date	Miles or Hours	Gals Gas	Gals. Diesel Fuel	Qts. Oil	Pounds Grease	Miles Traveled	Hours Machine Used	Blade Type	Blade Size	Bits Total Length	Tires No.	Tires Size	Chains No.	Chains & Size	Repairs What
1															
2															
3															
4															
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31															

REMARKS _____