U.S. Department of Transportation
Office of the Secretary of Transportation

USER'S MANUAL FOR THE COUNTY ROAD EVALUATION PROGRAM VOLUME I

University Research Program

User's Manual
Under Contract
DTRS-5682-C-00021

DOT/OST/P-34/86/034
January 1986

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Research Project HR 242
Sponsored by the
Iowa Department of Transportation
and the
Iowa Highway Research Board

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/OST/P-34/86-034		

4. Title and Subtitle	5. Report Date
User's Manual for the County Road Evaluation Program - Volume I	January 1986
	6. Performing Organization Code
	8. Performing Organization Report No.

7. Author(s)	
Gregory R. Pautsch C. Phillip Baumel	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Iowa State University of Science and Technology Department of Economics Ames, Iowa 50011	11. Contract or Grant No. DTRS5682-C-00021
	13. Type of Report and Period Covered User's Manual
12. Sponsoring Agency Name and Address U.S. Department of Transportation OST/University Research Program Washington, D.C. 20590	14. Sponsoring Agency Code P-34

15. Supplementary Notes

Technical Monitor, Carl Swerdloff, (OST, P-36)

16. Abstract

Provides instructions for using the computer program which was developed under the research project, "The Economics of Reducing the County Road System: Three Case Studies In Iowa". This program operates on an IBP personal computer with 300K storage. A fixed disk is required with at least 3 megabyles of storage. The computer must be equipped with DOS version 3.0; the programs are written in Fortran.

The user's manual describes all data requirements including network preparation, trip information, cost for maintenance, reconstruction, etc. Program operation instructions are presented, as well as sample solution output and a listing of the computer programs.

17. Key Words	18. Distribution Statement
Rural highways, highway abandonment, benefit-cost, property access, farm travel, gravel roads, unpaved roads, maintenance, low-volume roads, investment analysis.	This document is available to the U.S. public through the National Technical Information Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED		

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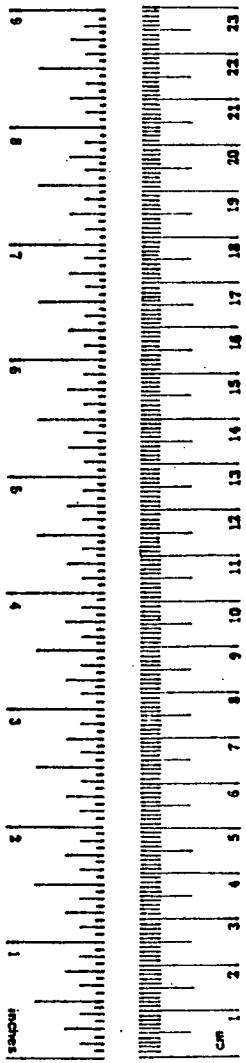
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

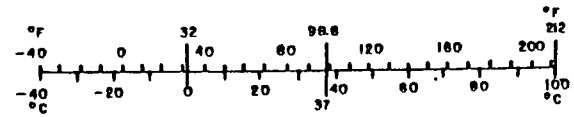
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.96	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



NOTICE

AVAILABILITY OF PROGRAM DISC

Anyone interested in obtaining a copy of the County Road Evaluation Program on disc, please send a check for $12.50 made out to **Iowa State University**, mail to:

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User's Manual
for the
County Road Evaluation Program
Volume I

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In Cooperation With
The Highway Division and Planning
and Research Division
Iowa Department of Transportation
and the
Iowa Highway Research Board
Iowa Department of Transportation HR 242
and the
University Research Program
Office of the Secretary
U.S. Department of Transportation

TABLE OF CONTENTS

List of Tables

List of Worksheets

Preface

The County Road and Bridge Evaluation program was taken from Baumel, C. Phillip, Cathy A. Hamlett, and Gregory R. Pautsch, "The Economics of Reducing the County Road System: Three Case Studies in Iowa." The programs can be executed on an IBM personal computer with at least 300K of storage. The personal computer must have a fixed disk with at least 3 megabytes of storage. The computer must be equipped with DOS version 3.0, and the programs are written in Fortran.

COUNTY ROAD EVALUATION PROGRAM

The County Road Evaluation Program is designed to enable county engineers to:

1. estimate the additional travel costs to the traveling public from county road abandonment or conversion of county roads to private drives,
2. estimate the investment cost savings from county road abandonment or conversion to private drives, and
3. compute a benefit-cost ratio for road abandonment or private drive decisions.

The underlying logic of the County Road Evaluation Program is described in Baumel, Hamlett and Pautsch.

I. DATA REQUIREMENTS

The first data set to be created for the County Road Evaluation Program is the road network. A network consists of a set of nodes connected by a set of arcs. A node represents a point where trips originate, are relayed, or terminate. Arcs represent the roads which allow traffic to flow between the nodes. Each arc in the network is described by:

a) a beginning node

b) an ending node

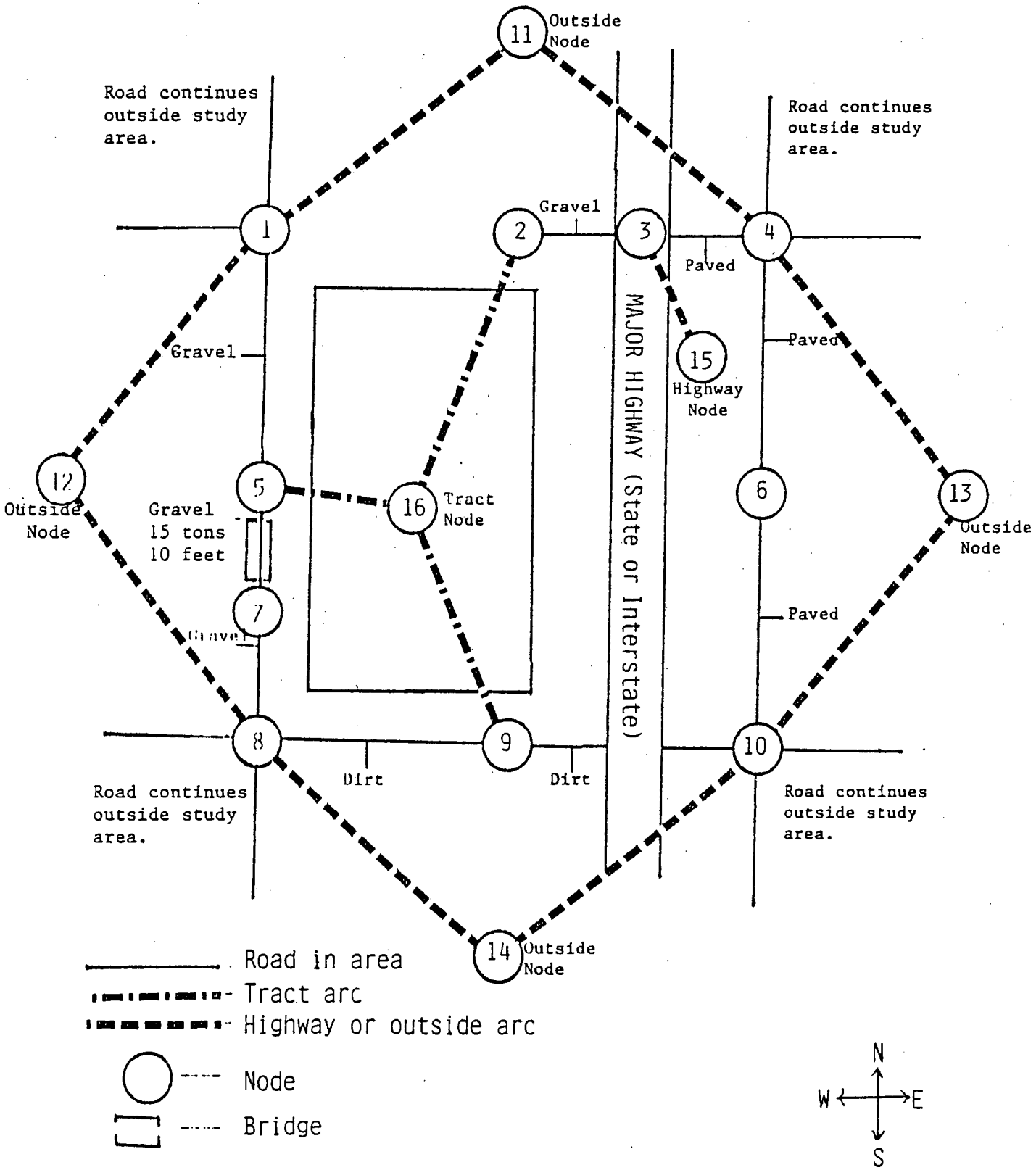
c) a distance

d) a weight constraint

e) a width constraint

f) the length of any bridge on the arc

Figure 1. A sample network of a one mile by one mile study area divided into half- and quarter-mile segments.



g) the width of any bridge on the arc

h) a surface code

The program requires four types of arcs to be created in a complete rural road and bridge network. The first type of arc is called a study area arc. A study area arc is created by dividing the roads in the study area into half- or quarter-mile segments. In figure 1, the roads in the one mile by one mile study area are divided into half- and quarter-mile segments. A node is placed at each intersection and at the end of each road segment. The node numbers must start at one and be sequential. A number cannot be skipped. All of the nodes on study area arcs should be assigned numbers before numbers are assigned to the nodes on all other types of arcs. The nodes on the study area arcs in the figure 1 study area begin at one and move sequentially to ten. The road segment connecting node 1 with node 5 is represented by two arcs. The arc allowing traffic to flow from node 1 to node 5 has a beginning node number of 1 and an ending node number of 5, while the arc allowing traffic to flow from node 5 to node 1 has a beginning node number of 5 and an ending node number of 1.

The distance of study area arcs must be an integer. Since the road segment between nodes 1 and 5 is one-half mile long, the distance for the two arcs representing this road segment is equal to 50. The distance for a mile road segment is 100, and the distance for a quarter-mile segment is 25.

In figure 1, a bridge is located on the road segment connecting nodes 5 and 7. The distance of any arc which has a bridge is given a

distance of 25. Hence, a node must be placed one-eighth of a mile away from both ends of the bridge. The weight constraint of an arc is the weight of the heaviest vehicle able to travel over its corresponding road segment, while the width constraint is the width of the widest vehicle able to travel over its corresponding road segment. Both the weight and width constraints must be integers. The weight constraint is measured in tons, while the width constraint is measured in feet.

The length and width of any bridge on an arc must be integers and both are measured in feet. If an arc does not have a bridge, the bridge length and width of that arc is set at zero.

The surface code of a study area arc can be any of the following numbers:

type of road	code
paved county road	1
gravel county road	2
dirt county road	3
paved non-county road	4

A paved non-county road is a state or interstate highway located in the study area.

The second type of arc to be created is outside arcs. Outside arcs are created to allow the computer to route vehicles through the study area when traveling to destinations outside of the study area. Outside nodes are placed north, south, east, and west of the study area. The node number for the outside nodes must start with the next number following the last number assigned to a study area arc and move sequentially. In figure 1, the nodes placed on the study area arcs

start at one and continue to 10. Hence, the numbers assigned to the outside nodes will start at 11 and continue on to 14.

Outside arcs are formed by connecting the outside node to the nodes on the respective edge of the study area that allow traffic to leave the study area. In figure 1, the west outside node is connected to nodes 1 and 8 since nodes 1 and 8 allow travel westward out of the study area. The west outside node is not connected to nodes 5 and 7 because nodes 5 and 7 do not allow travel westward out of the study area. Hence, if a farmer has a tract of land located west of the study area, the tract of land would be given the west outside node as the destination. Any trip to that outside tract is routed from the origin node within the study area to the west outside node. This allows for the calculation of within-study-area travel costs to destinations outside of the study area.

The third type of arc to be created is highway arcs. A highway node is placed on each state or interstate highway in the study area. The numbers assigned to the highway nodes follow the last number assigned to an outside node and move sequentially. In figure 1, the highway node is assigned the value of 15 since the last number assigned to an outside node is 14. A highway arc is created by connecting the highway node to the within-study-area nodes serving as access points to the highway. In figure 1, only node 3 serves as an access point to the highway; hence only node 3 is connected to node 15. Highway arcs are created to allow trips to distant locations under the assumption that travel to and from distant locations will maximize the use of state or

interstate highway. Therefore, the destination of any out-of-state trip is the highway node. The computer will route the trips to the closest access to a state or interstate highway which is in the general direction of the true destination.

The distance of all outside and highway arcs is set at 10,000 and the surface code is equal to 5. The weight and width constraints of outside and highway arcs are set at a value so that all vehicles are able to travel over these arcs. The program does not consider bridges on outside and highway arcs; hence, the length and width of a bridge on outside and highway arcs should be set at zero.

The final type of arc to be created is tract arcs. The origin or destination of many farm trips are to tracts of farm land. Tracts of farm land often have multiple access points. In most cases, the access used depends on the origin of the trip. Each tract of land within the study area is assigned a tract node. The numbers assigned to tracts follow the last number assigned to a highway node and continue sequentially. A tract arc is formed by connecting the tract node to the nodes in the study area that serve as access points to the tract of land. Hence, in figure 1, the tract node (node 16) is connected to nodes 2, 5 and 9, since these nodes serve as access to the tract of land. When a farmer travels from tract to tract, the origin and destination should be coded as each tract node number. The computer finds the cost-minimizing route between the two tracts by finding the optimal access points to use for each trip.

The distance for tract arcs is set at 10,000 so that only trips which have the tract node as an origin or destination are routed over the arc. This high distance value essentially prevents overhead traffic from "driving through the field." The surface code for tract arcs is 6. The weight and width constraints of tract arcs must be set at a value so that all vehicles are able to travel over these arcs. The length and width of any bridge on tract arcs is set at zero, since no bridges are located on tract arcs.

The second data set to be created is the travel information data set. The origin node number, destination node number, number of trips and the vehicle type code number must be entered into this data set. Table 1 shows the various vehicle code numbers for various types of vehicles. The sample study area in figure 2 includes three households numbered 1, 2 and 3. Suppose they furnished the following travel information (all trips are "one way," that is, they do not include return trips):

Household 1:

5 trips per week to N City in the family car

4 trips per month to N City in a pickup

2 trips per day to the field (node 16 in the diagram) in a pickup

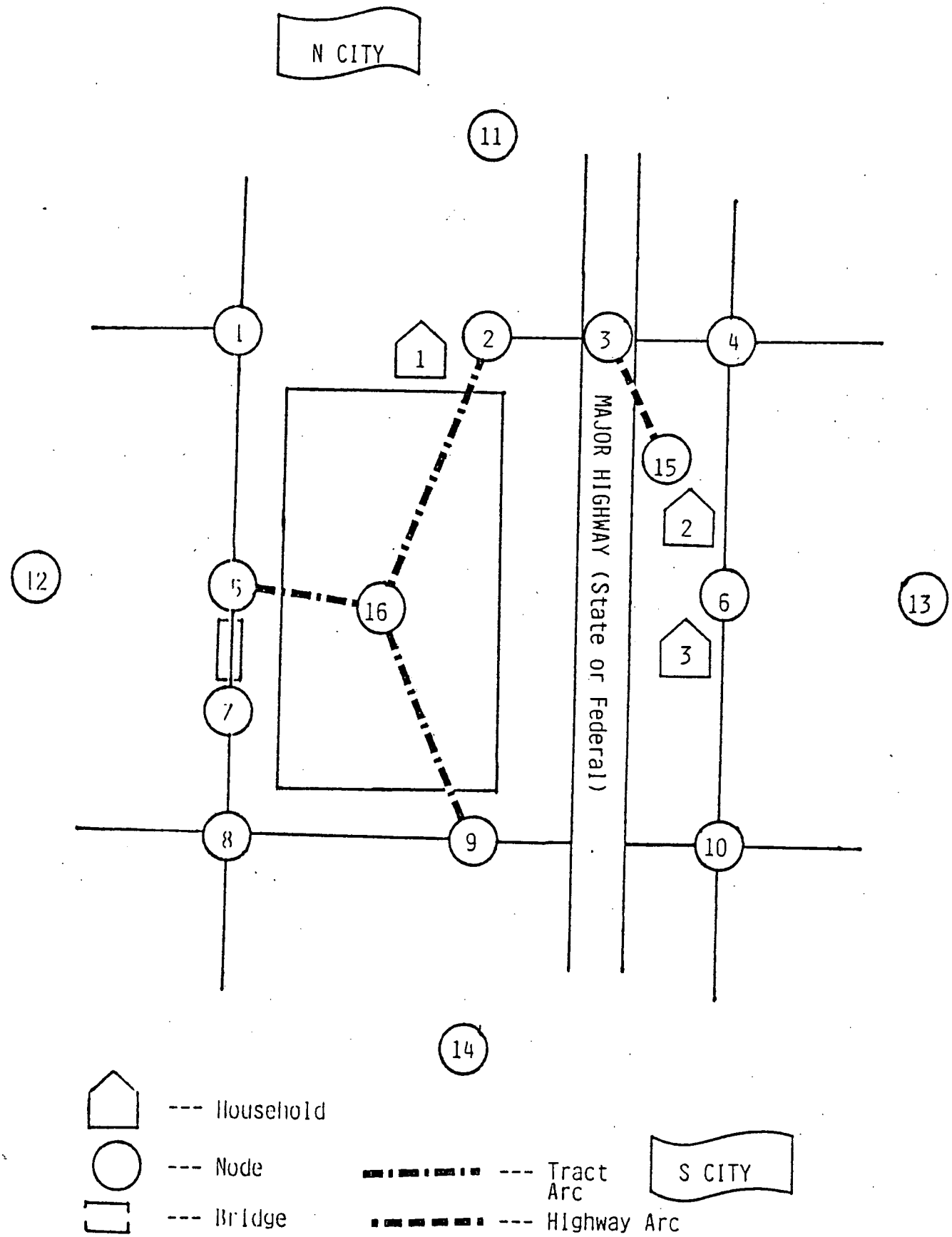
2 trips per day to the field during fall harvest in a tractor pulling a 450-bushel wagon

5 trips to the field in a 6-row combine during harvest

Table 1. Vehicle code numbers.

Vehicle code number	Vehicle description
1	Automobile
2	Commercial van
3	Pickup
4	Single axle truck - half loaded
5	Tandem axle truck - empty
6	Tractor pulling equipment
7	Tractor pulling equipment with timeliness
8	Pickup pulling trailer
9	Garbage truck
10	Commercial semitrailer - empty
11	Tractor
12	Combine - 2-row
13	Combine - 4-row
14	Combine - 6 or 8-row
15	Tractor pulling 125-bu. wagon - empty
16	Tractor pulling 250-bu. wagon - empty
17	Tractor pulling 350-bu. wagon - empty
18	Tractor pulling 450-bu. wagon - empty
19	Tractor pulling 550-bu. wagon - empty
20	Tractor pulling 2 350-bu. wagons - empty
21	Tractor pulling 2 450-bu. wagons - empty
22	Single axle truck with pup - empty
23	Farm semitrailer - empty
24	Tandem axle truck with pup - empty
25	Single axle truck pulling 250-bu. wagon - empty
26	Single axle truck pulling 350-bu. wagon - empty
27	Tandem axle truck pulling 450-bu. wagon - empty
28	Tractor pulling grain buggy - empty
29	Tandem axle truck pulling 550-bu. wagon - empty
30	Tandem axle truck pulling 2 350-bu. wagons - empty
31	Tandem axle truck pulling 2 450-bu. wagons - empty
32	Commercial semitrailer - loaded
33	Tandem axle truck - loaded
34	Farm semitrailer- loaded
35	Single axle truck with pup - loaded
36	Tandem axle truck with pup - loaded
37	Tractor pulling 125-bu. wagon - loaded
38	Tractor pulling 250-bu. wagon - loaded
39	Tractor pulling grain buggy - loaded
40	Tractor pulling 350-bu. wagon - loaded
41	Tractor pulling 450-bu. wagon - loaded
42	Tractor pulling 550-bu. wagon - loaded
43	Tractor pulling 2 350-bu. wagons - loaded
44	Tractor pulling 2 450-bu. wagons - loaded
45	Single axle truck pulling 250-bu. wagon - loaded
46	Single axle truck pulling 350-bu. wagon - loaded
47	Tandem axle truck pulling 450-bu. wagon - loaded
48	Tandem axle truck pulling 550-bu. wagon - loaded
49	Tandem axle truck pulling 2 350-bu. wagons - loaded
50	Tandem axle truck pulling 2 450-bu. wagons - loaded

Figure 2. Sample study area.



5 trips per year from S City in a tandem axle truck pulling a pup

Household 2:

10 trips per week to S City in an automobile

1 trip per month to N City in a pickup

2 trips per year to a distant location (using a major highway) in a car

3 trips per week to a neighbor, Household 1 in a pickup

Household 3:

15 trips per week to a city east of the study area in a car

5 trips per year to N City in a commericial semitrailer

4 trips per year from S City in a single axle truck

In smaller study areas, many trips originating within the study area go to outside locations, and many trips destined to locations within the study area begin at origins outside the study area. A complete estimation of travel data for a given household must include information on all their trips, both going to and coming from locations inside and outside the study area.

Once travel data has been collected for all households in the study area, the three steps in getting it ready for the County Road Evaluation Program are:

STEP 1

First, trip information must be converted to common units, such as number of trips per year. Because there are 52 weeks in a year, 12

months, 365 days, and one-quarter of these per season, the following conversions should be used:

1 trip per day = 1 x 365 = 365 trips per year

5 trips per week = 5 x 52 = 260 trips per year

1 trip per month = 1 x 12 = 12 trips per year

1 trip per day per season = 1 x 365 x 1/4 = 91 trips per year

STEP 2

Origin and destination nodes must be assigned to each trip, i.e. "requested route." Each household must be given a location node based on the closest node in the study area. In the case where a household is located exactly between two nodes, it should be assigned to the node nearest the middle of the arc on which it lies. In our example, Household 1 is located near node 2, while Households 2 and 3 are both closest to node 6. Hence, travel originating at Household 1 is given an origin node of 2. Travel originating at the field in the sample study area would be assigned an origin node of 16, the node of that tract of land. Travel originating outside the study area would be given the appropriate outside node as its origin, or, if travel originated at a distant location, the major highway node (15). Similarly, a destination node for each requested route must be assigned. Trips to Household 2, for example, would have the destination node 6. Trips going to N City would be assigned the destination node 11, because N City is outside and north of the study area, and node 11 is the north outside node.

STEP 3

The third step is to assign vehicle code numbers to each vehicle, based on the numbers given in table 1. For example, an automobile is given 1 as its code number. School buses and postal vehicles are excluded from table 1. School bus and postal service vehicles are routed based on larger geographic areas, and any change in school bus and postal travel costs must be calculated by hand. Table 2 presents a list of the coded travel information given for the sample study area in figure 2.

Table 2. The coded travel information for the sample study area.

Origin node number	Destination node number	Yearly trips	Vehicle code number
2	11	520	1
2	11	96	3
2	16	1460	3
2	16	183	18
2	16	183	41
2	16	10	14
14	2	5	24
14	2	5	36
6	14	1040	1
6	11	24	3
6	15	4	1
6	2	312	3
6	13	1560	1
6	11	5	32
6	11	5	10
14	6	8	4

Another required data set concerns vehicle groupings. Vehicle groupings allow several vehicles to be routed together to increase the efficiency of the computer. The vehicles in a grouping should have similar weight and width characteristics. Also, the ratios of cost per mile of traveling over a gravel surface to a paved surface and the cost per mile of traveling over a dirt surface must be similar. For each vehicle grouping, the following information is required:

a) the representative weight (in tons)

b) the representative width (in feet)

c) the representative ratio of cost per mile of travel over a gravel surface to a paved surface

d) the representative ratio of cost per mile of traveling over a dirt surface to a paved surface

e) the total number of vehicles in the grouping

In addition, the vehicle code numbers in table 1 and the variable cost in cents per mile of traveling over a paved surface must be entered into the vehicle grouping data set.

The representative weight and width of a vehicle grouping must be an integer value. The weight is expressed in tons, while the width is expressed in feet. The two representative ratios are rounded to two decimal places. The variable cost in cents per mile of traveling over a paved surface for a vehicle is rounded to one decimal place. The total number of vehicles in a vehicle grouping can be any integer value of 15 or less.

The next type of data required is the road maintenance, reconstruction and resurfacing cost data set. This data set requires that maintenance costs be separated into fixed and variable maintenance cost per mile of gravel, dirt and paved roads. The variable maintenance cost of a road is a function of the average daily traffic level of the road. The fixed maintenance cost of a road is the maintenance cost required independent of traffic levels. If the variable maintenance cost of paved roads is calculated using kip loads, insert zero for the paved road variable maintenance cost. An explanation of using kip loadings to calculate variable maintenance cost of paved roads is presented later in the text

The method used to calculate reconstruction and resurfacing costs is based on Iowa data. Data sources in other states may vary, and the procedure used to calculate reconstruction and resurfacing costs may need to be modified according to the available data.

The reconstruction and resurfacing costs are taken from tables 3, 4 and 5 which are extracted from the "Quadrennial Need Study on Highways, Roads and Streets for the Study Years 1982 through 2001." Table 3 shows a list of the 99 counties in Iowa and the cost area number for each county. Table 4 gives the cost area factors for each cost area, while table 5 shows the base reconstruction and resurfacing costs. These tables are used to calculate the per lane mile reconstruction and resurfacing cost for highway group numbers 3-8.

Hamilton County, Iowa is used as an example to show the method of calculating reconstruction and resurfacing costs. Table 3 shows the

Table 3. 1982-2001 needs study cost areas.

County	County number	Cost area	County	County number	Cost area	County	County number	Cost Area
Adair	1	4	Floyd	34	16	Monona	67	7
Adams	2	4	Franklin	35	19	Monroe	68	2
Allamakee	3	3	Fremont	36	9	Montgomery	69	8
Appanoose	4	2	Greene	37	15	Muscatine	70	14
Audubon	5	10	Grundy	38	20	O'Brien	71	19
Benton	6	15	Guthrie	39	8	Osceola	72	16
Black Hawk	7	20	Hamilton	40	21	Page	73	6
Boone	8	17	Hancock	41	19	Palo Alto	74	16
Bremer	9	17	Hardin	42	18	Plymouth	75	13
Buchanan	10	15	Harrison	43	7	Pocahantas	76	20
Buena Vista	11	18	Henry	44	10	Polk	77	23
Butler	12	17	Howard	45	8	Pottawattamie	78	9
Calhoun	13	19	Humboldt	46	19	Poweshiek	79	13
Carroll	14	15	Ida	47	13	Ringgold	80	1
Cass	15	8	Iowa	48	11	Sac	81	16
Cedar	16	18	Jackson	49	11	Scott	82	22
Cerro Gordo	17	21	Jasper	50	12	Shelby	83	11
Cherokee	18	13	Jefferson	51	5	Sioux	84	15
Chickasaw	19	11	Johnson	52	14	Story	85	18
Clarke	20	1	Jones	53	12	Tama	86	11
Clay	21	21	Keokuk	54	8	Taylor	87	3
Clayton	22	7	Kossuth	55	19	Union	88	4
Clinton	23	14	Lee	56	9	Van Buren	89	3
Crawford	24	11	Linn	57	22	Wapello	90	2
Dallas	25	13	Louisa	58	13	Warren	91	9
Davis	26	3	Lucas	59	1	Washington	92	14
Decatur	27	1	Lyon	60	16	Wayne	93	1
Delaware	28	16	Madison	61	6	Webster	94	20
Des Moines	29	11	Mahaska	62	8	Winnebago	95	17
Dickinson	30	13	Marion	63	9	Winneshiek	96	9
Dubuque	31	11	Marshall	64	14	Woodbury	97	9
Emmet	21	16	Mills	65	9	Worth	98	16
Fayette	33	14	Mitchell	66	16	Wright	99	21

Source: Iowa Department of Transportation, "Quadrennial Needs Study on Highways, Roads and Streets for Study Years 1982-2001." Volume I, Table 5-A.

Table 4. 1982-2001 needs study cost area factors.

Cost area	Right-of-way	Grade and drain	Base and surface	Other	Maintenance	Administration
1	1.00	1.00	1.19	1.00	0.90	1.00
2	1.03	1.10	1.13	1.00	1.19	1.00
3	1.06	1.00	1.06	1.00	0.88	1.00
4	1.08	1.00	1.13	1.00	0.89	1.00
5	1.10	1.10	1.19	1.00	0.88	1.00
6	1.12	1.00	1.06	1.00	1.01	1.00
7	1.15	1.10	1.13	1.00	1.08	1.00
8	1.17	1.00	1.13	1.00	0.87	1.00
9	1.19	1.00	1.13	1.00	1.22	1.00
10	1.22	1.10	1.13	1.00	0.97	1.00
11	1.26	1.29	1.00	1.00	1.29	1.00
12	1.26	1.10	1.06	1.00	1.07	1.00
13	1.26	1.00	1.06	1.00	0.85	1.00
14	1.33	0.60	1.19	1.00	1.16	1.00
15	1.33	0.60	1.13	1.00	0.89	1.00
16	1.33	0.60	1.00	1.00	0.80	1.00
17	1.38	0.60	1.00	1.00	0.98	1.00
18	1.40	0.60	1.13	1.00	0.93	1.00
19	1.42	0.60	1.00	1.00	0.80	1.00
20	1.44	0.60	1.00	1.00	1.01	1.00
21	1.47	0.60	1.00	1.00	1.06	1.00
22	1.56	1.49	1.19	1.00	1.45	1.00
23	1.33	1.00	1.06	1.00	1.82	1.00

Source: Iowa Department of Transportation, "Quadrennial Need Study on Highways, Roads and Streets for Study Years 1982-2001." Volume I, Table 5-B.

Table 5. 1982-2001 needs study rural unit costs in 1982 dollars.

Highway group	Right-of-way and utility adjustment	Grade and drain	Base and surface	Miscellaneous	Engineering percent
		Improvement type 3 (Reconstruction/2-Lane)			
1	—	—	—	—	—
2	4,400	106,000	115,000	5,000	13.8
3	4,400	95,000	90,000	4,000	13.8
4	4,400	51,000	68,000	4,000	12.5
5	4,400	18,000	36,000	1,500	12.5
6	4,400	12,000	14,000	500	12.5
7	4,400	8,000	5,000	500	12.5
8	4,400	5,000	3,000	500	12.5
		Improvement type 9 (Resurfacing)			
1	—	17,000	71,000	11,000	13.8
2	—	3,000	32,000	3,000	13.8
3	—	—	26,000	1,000	13.8
4	—	—	24,000	1,000	12.5
5	—	—	21,000	500	12.5
6	—	—	14,000	500	12.5
7	—	—	5,000	500	12.5
8	—	—	3,000	500	12.5

Source: Iowa Department of Transportation, "Quadrennial Need Study on Highways, Roads and Streets for Study Years 1982-2001." Volume I, Tables 5-k and 5-M.

Hamilton County cost area number to be 21. The cost area factors for cost area 21 are underlined in table 4. For the base reconstruction costs, use improvement type 3 and the columns headed grade and drain, base and surface and miscellaneous in table 5. The steps to calculate the reconstruction cost for highway group number 6 are shown below.

Step 1 - Multiply the base grade and drain cost by the proper grade and drain factor:

$12,000 x 0.60 = $7,200 per lane mile (1)

Step 2 - Multiply the base solution base and surface cost by the proper base and surface factor:

$14,000 x 1.00 = $14,000 per lane mile (2)

Step 3 - Multiply the base miscellaneous cost by the proper miscellaneous factor. The miscellaneous cost factor is found under the column heading of Other in table 4:

$500 x 1.00 = $500 per lane mile (3)

Step 4 - Sum the resulting numbers together in equations 1-3:

$7,200 + $14,000 + $500 = $21,700 per lane mile (4)

Step 5 - Multiply the resulting number in equation 4 by the engineering percentage and add this to the total number in equation 4. The engineering percentage for this example is 12.5 percent:

($21,700 x 0.125) + $21,700 = $24,412.50 per lane mile (5)

Step 6 - Multiply the resulting number in equation 5 by the administrative percentage of 7 percent and add this to the number in equation 5. The administrative percentage of 7

percent is the same for all counties and highway group numbers:

($24,412.50 x 0.07) + $24,412.50 = $26,121 per lane mile (6)

The resulting number in equation 6 is rounded to the nearest dollar. This method of calculating reconstruction cost must be done for highway group numbers 3-8.

To calculate resurfacing costs, the same cost area factors are used as in calculating reconstruction costs. The base resurfacing figures are found in table 5 under improvement type 9. Use the columns headed Base and Surface and Miscellaneous for calculating resurfacing costs. The method of using the engineering and administrative percentages is the same as in calculating reconstruction costs. Again, the administrative percentage of 7 percent is the same for all counties and all highway group numbers. Table 6 summarizes the results of the reconstruction and resurfacing costs for the highway group numbers 3-8 in Hamilton County, Iowa.

Table 6. Reconstruction and resurfacing costs per lane mile by highway group number, Hamilton County, Iowa.

Highway group number	Reconstruction costs	Resurfacing costs
3	$183,687	$32,877
4	123,505	30,094
5	58,141	25,881
6	26,121	17,454
7	12,399	6,621
8	7,824	4,213

Other information to be included in the maintenance, reconstruction and resurfacing cost data are the number of years between reconstruction of gravel, dirt and paved roads and the number of years between resurfacing of gravel and paved roads. Table 7 shows the frequency which resurfacing and reconstruction costs can be charged to different types of roads.

Table 7. Frequency of road resurfacing and reconstruction by road surface in years.

Surface type	Frequency in years	
	Resurfacing	Reconstruction
Paved	15	50
Gravel	20	60
Dirt	—	60

The real interest rate, bridge maintenance cost per square foot, the per acre rental value of farmland in the county and the cost of converting the right-of-way into agricultural production are additional information needed in the maintenance, reconstruction and resurfacing data set. The per acre farmland rental values can be estimated in two steps. First, the crop reporting district average rental rate per acre is calculated as a percent of the average land value in the crop reporting district. To obtain the estimated per acre county land rent, the year's average county farmland value is multiplied by the percent

that the average crop reporting district rental rates are of farm land value.

The estimated value of the cost of converting the right-of-way into agricultural production by type of terrain is presented in table 8.

Table 8. Estimated values of converting the right-of-way into agricultural production by type of terrain.

Type of terrain	Cost per mile
Flat - minimal side ditch and grade	$ 700
Rolling - little if any end haul dirt to move	1,000
Flat - good cross section of ditches and center line profile	8,500
Rolling - substantial end haul, good cross section of center line profile and ditches	16,000

The bridge maintenance cost per square foot is the annual square foot cost of keeping the bridges in an "as is" condition.

The final data set concerns paved county roads. This data set is created only if the variable maintenance cost of paved roads is calculated based on kip loadings. Therefore, if variable paved maintenance cost is calculated using average daily traffic levels, skip this section and do not create this data set. The following information is required in the paved county road data set:

a) the beginning node of each paved county road segment

b) the ending node of each paved county road segment

c) whether the road segment is paved of rigid or flexible pavement.

d) the structural number or slab thickness of each paved county road segment

e) the design term of each paved county road segment

f) the average annual paved road variable maintenance cost.

If the road segment is rigid pavement, the slab thickness can be any integer between 6 and 11. The design term can be any number rounded to one decimal place between 6.5 and 13.9. If the road segment is of flexible pavement, the structural number can be any integer between 1 and 6, while the design term can be any number rounded to one decimal place between 2.0 and 4.7.

The basic assumption underlying the maintenance cost for a paved road is that a portion of the cost varies directly with the number of axle loadings passing on the road. Therefore, the first step in estimating the maintenance costs is to express all vehicles in terms of equivalent 18,000-pound (18-kip) axle loadings that the road would sustain through one pass by each vehicle.

Pavements are designed to withstand the projected number of 18-kip loadings during the expected life of the road, usually 20 years. An increase in the projected number of 18-kip loadings within a given period of time will increase the maintenance cost of the road surface.

The measure of pavement condition used is the Pavement Serviceability Index (PSI). This surface roughness index ranges from 5.0 downward to 0.0 with the upper limit being the indication of the best condition possible.

Tables 9 and 10 show the remaining 18-kip load applications a pavement can be expected to sustain before resurfacing is needed at PSI of 2.0. Therefore, if the pavement was assumed to be new at 4.5 PSI and needing resurfacing at 2.0, the values in tables 9 and 10 can be used as estimates of the total number of 18-kip loads the pavement can sustain before it needs resurfacing.

The columns in tables 9 and 10 headed "Design term" are the pavement structure indicators used to determine the number of loads a road can withstand before it requires resurfacing. The origin of the roughness measurement is the AASHO Road Test of 1958-60. Roughness measured in Pavement Serviceability Index (PSI) changes from a maximum of 5.0 to a selected value of 2.0 over time indicates an increase in roughness.

The design term relates the number of passes of a standard 18,000 pound axle load to the load carrying capacity of the various pavement layers. The design term indicates the number of standard axle loads that can pass over a pavement before the roughness (PSI) reaches 2.0 for each flexible or rigid pavement thickness. The design term for each paved road should be computed from pavement type and thickness information supplied by the county and the state department of transportation records.

Tables 11 and 12 present the traffic equivalence factors for single axle and tandem axles on rigid pavements. These tables indicate the 18-kip equivalence for a range of kip-loads on rigid pavements with slab thickness ranging from 6 to 11 inches.

Table 9. Remaining 18-kip applications to a rigid pavement in very good condition before resurfacing will be required at PSI = 2.0, in thousands of applications by alternative design terms.*

Design term	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
6.	—	--	--	—	—	780	868	964	1,069	1,184
7.	1,309	1,445	1,592	1,753	1,927	2,116	2,322	2,544	2,785	3,046
8.	3,327	3,632	3,961	4,316	4,700	5,112	5,558	6,035	6,549	7,102
9.	7,695	8,331	9,016	9,743	10,529	11,363	12,260	13,219	14,236	15,332
10.	16,489	17,730	19,046	20,450	21,943	23,523	25,212	26,996	28,900	30,917
11.	33,045	35,310	37,714	40,244	42,914	45,751	48,753	51,928	55,259	58,790
12.	62,503	66,435	70,550	74,920	79,488	84,333	89,392	94,733	100,369	106,243
13.	112,460	118,932	125,777	132,954	140,475	148,320	156,603	165,272	174,341	183,823

* Initial road PSI = 4.5

Source: American Association of State Highway Officials Committee on Transportation, Manual of Instructions for Pavement Evaluation Survey, August, 1962.

Table 10. Remaining 18-kip applications for a flexible pavement in very good condition before resurfacing will be required at PSI = 2.0 for alternative design terms.* **

Design term	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
2.	(416)	(656)	(1,021)	(1,530)	(2,271)	(3,315)	(4,763)	(6,746)	(9,428)	(13,309)
3.	18	24	32	42	55	71	92	117	148	189
4.	233	289	357	438	535	651	788	950	1,141	1,366
5.	1,629	1,937	2,294	2,712	3,196	3,758	4,406	5,154	6,014	7,003
6.	8,137	9,434	10,914	12,601	14,522	16,705	19,177	21,979	25,147	28,717
7.	32,745	37,264	42,346	48,037	54,424	61,555	69,515	78,406	88,280	99,293
8.	111,486	125,017	140,043	156,675	175,009	195,285	217,631	242,220	269,296	299,082

*Figures in parentheses are units; all others in thousands.
**Initial PSI = 4.2

Source: American Association of State Highway Officials Committee on Transport, Manual of Instructions for Pavements Evaluation Survey.

Table 11. Traffic equivalence factors for single axles on rigid pavement where PSI = 2.0

Axle load kips	Slab thickness in inches					
	6	7	8	9	10	11
2	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
4	0.002	0.002	0.002	0.002	0.002	0.002
6	0.01	0.01	0.01	0.01	0.01	0.01
8	0.03	0.03	0.03	0.03	0.03	0.03
10	0.09	0.08	0.08	0.08	0.08	0.08
12	0.19	0.18	0.18	0.18	0.17	0.17
14	0.35	0.35	0.34	0.34	0.34	0.34
16	0.61	0.61	0.60	0.60	0.60	0.60
18	1.00	1.00	1.00	1.00	1.00	1.00
20	1.55	1.56	1.57	1.58	1.58	1.59
22	2.32	2.32	2.35	2.38	2.40	2.41
24	3.37	3.34	3.40	3.47	3.51	3.53
26	4.76	4.69	4.77	4.88	4.97	5.02
28	6.59	6.44	6.52	6.70	6.85	6.94
30	8.92	8.68	8.74	8.98	9.23	9.39
32	11.87	11.49	11.51	11.82	12.17	12.44
34	15.55	15.00	14.95	15.30	15.78	16.18
36	20.07	19.30	19.16	19.53	20.14	20.71
38	25.56	34.54	24.26	24.63	25.36	26.14
40	32.18	30.85	30.41	30.75	31.58	32.57

Source: AASHO Interim Guide for Design of Pavement Structures, 1972.

Table 12. Traffic equivalence factors for tandem axles on rigid pavements where PSI = 2.0.

Axle load kips	Slab thickness in inches					
	6	7	8	9	10	11
10	0.01	0.01	0.01	0.01	0.01	0.01
12	0.03	0.03	0.03	0.03	0.03	0.03
14	0.05	0.05	0.05	0.05	0.05	0.05
16	0.09	0.08	0.08	0.08	0.08	0.08
18	0.14	0.14	0.13	0.13	0.13	0.13
20	0.22	0.21	0.21	0.20	0.20	0.20
22	0.32	0.31	0.31	0.30	0.30	0.30
24	0.45	0.45	0.44	0.44	0.44	0.44
26	0.63	0.64	0.62	0.62	0.62	0.62
28	0.85	0.85	0.85	0.85	0.85	0.85
30	1.13	1.13	1.14	1.14	1.14	1.14
32	1.48	1.45	1.49	1.50	1.51	1.51
34	1.91	1.90	1.93	1.95	1.96	1.97
36	2.42	2.41	2.45	2.49	2.51	2.52
38	3.04	3.02	3.07	3.13	3.17	3.19
40	3.79	3.74	3.80	3.89	3.95	3.98
42	4.67	4.59	4.66	4.78	4.87	4.93
44	5.72	5.59	5.67	5.82	5.95	6.03
46	6.94	6.76	6.83	7.02	7.20	7.31
48	8.36	8.12	8.17	8.40	8.63	8.79

Source: AASHO Interim Guide for Design of Pavement Structures, 1972.

Note: For tandem axle loads under 10 kips, the following equivalence factors were utilized: 0.0004 for 4 kips, 0.0014 for 6 kips, and 0.004 for 8 kips.

Tables 13 and 14 present the traffic equivalence factors for single axles and tandem axles on flexible pavements for selected kip loadings and structural numbers.

Table 15 indicates the number and type of axles and the loading on each axle for all vehicles used in the County Road Evaluation Program. This table, along with tables 11, 12, 13 and 14 yield the number of 18-kip equivalent loads that each vehicle applies to a pavement. The 18-kip equivalent number is multiplied by the vehicle yearly traffic level on the road to obtain the total number of 18-kip loadings the vehicle applies to the road. Summing over all vehicle types yields the annual number of 18-kip loadings applied to a road.

The Iowa Department of Transportation reports an average total annual paved road maintenance cost. This number is multiplied by the cost area factor in table 4 under the heading of Maintenance for your county's cost area number. The result is the average total annual paved road maintenance cost per mile for your county. Your county's annual paved road fixed maintenance cost per mile is subtracted from average total annual paved road maintenance cost per mile to yield the average annual paved road variable maintenance cost.

II. CREATING YOUR DATA SETS

Creating Your Network Data Set

To review, the following information is required for each type of arc in a rural road and bridge network:

a) a beginning node

b) an ending node

Table 13. Traffic equivalence factors for single axles on flexible pavement where PSI = 2.0.

Axle load kips	Structural number					
	1	2	3	4	5	6
2	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
4	0.002	0.003	0.002	0.002	0.002	0.002
6	0.01	0.01	0.01	0.01	0.01	0.01
8	0.03	0.04	0.04	0.03	0.03	0.03
10	0.08	0.08	0.09	0.08	0.08	0.08
12	0.16	0.18	0.19	0.18	0.17	0.17
14	0.32	0.34	0.35	0.35	0.34	0.33
16	0.59	0.60	0.61	0.61	0.60	0.60
18	1.00	1.00	1.00	1.00	1.00	1.00
20	1.61	1.59	1.56	1.55	1.57	1.60
22	2.49	2.44	2.35	2.31	2.35	2.41
24	3.71	3.62	3.43	3.33	3.40	3.51
26	5.36	5.21	4.88	4.68	4.77	4.96
28	7.54	7.31	6.78	6.42	6.52	6.83
30	10.38	10.03	9.24	8.65	8.73	9.17
32	14.00	13.51	12.37	11.46	11.48	12.17
34	18.55	17.87	16.30	14.97	14.87	15.63
36	24.20	23.30	21.16	19.28	19.02	19.93
38	31.14	29.95	27.12	24.55	24.03	25.10
40	39.57	38.02	34.34	30.92	30.04	31.25

Source: AASHO Interim Guide for Design of Pavement Structures, 1972.

Table 14. Traffic equivalence factors for tandem axles on flexible pavement where PSI = 2.0

Axle load kips*	Structural number					
	1	2	3	4	6	8
10	0.01	0.01	0.01	0.01	0.01	0.01
12	0.01	0.02	0.02	0.01	0.01	0.01
14	0.02	0.03	0.03	0.03	0.02	0.02
16	0.04	0.05	0.05	0.05	0.04	0.04
18	0.07	0.08	0.08	0.08	0.07	0.07
20	0.10	0.12	0.12	0.12	0.11	0.10
22	0.16	0.17	0.18	0.17	0.16	0.16
24	0.23	0.24	0.26	0.25	0.24	0.23
26	0.32	0.34	0.36	0.35	0.34	0.33
28	0.45	0.46	0.49	0.48	0.47	0.46
30	0.61	0.62	0.65	0.64	0.63	0.62
32	0.81	0.82	0.84	0.84	0.83	0.82
34	1.06	1.07	1.08	1.08	1.08	1.07
36	1.38	1.38	1.38	1.38	1.38	1.38
38	1.76	1.75	1.73	1.72	1.73	1.74
40	2.22	2.19	2.15	2.13	2.16	2.18
42	2.77	2.73	2.64	2.62	2.66	2.70
44	3.42	3.36	3.23	3.18	3.24	3.31
46	4.20	4.11	3.92	3.83	3.91	4.02
48	5.10	4.98	4.72	4.58	4.68	4.83

*For tandem axle loads under 10 kips, the following equivalence factors were utilized: 0.0004 for 4 kips, 0.0014 for 6 kips, and 0.004 for 8 kips.

Source: AASHO Interim Guide for Design of Pavement Structures, 1972.

Table 15. Vehicle axle weights by type of vehicle in pounds.

Vehicle Description	Number of axles	Individual axle loadings*					
		First	Second	Third	Fourth	Fifth	Sixth
Car	2	1,750	1,750	—	—	—	—
Commercial van	2	2,800	2,400	—	—	—	—
Pickup	2	1,750	1,750	—	—	—	—
Single axle truck-half loaded	2	6,150	13,300	—	—	—	—
Tandem axle truck-empty	2	6,900	11,700T	—	—	—	—
Tractor with equipment	3	3,800	12,800	4,000	—	—	—
Pickup with trailer	3	1,750	1,750	6,000T	—	—	—
Garbage truck	2	7,000	29,000T	—	—	—	—
Commercial semitrailer-empty	3	9,000	13,400T	9,500T	—	—	—
Tractor	2	3,800	12,800	—	—	—	—
Tractor with equipment	3	3,800	12,800	4,000	—	—	—
Combine, 2-row	2	8,000	3,000	—	—	—	—
Combine, 4-row	2	12,615	3,700	—	—	—	—
Combine, 6-row	2	13,926	4,640	—	—	—	—
Tractor with 125-bu. wagon-empty	4	3,800	12,800	500	500	—	—
Tractor with 250-bu. wagon-empty	4	3,800	12,800	520	520	—	—
Tractor with 350-bu. wagon-empty	4	3,800	12,800	730	730	—	—
Tractor with 450-bu. wagon-empty	4	3,800	12,800	1,070	1,070	—	—
Tractor with 550-bu. wagon-empty	4	3,800	12,800	2,190	2,190	—	—
Tractor with 2 350-bu. wagons-empty	6	3,800	12,800	730	730	730	730
Tractor with 2 450-bu. wagons-empty	6	3,800	12,800	1,070	1,070	1,070	1,070
Single axle truck with pup-empty	3	5,500	6,600	6,640T	—	—	—
Farm semitrailer-empty	3	9,000	13,400T	9,500T	—	—	—
Tandem axle truck with pup-empty	3	6,900	11,700T	6,640T	—	—	—
Single axle truck with 250-bu. wagon-empty	4	5,500	6,600	520	520	—	—
Single axle truck with 350-bu. wagon-empty	4	5,500	6,600	730	730	—	—
Tandem axle truck with 450-bu. wagon-empty	4	6,900	11,700T	1,070	1,070	—	—
Tractor with grain buggy-empty	3	3,800	12,800	7,240	—	—	—
Tandem axle truck with 550-bu. wagon-empty	4	6,900	11,700T	2,190	2,190	—	—
Tandem axle truck with 2 350-bu. wagon-empty	6	6,900	11,700T	730	730	730	730
Tandem axle truck with 2 450-bu. wagon-empty	6	6,900	11,700T	1,070	1,070	1,070	1,070
Commercial semitrailer-loaded	3	9,800	28,800T	29,400T	—	—	—
Tandem axle truck-loaded	2	20,000	34,000T	—	—	—	—
Farm semitrailer-loaded	3	9,800	33,000T	33,000T	—	—	—
Single axle truck with pup-loaded	3	6,800	20,000	24,000T	—	—	—
Tandem axle truck with pup-loaded	3	20,000	34,000T	24,000T	—	—	—
Tractor with 125-bu. wagon-loaded	4	3,800	12,800	4,000	4,000	—	—
Tractor with 250-bu. wagon-loaded	4	3,800	12,800	7,520	7,520	—	—
Tractor with auger wagon-loaded	3	3,800	12,800	20,000	—	—	—
Tractor with 350-bu. wagon-loaded	4	3,800	12,800	10,530	10,530	—	—
Tractor with 450-bu. wagon-loaded	4	3,800	12,800	13,670	13,670	—	—
Tractor with 550-bu. wagon-loaded	4	3,800	12,800	17,590	17,590	—	—
Tractor with 2 350-bu. wagons-loaded	6	3,800	12,800	10,530	10,530	10,530	10,530
Tractor with 2 450-bu. wagons-loaded	6	3,800	12,800	13,670	13,670	13,670	13,670
Single axle truck with 250-bu. wagon-loaded	4	6,800	20,000	7,520	7,520	—	—
Single axle truck with 350-bu. wagon-loaded	4	6,800	20,000	10,530	10,530	—	—
Tandem axle truck with 450-bu. wagon-loaded	4	18,660	34,000T	13,670	13,670	—	—
Tandem axle truck with 550-bu. wagon-loaded	4	14,820	30,000T	17,590	17,590	—	—
Tandem axle truck with 2 350-bu. wagons-loaded	6	10,000	27,880T	10,530	10,530	10,530	10,530
Tandem axle truck with 2 450-bu. wagons-loaded	6	10,000	15,000T	13,670	13,670	13,670	13,670

*T represents a tandem axle, otherwise the axle is a single axle.

Source: Baumel, C. Phillip, Cathy A. Hamlett and Gregory A. Pautsch, "The Economics of Reducing the County Road System: Three Case Studies in Iowa," University Research Program, Office of the Secretary, U.S. Department of Transportation, Washington, D.C., forthcoming.

c) a distance - this value must be an integer

d) a weight constraint - this is the weight of the heaviest vehicle able to travel over the arc. The value is expressed in tons and must be an integer.

e) a width constraint - this is the width of the widest vehicle able to travel over the arc. The value is expressed in feet and must be an integer.

f) the length of any bridge arc - if there is no bridge on the arc, set the value to zero. The value is expressed in feet and must be an integer.

g) the width of any bridge on the arc - if there is no bridge on the arc, set the value to zero. The width must be expressed in feet and be an integer.

h) a surface code.

The surface codes are shown in table 16.

Table 16. Surface codes for each type of arc.

Type of arc	Surface code
paved county arc	1
gravel county arc	2
dirt county arc	3
paved non-county arc	4
outside or highway arc	5
tract arc	6

The distance for all outside, highway and tract arcs is set to 10,000. Also, the weight and width constraints of the the outside highway and tract arcs must be set at a value so that all vehicles can travel over them.

The data set name for the network must be called Net. Each arc in the network requires one line of data. Worksheet 1 provides the proper data set format for the sample network presented in figure 1. The column fields are shown in table 17. All values must be justified to the right, so that only blanks precede the value in its column field.

Table 17. The column fields for the network data set in figure 1.

Information	Column field
Beginning node of the arc	1-5
Ending node of the arc	6-10
Distance of the arc	11-20
Weight constraint of the arc	21-30
Width constraint of the arc	31-40
Length of any bridge on the arc	41-45
Width of any bridge on the arc	46-50
Surface code of the arc	51-55

Creating Your Trip Information Data Set

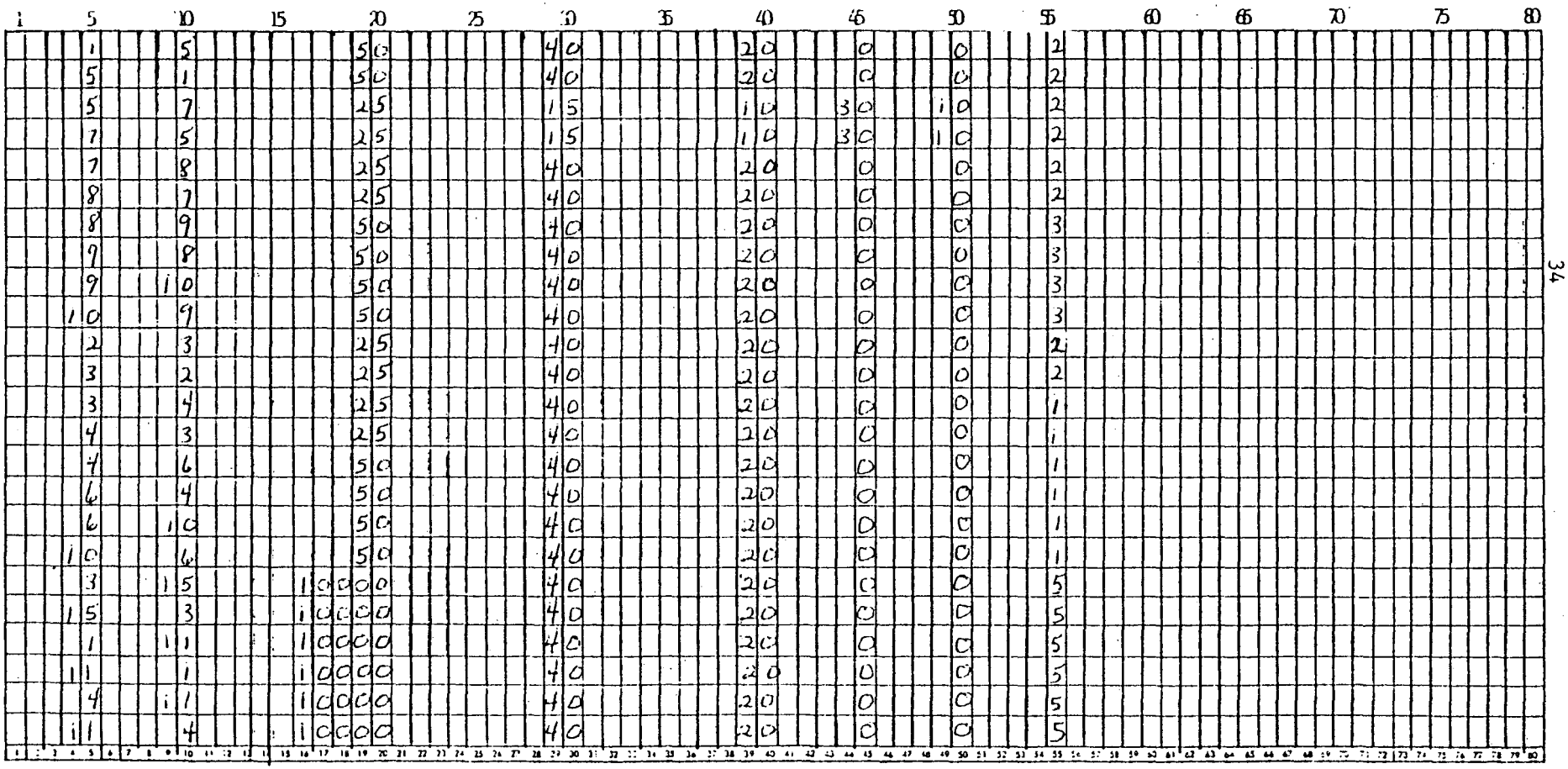
To review, the following information is required for all trips made in the study area:

a) the origin node number

b) the destination node number

Worksheet 1. The network data set format for the sample network presented in figure 1.

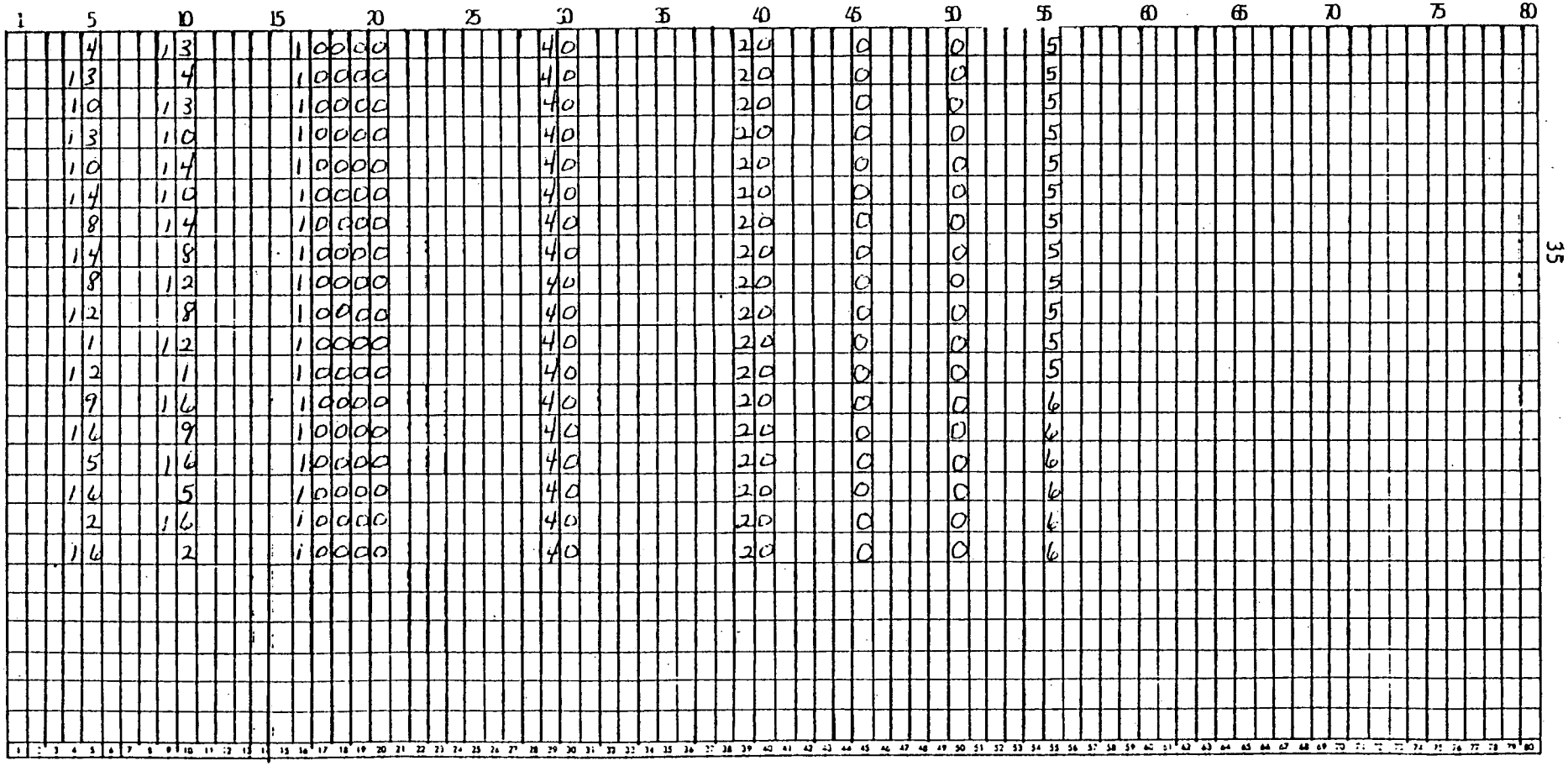
Data set name: Net



(Continued on following page)

Worksheet 1
(Continued)

Data set name: Net



c) the number of trips made in the year

c) the vehicle code number in table 1

The data set name for the trip information data set must be called Trip. The column fields for the data set are shown in table 18.

Table 18. The column fields for the trip information data set.

Information	Column field
Beginning node	1-10
Ending node	11-20
Number of trips	21-30
Vehicle code number	31-40

All values must be justified to the right so that only blanks precede the value in its column field. Worksheet 2 shows the proper trip information data set format for the coded travel information for the sample study area presented in table 2.

Creating Your Maintenance, Reconstruction and Resurfacing Costs Data Set

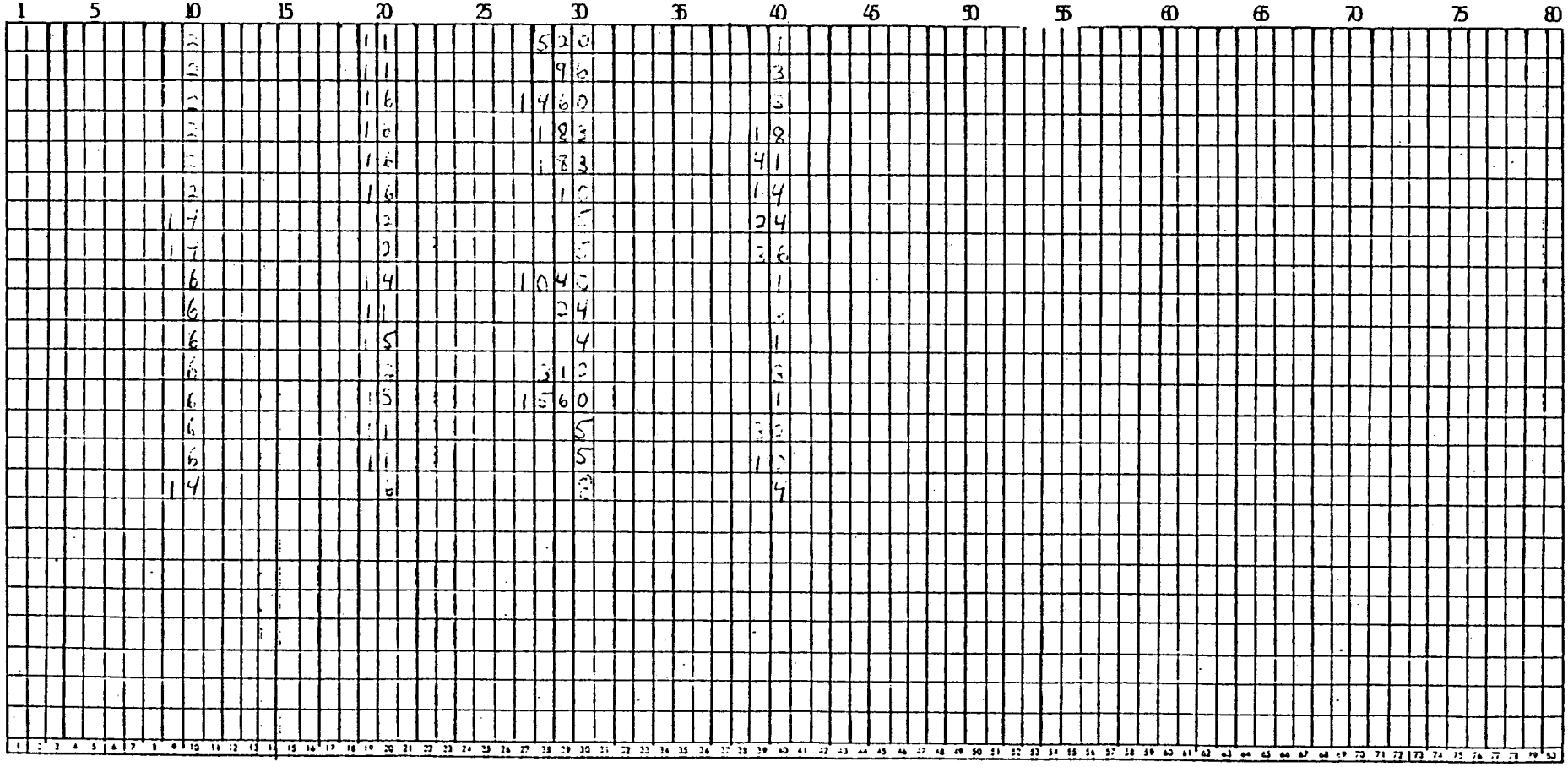
To review, the following information is required in the maintenance, reconstruction and resurfacing cost data set:

a) the fixed maintenance cost per mile of gravel, dirt and paved roads

b) the variable maintenance cost per mile of gravel, dirt and paved roads. Variable maintenance cost of a road is a function of the average daily traffic level of the road.

Worksheet 2. The data set format for the trip information presented in table 2.

Data set name: Trip



If variable maintenance cost is to be calculated using kip loadings, the variable paved maintenance cost is set to zero

c) the per lane mile reconstruction and resurfacing costs for highway group number 3-8 calculated with the latest version of the Iowa Need Study

d) the per acre rental value of farmland in the county in dollars

e) the cost per mile of converting the right-of-way into agricultural production

f) the real interest rate

g) the annual bridge maintenance cost per square foot to keep the bridges in an "as is" condition

h) the number of years between reconstruction for gravel, dirt and paved roads

i) the number of years between resurfacing for gravel and paved roads.

Table 19 shows the estimated values of the information required in the maintenance, reconstruction and resurfacing cost data set for Hamilton County, Iowa. The data set name for the maintenance, reconstruction and resurfacing cost data set is MRR. There are 10 lines in MRR, and each piece of information must be placed on a specific line and in a specific field of columns. Table 20 provides a list of the information required for each line and the specified field of columns where each piece of information is placed. Each piece of information is justified to the right in the column field, so there are only blanks preceding the number, not trailing the number in the column

Table 19. Estimated values of the data required in the maintenance, reconstruction and resurfacing cost data set for Hamilton County, Iowa.

Fixed maintenance cost per mile of road	
gravel	$2,376.00 per mile
dirt	2,206.00 per mile
paved	1,160.00 per mile
Variable maintenance cost per mile of road	
gravel	$4.70 per ADT
dirt	1.52 per ADT
paved	0.00 per ADT
The per lane mile reconstruction cost Highway Group Number	
3	$183,867.00 per lane mile
4	123,505.00 per lane mile
5	58,141.00 per lane mile
6	26,121.00 per lane mile
7	12,399.00 per lane mile
8	7,824.00 per lane mile
The per lane mile resurfacing cost Highway Group Number	
3	$32,877.00 per lane mile
4	30,094.00 per lane mile
5	25,881.00 per lane mile
6	17,454.00 per lane mile
7	6,621.00 per lane mile
8	4,213.00 per lane mile
The per acre rental value of farmland	140.91 per acre
The cost of converting right-of-way into agricultural production	$700.00 per mile
The real interest rate	5.6 percent
The annual bridge maintenance cost per square foot	$0.80
The number of years between reconstructions	
gravel	60 years
dirt	60 years
paved	50 years
The number of years between resurfacings	
gravel	20 years
paved	15 years

Table 20. Information required for each line and the specified columns for each piece of information in the data set MRR.

Line 1	Columns:	1-10	Fixed maintenance cost per mile of gravel road
		11-20	Fixed maintenance cost per mile of dirt road
		21-30	Fixed maintenance cost per mile of paved road
Line 2	Columns:	1-10	Variable maintenance cost per mile of gravel road
		11-20	Variable maintenance cost per mile of dirt road
		21-30	Variable maintenance cost per mile of paved road
Line 3	Columns:	1-15	Reconstruction cost per lane mile of highway group 3
		16-30	Resurfacing cost per lane mile of highway group 3
Line 4	Columns:	1-15	Reconstruction cost per lane mile of highway group 4
		16-30	Resurfacing cost per lane mile of highway group 4
Line 5	Columns:	1-15	Reconstruction cost per lane mile of highway group 5
		16-30	Resurfacing cost per lane mile of highway group 5
Line 6	Columns:	1-15	Reconstruction cost per lane mile of highway group 6
		16-30	Resurfacing cost per lane mile of highway group 6
Line 7	Columns:	1-15	Reconstruction cost per lane mile of highway group 7
		16-30	Resurfacing cost per lane mile of highway group 7
Line 8	Columns:	1-15	Reconstruction cost per lane mile of highway group 8
		16-30	Resurfacing cost per lane mile of highway group 8
Line 9	Columns:	1-10	The per acre rental value of farmland
		11-20	The cost of converting the right-of-way to farm land
		21-25	The annual bridge maintenance cost per square foot
		26-30	The interest rate
Line 10	Columns:	1-5	The number of years between reconstruction of gravel roads
		6-10	The number of years between reconstruction of dirt roads
		11-15	The number of years between reconstruction of paved roads
		16-20	The number of years between resurfacings of gravel roads
		21-25	The number of years between resurfacings of paved roads

field. Worksheet 3 presents the format of the data set MRR for information presented in table 19.

Creating Your Vehicle Grouping Data Set

To review, the following information is required for each vehicle grouping:

a) the representative weight. This value is expressed in tons and must be an integer.

b) the representative width. This value is expressed in feet and must be an integer.

c) the representative ratio of cost per mile of travel over a gravel surface to a paved surface. This value must be rounded to two decimal places.

d) the representative ratio of cost per mile of travel over a dirt surface to a paved surface. This value must be rounded to two decimal places.

e) the total number of vehicles in the grouping. The number of vehicles in a grouping cannot exceed 15.

Other information included in this data set is the total number of vehicle groupings, the vehicle code numbers and the variable cost per mile of traveling over a paved surface. The variable cost in cents per mile of traveling over a paved surface is rounded to one decimal place.

The vehicle grouping data set must be named Vehgroup. Each vehicle grouping requires 3 lines of data. Table 21 provides a list of the information required for each line and the specified field of

Worksheet 3. Using Hamilton County as an example, the maintenance, reconstruction and resurfacing data set.

Data set name: MRR

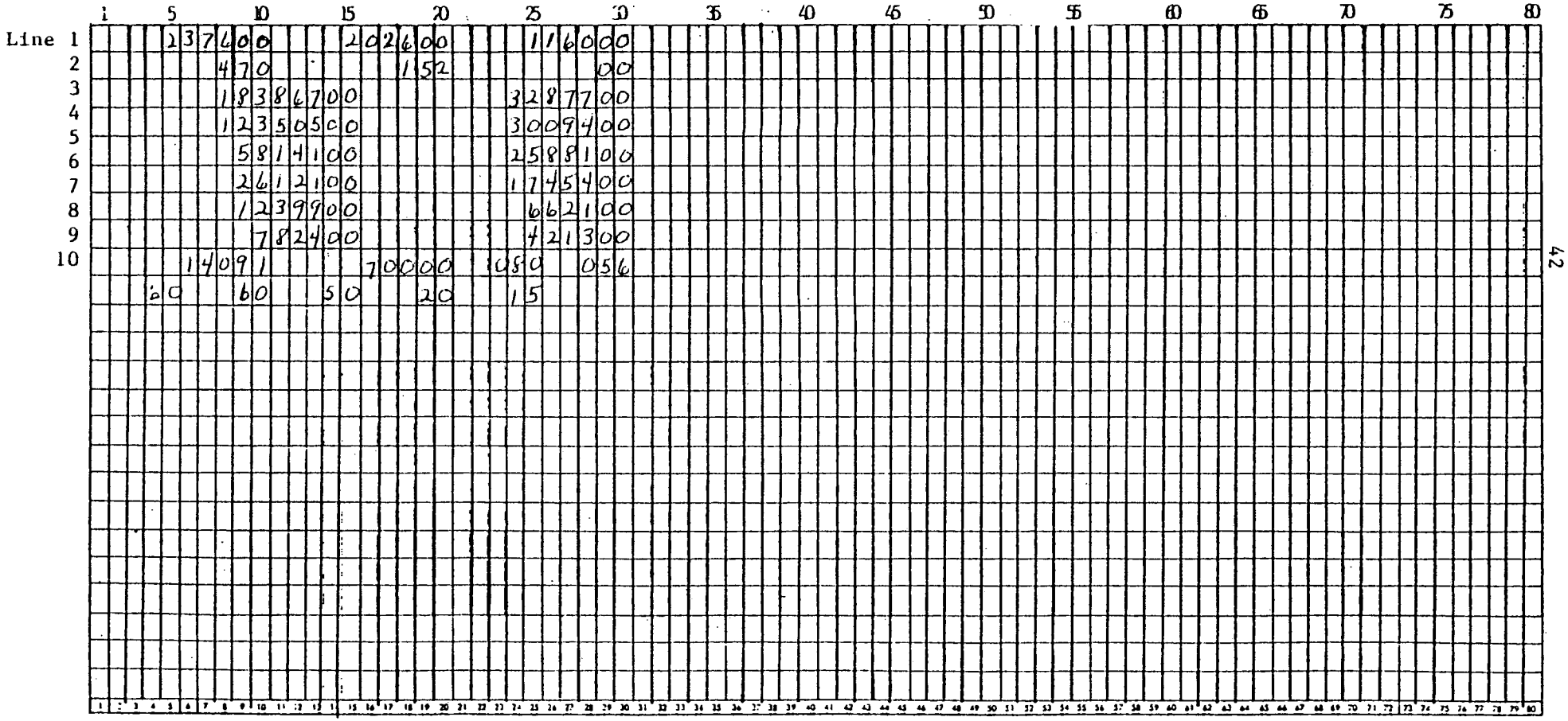


Table 21. The information required for each line and the specified columns for each piece of information in the data set Vehgroup.

Line 1	Columns:	1-75	the number of vehicle groupings
Line 2	Columns:	1-15	the representative weight for grouping 1
		16-30	the representative width for grouping 1
		31-45	the representative ratio of cost per mile of travel over a gravel surface to a paved surface for grouping 1
		46-60	the representative ratio of cost per mile of travel over a dirt surface to a paved surface for grouping 1
		61-75	the total number of vehicles in grouping 1
Line 3	Columns:	1-5	the first vehicle code number in grouping 1
		6-10	the second vehicle code number in grouping 1
		11-15	the third vehicle code number in grouping 1
		16-20	the fourth vehicle code number in grouping 1
		21-25	the fifth vehicle code number in grouping 1
		26-30	the sixth vehicle code number in grouping 1
		31-35	the seventh vehicle code number in grouping 1
		36-40	the eighth vehicle code number in grouping 1
		41-45	the ninth vehicle code number in grouping 1
		46-50	the tenth vehicle code number in grouping 1
		51-55	the eleventh vehicle code number in grouping 1
		56-60	the twelth vehicle code number in grouping 1
		61-65	the thirteenth vehicle code number in grouping 1
		66-70	the fourteenth vehicle code number in grouping 1
		71-75	the fifteenth vehicle code number in grouping 1
Line 4	Columns:	1-5	the first vehicle's variable cost per mile of traveling over a paved surface in grouping 1
		6-10	the second vehicle's variable cost per mile of traveling over a paved surface in grouping 1
		.	
		.	
		.	
		71-75	the fifteenth vehicles's variable cost per mile of traveling over a paved surface in grouping 1

Line 5 - pertains to vehicle grouping 2 and is formatted the same as Line 2

Line 6 - pertains to vehicle grouping 2 and is formatted the same as Line 3

Line 7 - pertains to vehicle grouping 2 and is formatted the same as Line 4

Line 8 - pertains to vehicle grouping 3 and is formatted the same as Line 2

Line 9 - pertains to vehicle grouping 3 and is formatted the same as Line 3

Line 10- pertains to vehicle grouping 3 and is formatted the same as Line 4

columns where each piece of information is placed. The number of vehicle groupings can be any value. As the number of vehicle groupings increases, the number of data lines in Vehgroup increases. For example, suppose an automobile, a commercial van, a pickup and a pickup pulling a trailer comprise one vehicle grouping while a loaded tandem axle truck, a loaded commercial semitrailer and a loaded farm semitrailer comprise another vehicle grouping. Table 22 provides a list of the relevant information pertaining to each vehicle grouping. Worksheet 4 presents the format of the data set Vehgroup for the information presented in table 22.

Creating Your Paved County Road Data Set

To review, the following information is required in the paved county road data set:

a) the beginning node of each county road segment

b) the ending node of each paved county road segment

c) whether the road segment is paved or rigid or flexible pavement

d) the structural number or slab thickness of each paved county road segment

e) the design term of each paved county road segment

f) the average annual paved road variable maintenance cost

The data set name for the paved county road data set must be called Pavement. Table 23 provides a list of the information required for each line and the specified field of columns where each piece of

Table 22. An example of vehicle grouping information.

Vehicle group	Description	Value
1	Representative weight	4 tons
	Representative width	6 feet
	Representative ratio of cost in cents per mile of travel over a gravel surface to a paved surface	1.39
	Representative ratio of cost in cents per mile of travel over a dirt surface to a paved surface	1.77
	Total number of vehicles	4
	Vehicle cost in cents per mile of travel over a paved surface	
	Code Vehicle	
	1 Automobile	20.2
	2 Commercial van	40.2
	3 Pickup	24.4
	8 Pickup pulling trailer	35.3
2	Representative weight	40 tons
	Representative width	8 feet
	Representative ratio of cost in cents per mile of travel over a gravel surface to a paved surface	1.48
	Representative ratio of cost per mile of travel over a dirt surface to a paved surface	1.96
	Total number of vehicles	3
	Vehicle cost in cents per mile of travel over a paved surface	
	Code Vehicle	
	33 Loaded tandem axle truck	42.4
	34 Loaded farm semitrailer	37.4
	32 Loaded commercial semitrailer	55.4

Worksheet 4. The proper data set format for the vehicle grouping information presented in table 14.

Data set name: Vehgroup

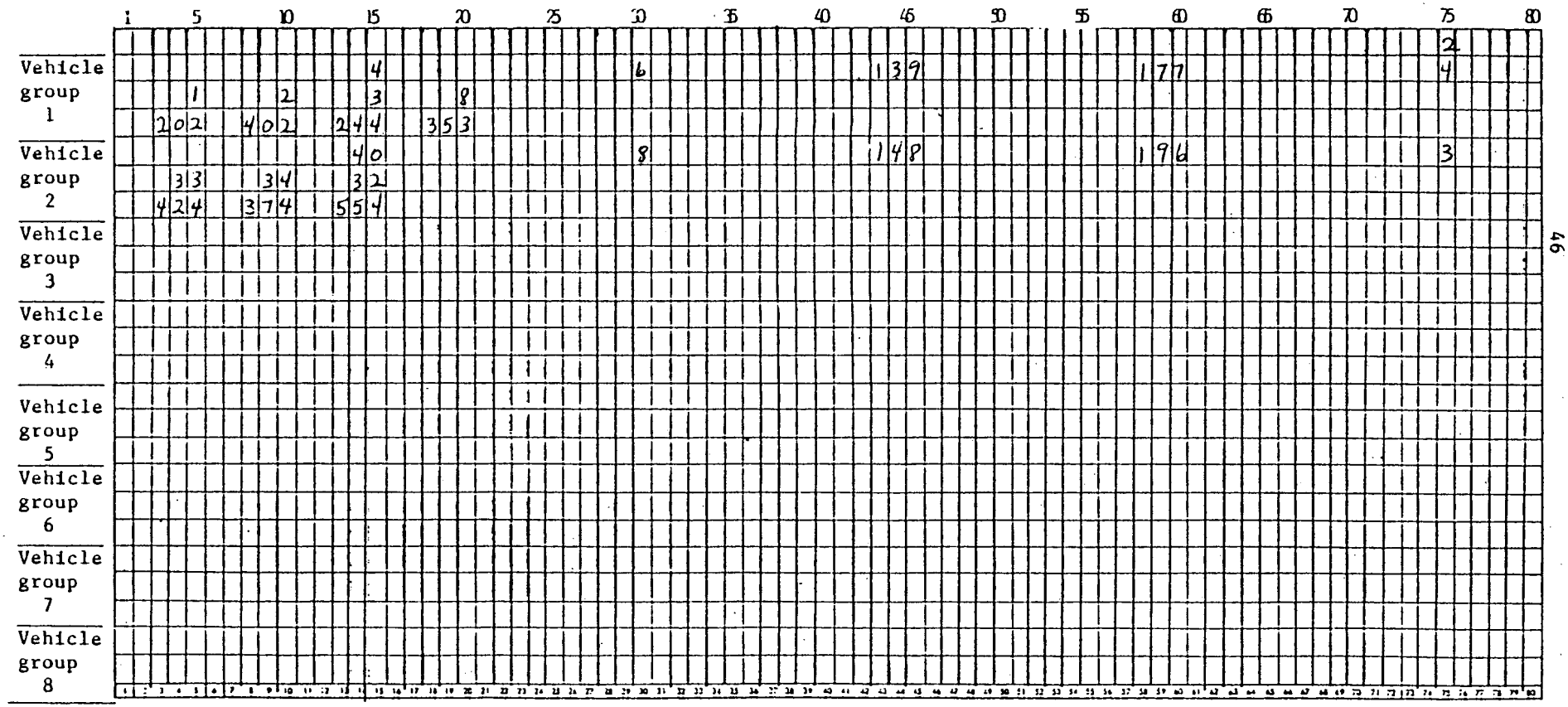


Table 23. Information required for each line and the specified columns for each piece of information in the data set Pavement.

Line	Columns	Information
1	1-25	the average annual paved road variable maintenance cost
2	1-5	the beginning node of the first paved county road segment
	6-10	the ending node of the first paved road county road segment
	15	"T" if the road segment pavement is rigid, or "F" if the road segment pavement is flexible
	16-20	the structural number if the road segment pavement is flexible, or the slab thickness if the road segment is rigid
	21-25	the design term of the paved county road segment
3		pertains to the next paved county road segment and is formatted the same as Line 2.

information is placed. If a road segment is paved of rigid pavement, a "T" is placed in column 15, while a road segment of flexible pavement has an "F" placed in column 15. The number of data lines in the data set Pavement depends on the number of paved county road segments in the study area. Table 24 provides an example of the information for the paved county roads in the sample network presented in figure 1. Worksheet 5 provides an example of the proper data set format for the data set Pavement using the paved county road information presented in table 24.

Table 24. An example of the information for the paved county roads in the study area presented in figure 1.

Road segment			Slab thickness or	
Beginning node	Ending node	Pavement	structural number	Design term
3	4	flexible	1	2.1
4	6	rigid	6	6.6
6	10	rigid	7	6.5
Average annual paved road maintenance cost - $170.65				

III. HOW TO RUN THE COUNTY ROAD EVALUATION PROGRAM

The disk provides three data sets and the execute files. The three data sets, NAMES, TABLES and VEHICLES, along with the user created data sets should be placed in the fixed disk of your microcomputer. The three execute files are named: PASS1.EXE, PASS2.EXE and PASS3.EXE, respectively.

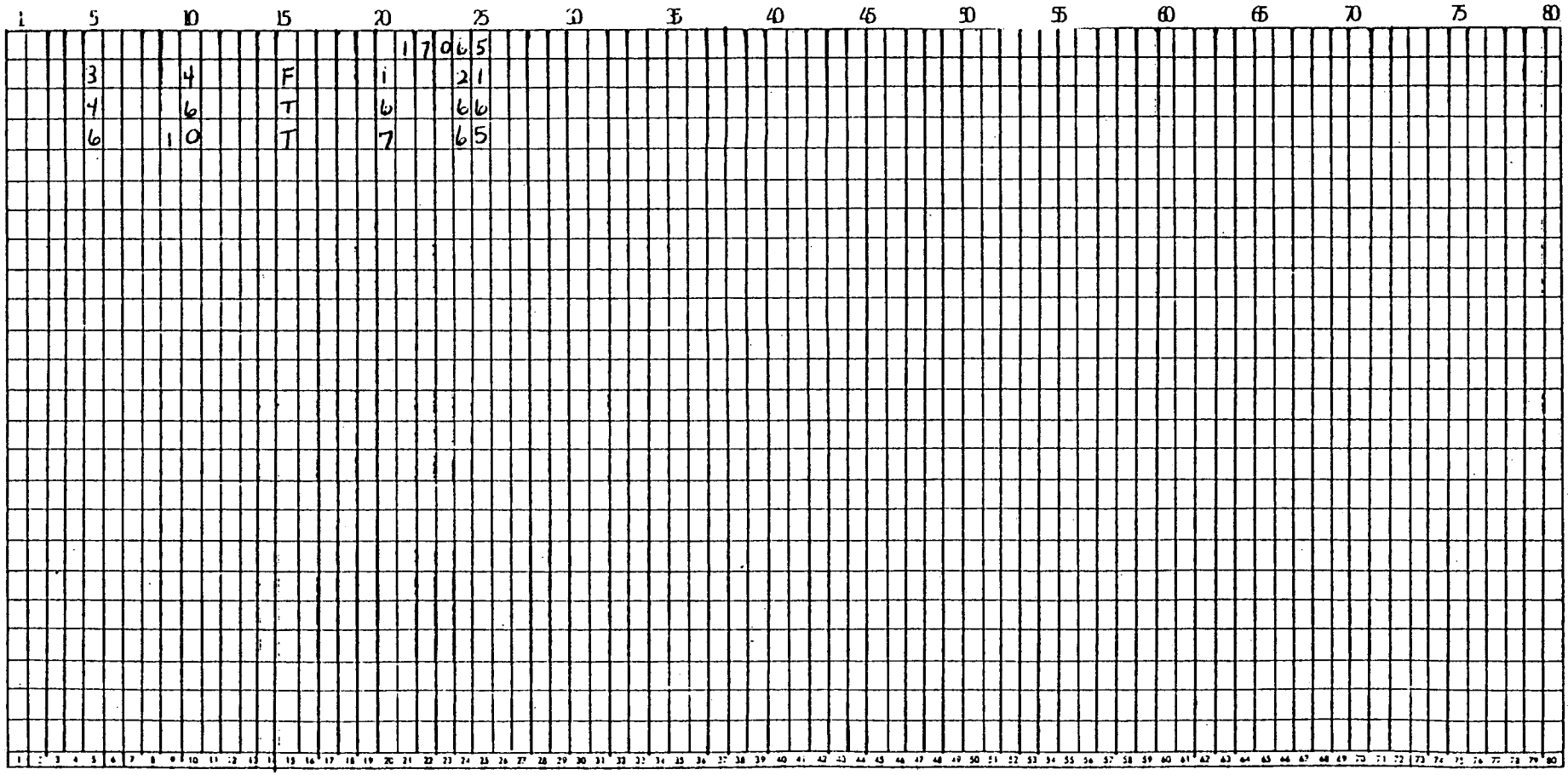
To begin the County Road Evaluation Program, type PASS1 on the keyboard. The following question will appear on the screen:

>IS THIS RUN FOR THE BASE SOLUTION? (Y/N)

If the base solution is to be run, i.e. with all the roads in the network, type Y for yes. If a reduced solution is to be run with one or more roads abandoned or converted to private drives, type N for no.

Worksheet 5. The proper data set format for the paved county road information presented in table 23.

Data set name: Pavement



Running a Base Solution

After typing Y to the first question, the following question will appear on the screen:

>ENTER THE NAME OF YOUR STUDY AREA

The study area name must start with a letter and consist of no more than 15 characters. Simply type in the study area name on the keyboard. When PASS1 is completed, the following message will appear:

>PASS ONE COMPLETED

After this message appears on the screen, type PASS2 on the keyboard. The following message will appear when PASS2 is completed:

>PASS TWO COMPLETED

After this message appears on the screen, type PASS3 on the keyboard. The following message will appear on the screen when PASS3 is completed:

>PASS THREE COMPLETED

The output of the base solution is found in the data set called RESULTS.

Running a Reduced Solution

After typing N to the first question, the following question will appear on the screen:

>ENTER THE NUMBER OF ROAD SEGMENTS TO BE ABANDONED

Type in the number of road segments to be abandoned. If there are no road segments are to be abandoned, type zero. The computer will then ask for the beginning node (BN) and the ending node (EN) for each road segment abandoned. Type in the BN and EN for only one of the arcs

representing the road segment, not both. Remember that each road segment is represented by two arcs. For example, the road segment connecting node 1 to node 5 in Figure 1 is represented by an arc with a beginning node of 1 and an ending node of 5 and by an arc with a beginning node of 5 and an ending node of 1. If the road segment connecting node 1 to node 5 is to be abandoned, then type in the BN and EN for only one of the arcs, but not both. After typing in the BN and EN for all the abandoned road segments, the following question will appear on the screen:

>ARE THERE ANY ROAD SEGMENTS TO BE CONVERTED TO PRIVATE DRIVES? (Y/N)

Type Y for yes if there are any road segments to be converted to private drives. Type N for no if there are not any road segments to be converted to private drives. If there are road segments to be converted to private drives, the following series of questions will appear on the screen:

>ENTER THE NUMBER OF ROAD SEGMENTS TO BE CONVERTED TO PRIVATE DRIVES

Type in the number of road segments to be converted to private drives. The total number of road segments converted to private drives cannot exceed 22. The computer will ask for the beginning node (BN) and ending node (EN) for each converted road segment. Again, type in the BN and EN for only one of the arcs representing the road segment. The computer will then ask for the private drive maintenance code for each converted road segment. Table 25 presents the values of the private drive maintenance cost code by type of access. After completing these questions, the following message will appear on the screen:

>PASS ONE COMPLETED

Table 25. Private drive maintenance cost code by type of access.

Type of access	Private drive maintenance cost code
Residence only	1
Small to medium farm	2
Large farm	3
Field access only	4

After this message appears on the screen, type PASS2 on the keyboard.

The following message will appear on the screen when PASS2 is completed:

>PASS TWO COMPLETED

After this message appears, type PASS3 on the keyboard. Each reduced solution must be compared with a previous solution, either the base solution or a different reduced solution. The computer will then ask the following series of questions concerning the previous solution:

>ENTER THE TOTAL VARIABLE MAINTENANCE COST FROM THE PREVIOUS SOLUTION

>ENTER THE TOTAL FIXED MAINTENANCE COST FROM THE PREVIOUS SOLUTION

>ENTER THE TOTAL RECONSTRUCTION COST FROM THE PREVIOUS SOLUTION

>ENTER THE TOTAL RESURFACING COST FROM THE PREVIOUS SOLUTION

>ENTER THE TOTAL VALUE OF LAND FROM THE PREVIOUS SOLUTION

>ENTER THE TOTAL BRIDGE MAINTENANCE COST FROM THE PREVIOUS SOLUTION

>ENTER THE TOTAL TRAVEL COST FROM THE PREVIOUS SOLUTION

>ENTER THE PRIVATE DRIVE MAINTENANCE COST FROM THE PREVIOUS SOLUTION

>ENTER THE PRIVATE DRIVE RECONSTRUCTION COST FROM THE PREVIOUS SOLUTION

>ENTER THE PRIVATE DRIVE BRIDGE MAINTENANCE COST FROM THE PREVIOUS SOLUTION.

All of the information from the previous solution is found in the output for that solution. After typing in this information, the following message will appear on the screen:

>PASS THREE COMPLETED

The output of a reduced solution is found in the data set called RESULTS.

RESULTS

A sample of a base solution output is presented in Appendix 1. A sample copy of a reduced solution and calculation of a benefit-cost ratio is presented in Appendix 2. A printout of the computer program is presented in Appendix 3.

Appendix 1
A sample of a base solution output

STUDY AREA NAME IS HAMILTON 3X3

THE BASE SOLUTION

BN	EN	YEARLY TRAFFIC	ADT
1	2	8209	22.49
1	20	15017	41.14
1	101	920	2.52
1	119	14857	40.70
1	122	7532	20.64
2	3	8334	22.83
2	83	56	.15
2	84	56	.15
2	119	0	.00
3	4	8766	24.02
3	57	432	1.18
4	5	21866	59.91
4	59	8	.02
4	60	0	.00
4	119	13092	35.87
5	6	2916	7.99
5	17	11683	32.01
5	56	298	.82
5	58	286	.78
5	82	377	1.03
6	7	8036	22.02
6	15	5472	14.99
7	8	3538	9.69
7	50	223	.61
7	99	2705	7.41
7	119	10004	27.41
8	9	3538	9.69
9	10	3374	9.24
9	113	0	.00
9	120	1772	4.85
10	11	2912	7.98
10	50	30	.08
10	51	216	.59
10	100	536	1.47
11	12	588	1.61
11	22	2996	8.21
11	112	236	.65
12	13	840	2.30
12	54	0	.00
12	106	252	.69
13	14	840	2.30
13	54	0	.00
13	72	0	.00
14	15	5484	15.02
14	16	1512	4.14
14	31	6912	18.94

14	54	60	.16
14	73	0	.00
15	53	1736	4.76
15	54	1734	4.75
15	82	40	.11
16	17	9613	26.34
16	18	7572	20.75
16	69	1312	3.59
16	114	1331	3.65
17	53	2550	6.99
17	58	0	.00
17	110	2153	5.90
17	111	823	2.25
18	19	7446	20.40
18	21	390	1.07
19	20	4302	11.79
19	55	1506	4.13
19	62	2948	8.08
19	63	3036	8.32
19	107	296	.81
20	47	17458	47.83
20	62	1864	5.11
20	103	426	1.17
20	104	204	.56
21	69	62	.17
21	116	372	1.02
21	117	194	.53
22	81	534	1.46
22	106	510	1.40
23	24	8919	24.44
23	46	8100	22.19
23	47	12702	34.80
23	64	214	.59
23	66	1552	4.25
23	80	484	1.33
23	122	3961	10.85
24	25	9942	27.24
24	52	223	.61
24	64	0	.00
24	74	50	.14
25	26	9942	27.24
26	27	7034	19.27
26	28	1747	4.79
26	44	3687	10.10
26	67	558	1.53
27	65	6356	17.41
27	67	2684	7.35
28	29	1271	3.48
28	89	610	1.67
29	30	6782	18.58
29	32	1171	3.21
29	39	6808	18.65
30	31	6868	18.82
30	97	236	.65

30	105	322	.88
31	73	138	.38
31	115	182	.50
32	33	1042	2.85
32	70	421	1.15
32	97	348	.95
33	31	428	1.17
33	35	550	1.51
33	61	192	.53
33	71	250	.68
34	98	428	1.17
35	36	734	2.01
35	70	432	1.19
36	37	4503	12.31
36	85	56	.15
36	95	2132	5.84
36	120	1806	4.95
36	121	1273	3.49
37	38	6794	18.61
37	72	557	1.53
37	75	346	.95
37	76	1602	4.39
37	96	3708	10.16
38	39	6116	16.76
38	40	9755	26.73
38	121	9547	26.16
39	70	467	1.28
39	72	1103	3.02
39	86	82	.22
39	89	482	1.32
39	118	172	.47
40	41	6738	18.46
40	77	3412	9.35
40	86	314	.86
40	92	132	.36
40	93	206	.56
41	42	8265	22.64
41	77	112	.31
41	92	2428	6.65
42	43	1512	4.14
42	45	7229	19.81
42	87	810	2.22
43	44	1594	4.37
43	77	111	.30
44	68	1118	3.06
44	74	182	.50
44	77	166	.45
44	88	70	.19
45	46	17792	48.75
45	78	5530	15.15
45	79	2860	7.84
45	87	988	2.71
45	88	66	.18

45	90	2769	7.59
45	91	280	.77
45	94	120	.33
45	109	182	.50
46	80	127	.35
46	108	300	.82
46	121	4923	13.49
46	123	7622	20.88
47	48	14	.04
47	49	1966	5.39
47	102	1501	4.11
47	122	3645	9.99
48	49	0	.00
48	120	4	.01

VEHICLE CODE NUMBER	ANNUAL DISTANCE IN MILES	ANNUAL COST
1	76475.00	$ 18780.11
2	2803.00	1299.67
3	52811.00	15853.00
4	2765.25	1118.50
5	1191.00	583.50
7	487.00	626.07
8	1941.50	792.48
9	42.00	42.98
10	133.50	72.51
11	2029.00	2590.80
12	3350.00	4352.05
13	31.50	33.07
15	463.50	737.92
16	138.50	246.54
17	.00	.00
18	391.75	492.14
19	613.25	776.90
20	264.00	388.52
21	245.25	359.77
22	213.50	308.61
23	11.00	17.01
24	.00	.00
25	11.50	4.70
26	.00	.00
27	53.00	28.61
28	205.50	112.80
29	.00	.00
30	.00	.00
31	.00	.00
32	.00	.00
33	.00	.00
40	133.50	78.21
41	1319.00	741.46
45	11.50	5.25
46	.00	.00
47	.00	.00
48	.00	.00

49	416.75	557.50
50	.00	.00
51	613.25	843.88
52	244.00	432.43
53	245.25	403.30
54	213.50	348.42
55	11.00	20.09
56	53.00	27.69
57	205.50	109.14
58	.00	.00
59	.00	.00
60	.00	.00
61	.00	.00
TOTAL	150054.80	$ 53185.70

BN	EN	ANNUAL VM	ANNUAL FM	ANNUAL RECON	ANNUAL RESURF
5	17	$ 75.22	$1188.00	$ 505.24	$ 393.44
4	15	35.23	1188.00	455.47	355.47
9	10	21.72	1188.00	455.47	355.47
10	11	18.75	1188.00	455.47	355.47
11	12	3.79	1188.00	455.47	355.47
11	22	9.64	594.00	227.73	177.74
12	13	2.70	594.00	227.73	177.74
13	14	2.70	594.00	227.73	177.74
14	15	35.31	1188.00	455.47	355.47
14	16	9.73	1188.00	455.47	355.47
14	31	22.35	594.00	227.73	177.74
16	17	61.89	1188.00	464.96	362.72
16	18	48.75	1188.00	455.47	355.47
18	19	47.94	1188.00	455.47	355.47
18	21	1.26	594.00	227.73	177.74
19	20	27.70	1188.00	455.47	355.47
23	24	57.42	1188.00	455.47	355.47
24	25	32.01	594.00	235.68	183.80
25	26	32.01	594.00	235.68	183.80
26	27	22.64	594.00	227.73	177.74
26	28	11.25	1188.00	455.47	355.47
26	44	23.74	1188.00	455.47	355.47
28	29	8.18	1188.00	455.47	355.47
29	30	43.66	1188.00	455.47	355.47
29	32	7.54	1188.00	455.47	355.47
29	39	43.83	1188.00	455.47	355.47

30	31	22.11	594.00	227.73	177.74
32	33	6.71	1188.00	455.47	355.47
33	34	1.38	594.00	227.73	177.74
33	35	3.54	1188.00	455.47	355.47
35	36	4.73	1188.00	455.47	355.47
36	37	28.99	1188.00	455.47	355.47
37	38	43.74	1188.00	455.47	355.47
38	39	39.38	1188.00	455.47	355.47
38	40	62.81	1188.00	467.73	364.82
40	41	21.69	594.00	227.73	177.74
41	42	26.61	594.00	227.73	177.74
42	43	4.87	594.00	227.73	177.74
42	45	46.54	1188.00	455.47	355.47
43	44	5.13	594.00	227.73	177.74
45	46	114.55	1188.00	624.11	484.12
TOTAL		$ 1139.64	$40392.00	$15741.94	$12281.38

TOTAL BRIDGE MAINTENANCE COST	$	.00
TOTAL VALUE OF LAND		.00
TOTAL PRIVATE DRIVE MAINTENANCE COST		.00
TOTAL PRIVATE DRIVE RECONSTRUCTION COST		.00
TOTAL PRIVATE DRIVE BRIDGE MAINTENANCE COST		.00

Appendix 2
A sample copy of reduced solution.

STUDY AREA NAME IS HAMILTON 3X3

THE REDUCED SOLUTION

THE ABANDONED ROAD SEGMENTS

11	12
12	13
13	14
32	33
43	44
28	29

THE ROAD SEGMENTS CONVERTED TO PRIVATE OWNERSHIP

23	24
24	25
25	26
26	27
26	28
26	44
42	43
29	32
18	21

BN	EN	YEARLY TRAFFIC	ADT
1	2	8448	23.15
1	20	15161	41.54
1	101	920	2.52
1	119	14857	40.70
1	122	7628	20.90
2	3	8574	23.49
2	83	56	.15
2	84	56	.15
2	119	0	.00
3	4	9006	24.67
3	57	432	1.18
4	5	22106	60.56
4	59	8	.02
4	60	0	.00
4	119	13092	35.87
5	6	3356	9.19
5	17	11883	32.56
5	56	298	.82
5	58	286	.78
5	82	377	1.03
6	7	9192	25.18
6	15	6188	16.95
7	8	4694	12.86
7	50	223	.61
7	99	2705	7.41

7	119	10004	27.41
8	9	4694	12.86
9	10	4214	11.55
9	113	0	.00
9	120	2088	5.72
10	11	3492	9.57
10	50	30	.08
10	51	216	.59
10	100	536	1.47
11	12	0	.00
11	22	3248	8.90
11	112	236	.65
12	13	0	.00
12	54	0	.00
12	106	0	.00
13	14	0	.00
13	54	0	.00
13	73	0	.00
14	15	6200	16.99
14	16	1189	3.26
14	31	7345	20.12
14	54	60	.16
14	73	0	.00
15	53	1736	4.76
15	54	1734	4.75
15	82	40	.11
16	17	9813	26.88
16	18	7449	20.41
16	69	1312	3.59
16	114	1331	3.65
17	53	2550	6.99
17	58	0	.00
17	110	2153	5.90
17	111	823	2.25
18	19	7323	20.06
18	21	390	1.07
19	20	4179	11.45
19	55	1506	4.13
19	62	2948	8.08
19	63	3036	8.32
19	107	296	.81
20	47	17479	47.89
20	62	1864	5.11
20	103	426	1.17
20	104	204	.56
21	69	62	.17
21	116	372	1.02
21	117	194	.53
22	81	534	1.46
22	106	762	2.09
23	24	9012	24.69
23	46	9548	26.16
23	47	12707	34.81
23	64	214	.59
23	66	1552	4.25
23	90	484	1.33
23	122	3221	8.82
24	25	9805	26.86
24	52	223	.61
24	64	0	.00
24	74	232	.64

25	26	9805	26.86
26	27	7034	19.27
26	28	124	.34
26	44	4287	11.75
26	67	558	1.53
27	65	6356	17.41
27	67	2684	7.35
28	29	0	.00
28	89	150	.41
29	30	6683	18.31
29	32	511	1.40
29	39	6440	17.64
30	31	7301	20.00
30	97	560	1.53
30	105	322	.88
31	73	138	.38
31	115	182	.50
32	33	0	.00
32	70	209	.57
32	97	24	.07
33	34	428	1.17
33	35	870	2.38
33	61	192	.53
33	71	250	.68
34	98	428	1.17
35	36	943	2.58
35	70	559	1.53
36	37	5086	13.93
36	85	56	.15
36	95	2132	5.84
36	120	1490	4.08
36	121	1257	3.44
37	38	7406	20.29
37	72	586	1.61
37	75	346	.95
37	76	1602	4.39
37	96	3708	10.16
38	39	7376	20.21
38	40	10913	29.90
38	121	9215	25.25
39	70	552	1.51
39	72	1074	2.94
39	86	82	.22
39	89	942	2.58
39	118	172	.47
40	41	7896	21.63
40	77	3412	9.35
40	86	314	.86
40	92	132	.36
40	93	206	.56
41	42	9423	25.82
41	77	112	.31
41	92	2428	6.65
42	43	304	.83
42	45	8957	24.54
42	87	810	2.22
43	44	0	.00
43	77	111	.30
44	69	1118	3.06
44	74	0	.00

44	77	166	.45
44	88	70	.19
45	46	19520	53.48
45	78	5530	15.15
45	79	2860	7.84
45	87	988	2.71
45	88	66	.18
45	90	2769	7.59
45	91	280	.77
45	94	120	.33
45	109	182	.50
46	80	127	.35
46	108	300	.82
46	121	5271	14.44
46	122	8250	22.60
47	48	14	.04
47	49	1966	5.39
47	102	1501	4.11
47	122	3661	10.03
48	49	0	.00
48	120	4	.01

VEHICLE CODE NUMBER	ANNUAL DISTANCE IN MILES	ANNUAL COST
1	77859.00	$ 19063.30
2	2887.00	1322.63
3	55779.00	14751.15
4	2765.25	1118.50
5	1196.00	585.53
7	561.00	719.73
8	1991.50	853.96
9	42.00	42.98
10	133.50	72.51
11	2334.00	2966.42
12	3754.50	4846.98
13	32.50	33.60
15	493.50	784.73
16	178.50	316.39
17	.00	.00
18	391.75	492.14
19	691.25	877.12
20	264.00	388.52
21	245.25	359.77
22	213.50	308.61
23	11.00	17.01
24	.00	.00
25	11.50	4.70
26	.00	.00
27	53.00	28.61
28	205.50	112.80
29	.00	.00
30	.00	.00
31	.00	.00
32	.00	.00
33	.00	.00

40	133.50	78.21
41	1328.00	745.88
45	11.50	5.25
46	.00	.00
47	.00	.00
48	.00	.00
49	416.75	557.50
50	.00	.00
51	691.25	953.66
52	264.00	432.43
53	245.25	403.30
54	213.50	348.42
55	11.00	20.09
56	53.00	27.69
57	205.50	109.14
58	.00	.00
59	.00	.00
60	.00	.00
61	.00	.00
TOTAL	155667.30	$ 55749.20

BN	EN	ANNUAL VM	ANNUAL FM	ANNUAL RECON	ANNUAL RESURF
5	17	$ 76.51	$1188.00	$ 509.13	$ 396.41
6	15	39.84	1188.00	455.47	355.47
9	10	27.13	1188.00	455.47	355.47
10	11	22.48	1188.00	455.47	355.47
11	22	10.46	594.00	227.73	177.74
14	15	39.92	1188.00	455.47	355.47
14	16	7.66	1188.00	455.47	355.47
14	31	23.64	594.00	227.73	177.74
16	17	63.18	1188.00	468.85	365.68
16	18	47.96	1188.00	455.47	355.47
18	19	47.15	1188.00	455.47	355.47
19	20	26.91	1188.00	455.47	355.47
29	30	43.03	1188.00	455.47	355.47
29	39	41.46	1188.00	455.47	355.47
30	31	23.50	594.00	227.73	177.74
33	34	1.38	594.00	227.73	177.74
33	35	5.60	1188.00	455.47	355.47
35	36	6.07	1188.00	455.47	355.47
36	37	32.75	1188.00	455.47	355.47
37	38	47.68	1188.00	455.47	355.47
38	39	47.49	1188.00	455.47	355.47
38	40	70.26	1188.00	490.26	382.01
40	41	25.42	594.00	227.73	177.74
41	42	30.33	594.00	230.63	179.95
42	45	57.67	1188.00	455.47	355.47
45	46	125.68	1188.00	657.73	509.77
TOTAL		$ 991.15	$27324.00	$10782.75	$ 8410.06

ANNUAL COSTS OF KEEPING THE ROADS		PREVIOUS		CURRENT		CHANGE
COSTS TO THE COUNTY						
TOTAL VARIABLE MAINTENANCE COST	$	1139.64	$	991.15	$	148.49
TOTAL FIXED MAINTENANCE COST		40392.00		27324.00		13068.00
TOTAL RECONSTRUCTION COST		15741.94		10782.75		4959.20
TOTAL RESURFACING COST		12281.38		8410.06		3871.32
TOTAL BRIDGE MAINTENANCE COST		.00		.00		.00
TOTAL COST TO THE COUNTY	$	69554.96	$	47507.95	$	22047.01
COSTS TO PRIVATE DRIVES						
TOTAL MAINTENANCE COST	$	.00	$	4335.75	$	-4335.75
TOTAL RECONSTRUCTION COST		.00		2960.54		-2960.54
TOTAL BRIDGE MAINTENANCE COST		.00		.00		.00
TOTAL COST TO PRIVATE DRIVES	$	.00	$	7296.29	$	-7296.29
TOTAL NET VALUE OF LAND	$	.00	$	1179.99	$	1179.99
CHANGE IN TOTAL COST OF KEEPING THE ROADS					$	15930.72

ANNUAL BENEFITS OF KEEPING THE ROADS	CURRENT	PREVIOUS	CHANGE
TOTAL TRAVEL COST	$ 55749.20	$ 53185.70	2563.50

$$\frac{\text{BENEFIT}}{\text{COST}} = \frac{\text{CHANGE IN TRAVEL COST}}{\text{CHANGE IN THE COST OF KEEPING THE ROADS}}$$

$$= \frac{2563.50}{15930.72}$$

$$= .16$$

IF THE BENEFIT-COST RATIO IS GREATER THAN ONE, THE VALUE OF OF THE ROAD(S) TO TH E TRAVELING PUBLIC EXCEED THE COST OF KEEPING THE ROADS(S).

IF THE BENEFIT-COST RATIO IS LESS THAN ONE, THE VALUE OF THE ROAD(S) TO THE TRAV ELING PUBLIC IS LESS THAN THE COST OF KEEPING THE ROADS(S).

Appendix 3
A printout of the computer programs.

```
$STORAGE:4
      PROGRAM PASS1
      CHARACTER C
      CHARACTER*15 FNAME,GNAME
      INTEGER*4 IJK
      LOGICAL TF,TORF,TFAXE
      COMMON /A3/I,J,K,L,M,N1,N2,N3,N4 /A4/FNAME,GNAME/A5/A1(20),A2(20)
      COMMON /A6/ NODES,NR,LNUM,IJ,JW,JD,JH /A7/ KVTYPE(1000)
      COMMON /A8/ KFREQ(500,2) /A9/ KDATA(2000,4),NH,MH,KN(22)
      COMMON /A10/ TF(2000),TORF(1000) /A11/ JVEH(20),NVEH
      COMMON /B1/ IBN(1000) /B2/ IEN(1000) /B3/ L1(1000)
      COMMON /B4/ L2(1000) /B5/ M1(1000) /B6/ M2(1000)
      COMMON /B7/ M3(1000) /B8/ M4(1000) /B9/ MDATA(1000,6)
      COMMON /B10/ N5,N6,N7,N8 /B11/ CVEH(20) /B12/ C
      COMMON /C1/KJ(22),KL(22),KM(200),N,IN,IT,II,IL,NM,KK,NA,NP,NU,NUM
      COMMON /C2/ L3(1000) /C4/ L4(1000) /C5/ LM(500)
      DIMENSION TFAXE(15),IJK(15)
      WRITE(*,800)
 800  FORMAT(' IS THIS RUN FOR THE BASE SOLUTION ? (Y/N)')
      READ(*,'(A)') C
      IF(C.NE.'Y') CALL SUPER
      IF(C.NE.'Y') GO TO 999
      N9=0
      OPEN(2,FILE='NAMES',STATUS='OLD',ACCESS='DIRECT',RECL=15,FORM='FOR
     +MATTED')
       CALL MOVE
      WRITE(*,924)
 924  FORMAT(' ENTER THE NAME OF YOUR STUDY AREA')
      READ(*,'(A15)') FNAME
      WRITE(2,'(A15)') FNAME
      OPEN(9,FILE='WEIGHTS.GRP',STATUS='NEW')
      OPEN(14,FILE='VEHICLES',STATUS='OLD',ACCESS='DIRECT',RECL=60,FORM=
     +'FORMATTED')
      OPEN(1,FILE='NETWORK.GRP',STATUS='NEW',ACCESS='DIRECT',RECL=70,FOR
     +M='FORMATTED')
      OPEN(12,FILE='TRIP')
      OPEN(13,FILE='NET')
 520  FORMAT(4I10)
 521  FORMAT(2I5,3I10,3I5)
      N9=0
      NR=1
      NODES=0
      ND=20000
 90   READ(13,521,END=91) IBN(NR),IEN(NR),L2(NR),M1(NR),M2(NR),L3(NR),L4
     +(NR),M4(NR)
      M3(NR)=20000
      IF(IEN(NR).GT.NODES) NODES=IEN(NR)
      IF(M4(NR).EQ.1) N9=N9+1
      IF(M4(NR).LE.4) GO TO 99
      IF(IBN(NR).GT.IEN(NR)) GO TO 99
      IF(ND.GT.IEN(NR)) ND=IEN(NR)
 99   NR=NR+1
      GO TO 90
 91   NUM=1
      N9=N9/2
 92   READ(12,520,END=93) (KDATA(NUM,J),J=1,4)
```

```
      IF(NUM).FALSE.
      NUM=NUM+1
      GO TO 92
   93 NUM=NUM-1
      NR=NR-1
      L=NR-1
      DO 100 I=1,L
        N1=IBN(I)
        N2=IEN(I)
        N4=L2(I)
        N5=M1(I)
        N6=M2(I)
        N7=M3(I)
        N8=M4(I)
        N11=L3(I)
        N10=L4(I)
        M=I+1
        K=I
        DO 105 J=M,NR
          IF(N1-IBN(J)) 105,126,127
  127     N1=IBN(J)
          N2=IEN(J)
          N4=L2(J)
          N5=M1(J)
          N6=M2(J)
          N7=M3(J)
          N8=M4(J)
          N11=L3(J)
          N10=L4(J)
          K=J
          GO TO 105
  126     IF(N2-IEN(J)) 105,105,128
  128     N2=IEN(J)
          N4=L2(J)
          N5=M1(J)
          N6=M2(J)
          N7=M3(J)
          N8=M4(J)
        N11=L3(J)
        N10=L4(J)
          K=J
  105   CONTINUE
        M1(K)=M1(I)
        M2(K)=M2(I)
        M3(K)=M3(I)
        M4(K)=M4(I)
        IBN(K)=IBN(I)
        IEN(K)=IEN(I)
        L2(K)=L2(I)
        L3(K)=L3(I)
        L4(K)=L4(I)
        IBN(I)=N1
        IEN(I)=N2
        L2(I)=N4
        M1(I)=N5
        M2(I)=N6
        M3(I)=N7
```

```
        M4(I)=N8
        L3(I)=N11
        L4(I)=N10
100   CONTINUE
      OPEN(8,FILE='VEHGROUP')
      READ(8,531) IN
531   FORMAT(I75)
      IJ=0
      WRITE(1,500) NODES,NR,NUM,IN,IJ,IJ,ND,N9
500   FORMAT(6X,8I8)
      DO 104 I=1,NR
         WRITE(1,591) IBN(I),IEN(I),L2(I),M1(I),M2(I),M3(I),M4(I),L3(I),
     +L4(I)
591      FORMAT(2I5,1X,7I8)
104   CONTINUE
      MT=0
532   FORMAT(2I15,2F15.2,I15)
533   FORMAT(15I5)
534   FORMAT(15F5.3)
522   FORMAT(I60)
523   FORMAT(10I6)
524   FORMAT(10L6)
863   FORMAT(2I10)
862   FORMAT(I10,9X,L1)
      JH=0
      DO 39 IJ=1,IN
        MT=MT+2
        READ(2,'(A15)',REC=MT) GNAME
        READ(8,532) JW,JD,A1(IJ),A2(IJ),NVEH
        READ(8,533) (JVEH(J),J=1,NVEH)
        READ(8,534) (CVEH(J),J=1,NVEH)
         DO 37 I=1,NVEH
           L=(JVEH(I)*2)-1
           READ(14,522,REC=L) NA
           L=L+1
           READ(14,523,REC=L) (IJK(M),M=1,NA)
           L=122+JVEH(I)
           READ(14,524,REC=L) (TFAXE(M),M=1,NA)
           WRITE(9,863) JVEH(I),NA
           DO 38 J=1,NA
              WRITE(9,862) IJK(J),TFAXE(J)
38         CONTINUE
37       CONTINUE
      K=0
      DO 22 J=1,NUM
          IF(TF(J)) GO TO 22
         DO 23 L=1,NVEH
          IF(KDATA(J,4).NE.JVEH(L)) GO TO 23
          K=K+1
            DO 24 M=1,4
               MDATA(K,M)=KDATA(J,M)
```

```
24          CONTINUE
           TF(J)=.TRUE.
          GO TO 22
23       CONTINUE
22    CONTINUE
      LNUM=K
      CALL MANU
39    CONTINUE
999   CONTINUE
      STOP 'PASS ONE COMPLETED'
      END
C
C
C
C
C
      SUBROUTINE MANU
      CHARACTER C
      CHARACTER*15 FNAME,GNAME
      LOGICAL TF,TORF
      COMMON /A3/I,J,K,L,M,N1,N2,N3,N4 /A4/FNAME,GNAME/A5/A1(20),A2(20)
      COMMON /A6/ NODES,NR,LNUM,IJ,JW,JD,JH /A7/ KVTYPE(1000)
      COMMON /A8/ KFREQ(500,2) /A9/ KDATA(2000,4),NH,MH,KN(22)
      COMMON /A10/ TF(2000),TORF(1000) /A11/ JVEH(20),NVEH
      COMMON /B1/ IRN(1000) /B2/ IEN(1000) /B3/ L1(1000)
      COMMON /B4/ L2(1000) /B5/ M1(1000) /B6/ M2(1000)
      COMMON /B7/ M3(1000) /B8/ M4(1000) /B9/ MDATA(1000,6)
      COMMON /B10/ N5,N6,N7,N8 /B11/ CVEH(20) /B12/ C
      COMMON /C1/KJ(22),KL(22),KM(200),N,IN,IT,II,IL,MM,KK,NA,NP,NU,NUM
      COMMON /C2/ L3(1000) /C4/ L4(1000) /C5/ LM(500)
       L=LNUM-1
       DO 10 I=1,L
          N1=MDATA(I,1)
          N2=MDATA(I,2)
          N3=MDATA(I,3)
          N4=MDATA(I,4)
          M=I+1
          K=I
          DO 15 J=M,LNUM
             IF(N1-MDATA(J,1)) 15,26,27
27           N1=MDATA(J,1)
             N2=MDATA(J,2)
             N3=MDATA(J,3)
             N4=MDATA(J,4)
             K=J
             GO TO 15
26           IF(N2-MDATA(J,2)) 15,15,28
28           N2=MDATA(J,2)
             N3=MDATA(J,3)
             N4=MDATA(J,4)
             K=J
```

```
 15        CONTINUE
           MDATA(K,1)=MDATA(I,1)
           MDATA(K,2)=MDATA(I,2)
           MDATA(K,3)=MDATA(I,3)
           MDATA(K,4)=MDATA(I,4)
           MDATA(I,1)=N1
           MDATA(I,2)=N2
           MDATA(I,3)=N3
           MDATA(I,4)=N4
 10        CONTINUE
C
C  BRING ON THE NETWORK
C
          DO 300 I=1,NR
             IF(M4(I).EQ.1) L1(I)=L2(I)
             IF(M4(I).EQ.2) L1(I)=L2(I)*A1(IJ)
             IF(M4(I).EQ.3) L1(I)=L2(I)*A2(IJ)
             IF(M4(I).EQ.4) L1(I)=L2(I)
             IF(M4(I).EQ.5) L1(I)=L2(I)
             IF(M4(I).EQ.6) L1(I)=L2(I)
             IF(M1(I).LT.JW) L1(I)=10000
             IF(M2(I).LT.JD) L1(I)=10000
             IF(M3(I).LT.JH) L1(I)=10000
 300     CONTINUE
         CALL HELPME
         RETURN
         END
C
C
C
C
C
C
C
         SUBROUTINE HELPME
         CHARACTER C
         CHARACTER*15 FNAME,GNAME
         LOGICAL TF,TORF
         COMMON /A3/I,J,K,L,M,N1,N2,N3,N4 /A4/FNAME,GNAME/A5/A1(20),A2(20)
         COMMON /A6/ NODES,NR,LNUM,IJ,JW,JD,JH /A7/ KVTYPE(1000)
         COMMON /A8/ KFREQ(500,2) /A9/ KDATA(2000,4),NH,MH,KN(22)
         COMMON /A10/ TF(2000),TORF(1000) /A11/ JVEH(20),NVEH
         COMMON /B1/ IBN(1000) /B2/ IEN(1000) /B3/ L1(1000)
         COMMON /B4/ L2(1000) /B5/ M1(1000) /B6/ M2(1000)
         COMMON /B7/ M3(1000) /B8/ M4(1000) /B9/ MDATA(1000,4)
         COMMON /B10/ N5,N6,N7,N8 /B11/ CVEH(20) /B12/ C
         COMMON /C1/KJ(22),KL(22),KM(200),N,IN,IT,II,IL,MM,KK,NA,NP,NU,NUM
         COMMON /C2/ L3(1000) /C4/ L4(1000) /C5/ LM(500)
C
C    FIND KVTYPE AND LNUMOD
C
          DO 123 I=1,LNUM
            TORF(I)=.FALSE.
            MDATA(I,5)=0
            MDATA(I,6)=0
```

```
123    CONTINUE
       N=0
       DO 30 J=1,LNUM
          IF(TORF(J)) GO TO 30
          N1=MDATA(J,1)
          N2=MDATA(J,2)
          M=J+1
          N=N+1
          K=1
          IF(M.GT.LNUM) GO TO 31
          DO 40 I=M,LNUM
             IF(MDATA(I,1).NE.N1) GO TO 31
             IF(MDATA(I,2).NE.N2) GO TO 31
             TORF(I)=.TRUE.
             K=K+1
40        CONTINUE
31        KVTYPE(N)=K
30     CONTINUE
       NUMOD=N
C
C    FIND KFREQ AND NFREQ
C
       K=0
       DO 50 J=1,NODES
         K=K+1
         N=0
         DO 60 I=1,LNUM
           IF(MDATA(I,1).EQ.J) N=N+1
           IF(MDATA(I,2).EQ.J) N=N+1
60       CONTINUE
         IF(N.EQ.0) K=K-1
         IF(N.EQ.0) GO TO 50
         KFREQ(K,1)=J
         KFREQ(K,2)=N
50     CONTINUE
       NFREQ=K
       L=K-1
       DO 70 I=1,L
         K=I
         N1=KFREQ(I,1)
         N2=KFREQ(I,2)
         M=I+1
         DO 80 J=M,NFREQ
           IF(N2.GE.KFREQ(J,2)) GO TO 80
           N1=KFREQ(J,1)
           N2=KFREQ(J,2)
           K=J
80       CONTINUE
       KFREQ(K,1)=KFREQ(I,1)
       KFREQ(K,2)=KFREQ(I,2)
       KFREQ(I,1)=N1
```

```
      KFREQ(I,2)=N2
   70 CONTINUE
      OPEN(3,FILE=GNAME,STATUS='NEW',ACCESS='DIRECT',RECL=60,FORM='FORMA
     +TTED')
      WRITE(3,560) NODES,NR,NUMOD,LNUM,NFREQ,NVEH
  560 FORMAT(6I10)
      DO 205 I=1,NUMOD
         WRITE(3,530) KVTYPE(I)
  530    FORMAT(I60)
  205 CONTINUE
      DO 207 I=1,NVEH
         WRITE(3,570) JVEH(I),CVEH(I)
  570    FORMAT(I5,F55.5)
  207 CONTINUE
      DO 210 I=1,LNUM
         WRITE(3,540) (MDATA(I,J),J=1,6)
  540    FORMAT(6I10)
  210 CONTINUE
      DO 215 I=1,NFREQ
         WRITE(3,550) (KFREQ(I,J),J=1,2)
  550    FORMAT(2I30)
  215 CONTINUE
      DO 220 I=1,NR
         WRITE(3,505) IBN(I),IEN(I),L1(I),L2(I)
  505    FORMAT(4I15)
  220 CONTINUE
       RETURN
       END
C
C
C
C
C
C
      SUBROUTINE SUPER
      CHARACTER C,CC
      CHARACTER*15 FNAME,GNAME
      LOGICAL TF,TORF
      COMMON /A3/I,J,K,L,M,N1,N2,N3,N4 /A4/FNAME,GNAME/A5/A1(20),A2(20)
      COMMON /A6/ NODES,NR,LNUM,IU,JW,JD,JH /A7/ KVTYPE(1000)
      COMMON /A8/ KFREQ(500,2) /A9/ KDATA(2000,4),NH,MH,KN(22)
      COMMON /A10/ TF(2000),TORF(1000) /A11/ JVEH(20),NVEH
      COMMON /B1/ IBN(1000) /B2/ IEN(1000) /B3/ L1(1000)
      COMMON /B4/ L2(1000) /B5/ M1(1000) /B6/ M2(1000)
      COMMON /B7/ M3(1000) /B8/ M4(1000) /B9/ MDATA(1000,6)
      COMMON /B10/ N5,N6,N7,N8 /B11/ CVEH(20) /B12/ C
      COMMON /C1/KJ(22),KL(22),KM(200),N,IN,IT,II,IL,MM,KK,NA,NP,NU,NUM
      COMMON /C2/ L3(1000) /C4/ L4(1000) /C5/ LM(500)
      OPEN(4,FILE='NETWORK.GRP',ACCESS='DIRECT',RECL=70,FORM='FORMATTED'
     +)
      READ(4,500,REC=1) NODES,NR,NUM,IN,NA,NP,ND,N9
```

```
500   FORMAT(6X,8I8)
      DO 11 J=1,200
         KM(J)=0
11    CONTINUE
         DO 12 J=1,22
            KL(J)=0
            KJ(J)=0
            KN(J)=0
12       CONTINUE
      DO 10 I=1,NR
         READ(4,501) IBN(I),IEN(I),L2(I),M1(I),M2(I),M3(I),M4(I),L3(I),L
     +4(I)
501      FORMAT(2I5,4X,7I8)
10    CONTINUE
        CALL MOVE
      WRITE(*,801)
801   FORMAT(' ENTER THE NUMBER OF ROAD SEGMENTS TO BE ABANDONED')
      L=NR+2
      READ(*,*) NA
      IF(NA.EQ.0) GO TO 942
      DO 15 I=1,NA
         CALL MOVE
         WRITE(*,803) I
803   FORMAT(' ENTER THE THE BN AND EN FOR ABANDONED ROAD SEGEMNT #',I3
     +)
         READ(*,*) IB,IE
944      DO 20 J=1,NR
            IF(IBN(J).NE.IB) GO TO 22
            IF(IEN(J).NE.IE) GO TO 22
            M1(J)=0
            M2(J)=0
           LA=L3(J)
           LW=L4(J)
            M3(J)=0
22          IF(IBN(J).NE.IE) GO TO 20
            IF(IEN(J).NE.IB) GO TO 20
            M1(J)=0
            M2(J)=0
            M3(J)=0
20       CONTINUE
         WRITE(4,502,REC=L) LA,LW,IB,IE
         L=L+1
502      FORMAT(10X,4I15)
15    CONTINUE
942   CONTINUE
         CALL MOVE
      WRITE(*,809)
809   FORMAT(' ARE THERE ANY ROAD SEGMENTS TO BE CONVERTED TO PRIVATE DR
     +IVES ? (Y/N)')
      READ(*,'(A)') CC
      IF(CC.EQ.'Y') NP=1
      IF(CC.NE.'Y') NP=0
      IF(NP.EQ.0) GO TO 945
         CALL MOVE
         WRITE(*,601)
```

```
601  FORMAT(' ENTER THE NUMBER OF ROAD SEGMENTS IN ALL OF THE PRIVATE D
     +RIVES')
        READ(*,*) NH
        DO 29 K=1,NH
           CALL MOVE
           WRITE(*,602) K
602  FORMAT(' ENTER THE BN & EN FOR ROAD SEGMENT # ',I3,' FOR THE PRIVA
     +TE DRIVES')
           READ(*,*) KJ(K),KL(K)
           CALL MOVE
           WRITE(*,603) KJ(K),KL(K)
603  FORMAT(' ENTER THE PRIVATE DRIVE MAINTENANCE COST CODE FOR ROAD SE
     +GMENT',2I5)
           READ(*,*) KN(K)
29      CONTINUE
     DO 33 K=1,NH
        DO 33 J=1,NR
           IF(IBN(J).NE.KJ(K)) GO TO 23
           IF(IEN(J).NE.KL(K)) GO TO 23
           M3(J)=0
23         IF(IBN(J).NE.KL(K)) GO TO 28
           IF(IEN(J).NE.KJ(K)) GO TO 28
           M3(J)=0
28      CONTINUE
33   CONTINUE
     WRITE(4,504,REC=L) NH,(KJ(K),K=1,22)
     L=L+1
     WRITE(4,505,REC=L) (KL(K),K=1,22)
504  FORMAT(I4,22I3)
505  FORMAT(4X,22I3)
     L=L+1
     WRITE(4,505,REC=L) (KN(K),K=1,22)
     L=L+1
     K=0
     DO 34 I=1,NR
        IF(M4(I).NE.6) GO TO 34
        IF(IBN(I).GT.IEN(I)) GO TO 34
        DO 35 J=1,NH
           IF(IBN(I).NE.KL(J)) GO TO 36
           K=K+1
           LM(K)=IEN(I)
           GO TO 34
36         IF(IBN(I).NE.KJ(J)) GO TO 35
           K=K+1
           LM(K)=IEN(I)
           GO TO 34
35      CONTINUE
34   CONTINUE
     NH=0
     DO 40 J=1,K
        N6=LM(J)
        DO 41 I=1,K
           IF(N6.EQ.KM(I)) GO TO 40
```

```
41        CONTINUE
          MH=MH+1
          KM(MH)=N6
40    CONTINUE
51    WRITE(4,504,REC=L) MH,(KM(K),K=1,22)
      J=MH/22
      IF(J.EQ.0) GO TO 945
      DO 50 I=1,J
         JA=(22*I)+1
         JB=JA+21
         L=L+1
         WRITE(4,505,REC=L) (KM(K),K=JA,JB)
50    CONTINUE
945   CONTINUE
      WRITE(4,500,REC=1) NODES,NR,NUM,IN,NA,NP,ND,N9
      CALL CHECK
941   CONTINUE
      RETURN
      END
C
C
C
C
C
      SUBROUTINE CHECK
      CHARACTER C
      CHARACTER*15 FNAME,GNAME
      LOGICAL TF,TORF
      COMMON /A3/I,J,K,L,M,N1,N2,N3,N4 /A4/FNAME,GNAME/A5/A1(20),A2(20)
      COMMON /A6/ NODES,NR,LNUM,IJ,JW,JD,JH /A7/ KVTYPE(1000)
      COMMON /A8/ KFREQ(500,2) /A9/ KDATA(2000,4),NH,MH,KN(22)
      COMMON /A10/ TF(2000),TORF(1000) /A11/ JVEH(20),NVEH
      COMMON /B1/ IBN(1000) /B2/ IEN(1000) /B3/ L1(1000)
      COMMON /B4/ L2(1000) /B5/ M1(1000) /B6/ M2(1000)
      COMMON /B7/ M3(1000) /B8/ M4(1000) /B9/ MDATA(1000,6)
      COMMON /B10/ N5,N6,N7,N8 /B11/ CVEH(20) /B12/ C
      COMMON /C1/KJ(22),KL(22),KM(200),N,IN,IT,II,IL,MM,KK,NA,NP,NU,NUM
      COMMON /C2/ L3(1000) /C4/ L4(1000) /C5/ LM(500)
      OPEN(5,FILE='NAMES',ACCESS='DIRECT',RECL=15,FORM='FORMATTED')
      OPEN(8,FILE='VEHGROUP')
      READ(8,531) NU
531   FORMAT(I75)
      JH=10
      K=0
      DO 30 J=1,IN
532     FORMAT(2I15,2F15.2,I15)
533     FORMAT(15I5)
534     FORMAT(15F5.3)
        READ(8,532) JW,JD,A1(J),A2(J),NVEH
        READ(8,533) (JVEH(JY),JY=1,NVEH)
        READ(8,534) (CVEH(JY),JY=1,NVEH)
         K=K+2
         READ(5,'(A15)',REC=K) FNAME
         OPEN(4,FILE=FNAME,ACCESS='DIRECT',RECL=60,FORM='FORMATTED')
         READ(4,504) NUMOD,LNUM,NFREQ,NVEH
```

```
504       FORMAT(20X,4I10)
          L=NUMOD+LNUM+NFREQ+NVEH+2
      DO 300 I=1,NR
          IF(M4(I).EQ.1) L1(I)=L2(I)
          IF(M4(I).EQ.2) L1(I)=L2(I)*A1(J)
          IF(M4(I).EQ.3) L1(I)=L2(I)*A2(J)
          IF(M4(I).EQ.4) L1(I)=L2(I)
          IF(M4(I).EQ.5) L1(I)=L2(I)
          IF(M4(I).EQ.6) L1(I)=L2(I)
          IF(M1(I).LT.JW) L1(I)=10000
          IF(M2(I).LT.JD) L1(I)=10000
          IF(M3(I).LT.JH) L1(I)=10000
300   CONTINUE
          DO 35 I=1,NR
             WRITE(6,505,REC=L) IBN(I),IEN(I),L1(I),L2(I)
505          FORMAT(4I15)
             L=L+1
35        CONTINUE
          REWIND 6
30    CONTINUE
      IF(NP.EQ.0) GO TO 947
      REWIND 8
      READ(8,531) NU
      MM=(IN*2)+2
          KK=0
          DO 32 IL=1,IN
             READ(8,532) JW,JD,A1(IL),A2(IL),NVEH
             READ(8,533) (JVEH(JY),JY=1,NVEH)
             READ(8,534) (CVEH(JY),JY=1,NVEH)
             READ(5,'(A15)',REC=MM) GNAME
             MM=MM+2
             KK=KK+2
             READ(5,'(A15)',REC=KK) FNAME
             OPEN(7,FILE=FNAME,ACCESS='DIRECT',RECL=60,FORM='FORMATTED')
             READ(7,561) NODES,NR,NUMOD,LNUM,NFREQ,NVEH
561          FORMAT(6I10)
             DO 60 N=1,NR
                IF(M4(N).EQ.1) L1(N)=L2(N)
                IF(M4(N).EQ.2) L1(N)=L2(N)*A1(IL)
                IF(M4(N).EQ.3) L1(N)=L2(N)*A2(IL)
                IF(M4(N).EQ.4) L1(N)=L2(N)
                IF(M4(N).EQ.5) L1(N)=L2(N)
                IF(M4(N).EQ.6) L1(N)=L2(N)
                IF(M1(N).LT.JW) L1(N)=10000
                IF(M2(N).LT.JD) L1(N)=10000
60           CONTINUE
             JH=0
          L=NUMOD+NVEH+2
             DO 34 N=1,LNUM
                READ(7,541,REC=L) N4,N5,N6,N7
541             FORMAT(4I10)
```

```
                L=L+1
               DO 23 IM=1,NH
                  IB=KJ(IM)
                  IE=KL(IM)
                  IF(IB.EQ.N4) GO TO 51
                  IF(IB.EQ.N5) GO TO 51
                  IF(IE.EQ.N4) GO TO 51
                  IF(IE.EQ.N5) GO TO 51
                 GO TO 23
 51             JH=JH+1
                MDATA(JH,1)=N4
                MDATA(JH,2)=N5
                MDATA(JH,3)=N6
                MDATA(JH,4)=N7
                GO TO 34
 23            CONTINUE
                IF(MH.EQ.0) GO TO 34
                DO 22 I=1,MH
                   IF(KM(I).EQ.N4) GO TO 25
                   IF(KM(I).EQ.N5) GO TO 25
                   GO TO 22
 25                JH=JH+1
                   MDATA(JH,1)=N4
                   MDATA(JH,2)=N5
                   MDATA(JH,3)=N6
                   MDATA(JH,4)=N7
                   GO TO 34
 22             CONTINUE
 34          CONTINUE
             LNUM=JH
             CALL HELPME
             REWIND 7
 32       CONTINUE
 947   CONTINUE
       RETURN
       END
C
C
C
C
C
       SUBROUTINE MOVE
       CHARACTER C
       CHARACTER*15 FNAME,GNAME
       LOGICAL TF,TORF
       COMMON /A3/I,J,K,L,M,N1,N2,N3,N4 /A4/FNAME,GNAME/A5/A1(20),A2(20)
       COMMON /A6/ NODES,NR,LNUM,IJ,JW,JD,JH /A7/ KVTYPE(1000)
       COMMON /A8/ KFREQ(500,2) /A9/ KDATA(2000,4),NH,MH,KN(22)
       COMMON /A10/ TF(2000),TORF(1000) /A11/ JVEH(20),NVEH
       COMMON /B1/ IBN(1000) /B2/ IEN(1000) /B3/ L1(1000)
       COMMON /B4/ L2(1000) /B5/ M1(1000) /B6/ M2(1000)
       COMMON /B7/ M3(1000) /B8/ M4(1000) /B9/ MDATA(1000,6)
       COMMON /B10/ N5,N6,N7,N8 /B11/ CVEH(20) /B12/ C
       COMMON /C1/KJ(22),KL(22),KM(200),N,IN,IT,II,IL,MM,KK,NA,NP,NU,NUM
       COMMON /C2/ L3(1000) /C4/ L4(1000) /C5/ LM(500)
       DO 29 JZ=1,25
          WRITE(*,596)
 596      FORMAT(5X)
 29    CONTINUE
       RETURN
       END
```

```
      PROGRAM PASS2
      CHARACTER*15 FNAME,GNAME
      LOGICAL LOD,LP
      INTEGER OPTPAT
      INTEGER*4 PL,TL,PD,XMIN,DIST
      INTEGER*4 IV,KVAL,KDIST,IDIST,LDIST,LDIST1,LDIST2,KDATA,KC
      DIMENSION KJ(22),KL(22),KM(22)
       COMMON /A1/ NODES /A2/ NV /A3/ MM /A4/ NR /A6/ NFREQ
       COMMON /B1/ PL(500) /B2/ IFND(500) /B3/ IBEGIN(500)
       COMMON /C1/ JVEH(20) /C4/ NSPEC
       COMMON /D1/ LOD(1000) /D2/ KVTYPE(1000) /D3/ NUMVEH
       COMMON /E1/ KFREQ(500,2) /E2/ KDATA(1000,6)
       COMMON /F1/ NAME(1000,20) /F3/ II(1000) /F4/ IV(1000)
      COMMON /G1/I,I1,I2,IAA,IM,IN,IX,IZ /G2/J,JSAVE,JJJ,JKJ
      COMMON /G3/K,KDIST,KGG,KNT,KVAL,K1 /G4/K2,KC,KK,KLK,KP,KTOT,KY
      COMMON /G5/KTRIPS,LL,LVTYPE,L,L1,L2,LASTLP,LDIST,M,MIN,N
      COMMON /G6/MIKE,MMM,NBN,NEN,NSTART,NUM,NUMOD,ND
      COMMON /G7/IDIST(1000),LP(500)/G8/PD(500),TL(500),DIST,XMIN
      COMMON /H1/AMM,IQ,NA(50),KROUTE(500),OPTPAT(500)
      COMMON /H2/ NROUTE(50,500)
      COMMON /H3/IY,IP /H4/ FNAME,GNAME /H5/ CVEH(20)
      OPEN(2,FILE='NAMES')
      READ(2,'(A15)') FNAME
      OPEN(4,FILE='NETWORK.GRP',ACCESS='DIRECT',RECL=70,FORM='FORMATTED'
     +)
      READ(4,516) NODES,NR,LNUM,IY,NB,NP,ND,NP
  516 FORMAT(6X,8I8)
      IF(NP.EQ.0) GO TO 95
      L=NR+NB+2
      READ(4,517,REC=L) JM
      READ(4,518,REC=L) (KJ(IG),IG=1,JM)
      L=L+1
      READ(4,518,REC=L) (KL(IG),IG=1,JM)
      L=L+2
      READ(4,517,REC=L) MM
      IF(MM.EQ.0) GO TO 95
      READ(4,518,REC=L) (KM(IG),IG=1,22)
      J=MM/22
      IF(J.EQ.0) GO TO 95
      DO 110 I=1,J
         JA=(22*I)+1
         JB=JA+21
          L=L+1
         READ(4,518,REC=L) (KM(K),K=JA,JB)
  110 CONTINUE
  517 FORMAT(I4)
  518 FORMAT(1X,22I3)
   95 IC=IY+(NP*IY)
      DO 101 IP=1,IC
      READ(2,'(A15)') FNAME
      READ(2,'(A15)') GNAME
      OPEN(3,FILE=FNAME)
  501 FORMAT(6I10)
      READ(3,501) NODES,NR,NUMOD,NUM,NFREQ,NUMVEH
      IF(NUM.EQ.0) GO TO 102
      DO 13 J=1,20
```

```
            DO 13 I=1,NR
               NAME(I,J)=0
 13      CONTINUE
         DO 11 I=1,NUMOD
            LOD(I)=.FALSE.
 11      CONTINUE
C
C READ INPUT DATA
C
 555     FORMAT(I60)
         DO 14 J=1,NUMOD
            READ(3,555) KVTYPE(J)
 14      CONTINUE
 560     FORMAT(I5,F55.5)
         DO 15 K=1,NUMVEH
            READ(3,560) JVEH(K),QVEH(K)
 15      CONTINUE
 500     FORMAT(6I10)
         DO 21 K=1,NUM
            READ(3,500) (KDATA(K,N),N=1,6)
 21      CONTINUE
 502     FORMAT(2I30)
         DO 99 I=1,NFREQ
            READ(3,502) (KFREQ(I,M),M=1,2)
 99      CONTINUE
         JSAVE=0
         DO 20 L=1,NR
            READ(3,520) J,I,KVAL,KDIST
 520     FORMAT(4I15)
            IF(J.EQ.JSAVE) GO TO 22
            IBEGIN(J)=L
 22         JSAVE=J
            II(L)=I
            IV(L)=KVAL
            IDIST(L)=KDIST
            IEND(J)=L
 20      CONTINUE
         DO 90 IAA=1,NFREQ
            IF(KFREQ(IAA,2).EQ.0) GO TO 90
         DO 10 I=1,NODES
            TL(I)=2.E06
            PL(I)=2.E06
            PD(I)=2.E06
            LP(I)=.FALSE.
 10      CONTINUE
         NSTART=KFREQ(IAA,1)
         LP(NSTART)=.TRUE.
         PL(NSTART)=0
         PD(NSTART)=0
         LASTLP=NSTART
         DO 30 I=2,NODES
            I1=IBEGIN(LASTLP)
            I2=IEND(LASTLP)
            DO 16 J=I1,I2
               KGG=II(J)
               IF(LP(KGG)) GO TO 16
               IF(PL(LASTLP)+IV(J).GE.TL(KGG)) GO TO 16
               TL(KGG)=PL(LASTLP)+IV(J)
               PD(KGG)=PD(LASTLP)+IDIST(J)
```

```
 16       CONTINUE
C
C  STEP B
C
 31       MIN=2
          XMIN=TL(2)
          DO 17 J=1,NODES
             IF(LP(J)) GO TO 17
             IF(TL(J).GT.XMIN) GO TO 17
             MIN=J
             XMIN=TL(J)
 17       CONTINUE
          PL(MIN)=XMIN
          TL(MIN)=2.E06
          LP(MIN)=.TRUE.
          LASTLP=MIN
 30    CONTINUE
       KNT=1
       MM=0
       DO 35 IK=1,NUMOD
          IM=KDATA(KNT,1)
          IN=KDATA(KNT,2)
          NV=KVTYPE(IK)
          KNT=KNT+NV
          IF(NP.EQ.0) GO TO 42
          IF(IP.GT.IY) GO TO 42
           DO 59 IG=1,JM
             IF(KJ(IG).EQ.IM) GO TO 49
             IF(KJ(IG).EQ.IN) GO TO 49
             IF(KL(IG).EQ.IM) GO TO 49
             IF(KL(IG).EQ.IN) GO TO 49
 59        CONTINUE
           IF(MH.EQ.0) GO TO 42
           DO 97 IGG=1,MH
              IF(KM(IGG).EQ.IM) GO TO 49
              IF(KM(IGG).EQ.IN) GO TO 49
 97        CONTINUE
 42       CONTINUE
          LDIST=PD(IM)-PD(IN)
          LDIST1=IABS(LDIST)
          IF(LOD(IK)) GO TO 49
          DIST=PL(IM)-PL(IN)
          IF(DIST) 43,49,44
 43       DIST=IABS(DIST)
          IB=IN
          IE=IM
          GO TO 50
 44       IB=IM
          IE=IN
```

```
50      CALL TRACED(IB,IE,IK,LDIST1)
49      MM=KNT-1
35    CONTINUE
90    CONTINUE
       OPEN(8,FILE=GNAME,STATUS='NEW')
603    FORMAT(2I5,20I8)
699    FORMAT(2X,6I?8)
777   FORMAT(I85,F85.5)
      DO 56 I=1,NUMVEH
        WRITE(8,777) JVEH(I),CVEH(I)
56    CONTINUE
       WRITE(8,699) ((KDATA(I,J),J=1,6),I=1,NUM)
      DO 55 I=1,NODES
         L1=IBEGIN(I)
         L2=IEND(I)
         DO 65 J=L1,L2
            WRITE(8,603) I,II(J),(NAME(J,L),L=1,20)
65       CONTINUE
55     CONTINUE
       CLOSE(8,STATUS='KEEP')
       GO TO 101
102    OPEN(9,FILE=GNAME,STATUS='NEW')
      MM=0
      AMM=0.0
      WRITE(9,777) MM,AMM
       CLOSE(9,STATUS='KEEP')
101   CONTINUE
       STOP 'PASS TWO COMPLETED'
       END
       SUBROUTINE TRACED(ID,IQ,JJ,LDIST2)
      CHARACTER*15 FNAME,GNAME
      LOGICAL LOD,LP
      INTEGER OPTPAT
      INTEGER*4 PL,TL,PD,XMIN,DIST
      INTEGER*4 IV,KVAL,KDIST,IDIST,LDIST,LDIST1,LDIST2,KDATA,KC
       COMMON /A1/ NODES /A2/ NV /A3/ MM /A4/ NR /A6/ NFREQ
       COMMON /B1/ PL(500) /B2/ IEND(500) /B3/ IBEGIN(500)
       COMMON /C1/ JVEH(20) /C4/ NSPEC
       COMMON /D1/ LOD(1000) /D2/ KVTYPE(1000) /D3/ NUMVEH
       COMMON /E1/ KFREQ(500,2) /E2/ KDATA(1000,6)
       COMMON /F1/ NAME(1000,20) /F3/ II(1000) /F4/ IV(1000)
      COMMON /G1/I,I1,I2,IAA,IM,IN,IX,IZ /G2/J,JSAVE,JJJ,JKJ
      COMMON /G3/K,KDIST,KGG,KNT,KVAL,K1 /G4/K2,KC,KK,KLK,KP,KTOT,KY
      COMMON /G5/KTRIPS,LL,LVTYPE,L,L1,L2,LASTLP,LDIST,M,MIN,N
      COMMON /G6/MIKE,MMM,NBN,NEN,NSTART,NUM,NUMOD,ND
      COMMON /G7/IDIST(1000),LP(500)/G8/PD(500),TL(500),DIST,XMIN
      COMMON /H1/AMM,IQ,NA(50),KROUTE(500),OPTPAT(500)
      COMMON /H2/ NROUTE(50,500)
      COMMON /H3/ IY,IP /H4/ FNAME,GNAME /H5/ CVEH(20)
       N=1
       KY=0-1
       IX=ID
       IQ=IQ
       OPTPAT(1)=IQ
       M=1
       K=2
       LJ=IBEGIN(IQ)
```

```
 32     L2=IEND(IQ)
        DO 50 I=L1,L2
           MIKE=II(I)
           KC=(PL(IQ)-PL(MIKE))*KY
           IF(KC.EQ.IV(I)) GO TO 55
 50     CONTINUE
        K=K-1
        GO TO 58
 55     KROUTE(IQ)=I
        OPTPAT(K)=MIKE
        IF(MIKE.EQ.IX) GO TO 31
        IQ=MIKE
        K=K+1
        L1=IBEGIN(IQ)
        GO TO 32
 58     KP=K-1
        IF(KP.LE.0) GO TO 13
 59     IQ=OPTPAT(K-1)
        L1=KROUTE(IQ)+1
        IF(L1.LE.IEND(IQ)) GO TO 32
        K=K-1
        GO TO 58
 31     CONTINUE
        NA(N)=K
        LOD(JJ)=.TRUE.
        DO 60 J=1,K
           NROUTE(N,J)=OPTPAT(J)
 60     CONTINUE
        N=N+1
        GO TO 59
 13     CONTINUE
        IF(.NOT.LOD(JJ)) GO TO 18
        DO 92 IZ=1,NFREQ
           IF(KFREQ(IZ,1).EQ.IO) KFREQ(IZ,2)=KFREQ(IZ,2)-1
           IF(KFREQ(IZ,1).EQ.ID) KFREQ(IZ,2)=KFREQ(IZ,2)-1
 92     CONTINUE
        MMM=N-1
        IF(ID.GE.ND) THEN
          DIST=DIST-10000
          LDIST2=LDIST2-10000
        ENDIF
        IF(IO.GE.ND) THEN
          DIST=DIST-10000
          LDIST2=LDIST2-10000
        ENDIF
        DO 200 M=1,NV
           MM=MM+1
           KDATA(MM,5)=LDIST2
           KDATA(MM,6)=DIST
           LVTYPE=KDATA(MM,4)
           DO 250 JKJ=1,NUMVEH
              IF(LVTYPE.EQ.JVEH(JKJ)) GO TO 201
250        CONTINUE
201        KLK=JKJ
        AMM=N+0.0
        KTOT=KDATA(MM,3)
        DO 300 LL=1,MMM
           K=NA(LL)
           AMM=AMM-1.0
           KTRIPS=INT((KTOT/AMM)+0.5)
           KTOT=KTOT-KTRIPS
           JJ=K-1
```

```
      DO 400 KK=1,JJJ
         NBN=NROUTE(LL,KK)
         NEN=NROUTE(LL,KK+1)
         K1=IBEGIN(NBN)
         K2=IEND(NBN)
         DO 452 J=K1,K2
            IF(II(J).EQ.NEN) GO TO 453
452      CONTINUE
453      NAME(J,KLK)=KTRIPS+NAME(J,KLK)
400    CONTINUE
300    CONTINUE
200    CONTINUE
       GO TO 19
18     MM=NN+NV
19     CONTINUE
       RETURN
       END
```

```
      PROGRAM PASS3
      CHARACTER*15 FNAME,GNAME,HNAME,INAME
      INTEGER*2 DIST,SURF
      LOGICAL*2 Y,T
      COMMON /A1/L,NR,LNUM,IN,NA,NP,N9,IB,IE,I,J,MM,IC,NUM,NVEH
      COMMON /A2/ KTOT(1000) /A3/ IBN(1000) /A4/ IEN(1000)
      COMMON /A5/ NAME(1000,20) /A6/ KDATA(1000,4)
      COMMON /B1/ FNAME,GNAME,HNAME,INAME
      COMMON /B2/ CVEH(70) /B3/ JVEH(70) /B4/ SUM(70,2) /B5/ATOT,CTOT
      COMMON /C1/ KJ(22),KL(22),JH
      DIMENSION KM(22)
      MM=0
      DO 53 I=1,1000
        KTOT(I)=0
53    CONTINUE
      DO 69 I=1,70
         CVEH(I)=0.0
        DO 66 J=1,2
          SUM(I,J)=0.0
66    CONTINUE
69    CONTINUE
      OPEN(8,FILE='MRR')
      OPEN(1,FILE='NAMES')
      OPEN(5,FILE='NETWORK.GRP',ACCESS='DIRECT',RECL=70,FORM='FORMATTED'
     +)
      READ(5,504) NR,LNUM,IN,NA,NP,N9
504   FORMAT(14X,5I8,8X,I8)
      IF(NP.EQ.0) GO TO 309
      L=NR+NA+2
      READ(5,551,REC=L) JH,(KJ(K),K=1,22)
      L=L+1
      READ(5,553,REC=L) (KL(K),K=1,22)
      L=L+1
      READ(5,553,REC=L) (KM(K),K=1,22)
551   FORMAT(I4,22I3)
553   FORMAT(4X,22I3)
309   READ(8,508) GF,DF,PF
      READ(8,508) GV,DV,PV
      READ(8,509) PC3,PS3
      READ(8,509) PC2,PS2
      READ(8,509) PC1,PS1
      READ(8,509) GC3,GS3
      READ(8,509) GC2,GS2
      READ(8,509) GC1,GS1
      READ(8,512) VL,ROW,BMC,AI
      READ(8,511) N2,N3,N1,N22,N11
508   FORMAT(3F10.2)
509   FORMAT(2F15.2)
512   FORMAT(2F10.2,F5.2,F5.3)
511   FORMAT(5I5)
      AFACT=(AI+1.0)**N2
      AGRC=(AI*AFACT)/(AFACT-1.0)
      AFACT=(AI+1.0)**N22
```

```
      AGRS=(AI*AFACT)/(AFACT-1.0)
      AFACT=(AI+1.0)**N1
      APRC=(AI*AFACT)/(AFACT-1.0)
      AFACT=(AI+1.0)**N11
      APRS=(AI*AFACT)/(AFACT-1.0)
      AFACT=(AI+1.0)**N2
      ADRC=(AI*AFACT)/(AFACT-1.0)
      READ(1,'(A15)') GNAME
      IC=IN+(IN*NP)
      DO 10 IP=1,IC
         READ(1,'(A15)') FNAME
         OPEN(2,FILE=FNAME)
500      FORMAT(10X,I10,10X,I10,10X,I10)
         READ(2,500) NR,NUM,NVEH
501      FORMAT(I85,F85.5)
         READ(1,'(A15)') FNAME
         OPEN(4,FILE=FNAME)
         IF(IP.LE.IN) MM=MM+NVEH
            DO 15 I=1,NVEH
               READ(4,501) IG,A7
               CVEH(IG)=A7
15          CONTINUE
502      FORMAT(58X,4I28)
         DO 20 I=1,NUM
            READ(4,502) (KDATA(I,J),J=1,4)
            K=KDATA(I,2)
            SUM(K,1)=(KDATA(I,1)*KDATA(I,3)/100.0)+SUM(K,1)
            SUM(K,2)=(KDATA(I,1)*KDATA(I,4)*CVEH(K)/100.0)+SUM(K,2)
20       CONTINUE
503      FORMAT(2I5,20I3)
         DO 35 I=1,NR
            READ(4,503) IBN(I),IEN(I),(NAME(I,J),J=1,20)
            DO 40 J=1,NVEH
               KTOT(I)=KTOT(I)+NAME(I,J)
40          CONTINUE
35       CONTINUE
10    CONTINUE
      OPEN(3,FILE='RESULTS',STATUS='NEW')
      FNAME='REDUCED'
      WRITE(3,961)
      WRITE(3,961)
      WRITE(3,980) GNAME
980   FORMAT('  STUDY AREA NAME IS ',A15)
      I=NA+NP
      IF(I.EQ.0) FNAME='BASE'
      WRITE(3,961)
      WRITE(3,961)
      WRITE(3,981) FNAME
981   FORMAT('  THE ',A15,' SOLUTION')
      IF(NA.NE.0) CALL ABANDON
      IF(NP.NE.0) CALL PRIVATE
      WRITE(3,961)
      WRITE(3,961)
960   FORMAT('  BN    EN    YEARLY TRAFFIC       ADT')
      WRITE(3,960)
961   FORMAT(5X)
      WRITE(3,961)
      WRITE(3,961)
      DO 50 I=1,NR
```

```
          IF(IBN(I).GT.IEN(I)) GO TO 50
          DO 60 J=I,NR
             IF(I.EQ.J) GO TO 60
             IF(IBN(J).NE.IEN(I)) GO TO 60
             IF(IEN(J).NE.IBN(I)) GO TO 60
             KTOT(I)=KTOT(I)+KTOT(J)
             ATOT=KTOT(I)/365.0
498          FORMAT(2I5,I10,5X,F10.2)
             WRITE(3,498) IBN(I),IEN(I),KTOT(I),ATOT
             GO TO 50
60        CONTINUE
50     CONTINUE
       WRITE(3,961)
       WRITE(3,961)
970    FORMAT(3X,'VEHICLE',12X,' ANNUAL')
971    FORMAT(4X,'CODE',14X,'DISTANCE',14X,'ANNUAL')
972    FORMAT(4X,'NUMBER',12X,'IN MILES',15X,'COST')
973    FORMAT(I7,3X,F20.2,10X,'$',F9.2)
       WRITE(3,970)
       WRITE(3,971)
       WRITE(3,972)
       WRITE(3,961)
       WRITE(3,961)
       CTOT=0.0
       ATOT=0.0
       T=.TRUE.
       DO 80 I=1,70
497       FORMAT(I7,3X,2F20.2)
          IF(CVEH(I).EQ.0.0) GO TO 80
          IF(T) THEN
          WRITE(3,973) I,(SUM(I,K),K=1,2)
          T=.FALSE.
         GO TO 81
          ENDIF
          WRITE(3,497) I,(SUM(I,K),K=1,2)
81        CTOT=CTOT+SUM(I,2)
          ATOT=ATOT+SUM(I,1)
80     CONTINUE
       WRITE(3,961)
       WRITE(3,496) ATOT,CTOT
496    FORMAT('      TOTAL',F20.2,10X,'$',F9.2)
505    FORMAT(14X,I3,24X,3I3)
       K=2
       PMCB=0.0
       PREC=0.0
       PFM=0.0
       TVL=0.0
       TMCB=0.0
       TRS=0.0
       TUPC=0.0
       TRC=0.0
       TVM=0.0
       TFM=0.0
       WRITE(3,961)
       WRITE(3,961)
```

```
974   FORMAT(19X,'ANNUAL',9X,'ANNUAL',9X,'ANNUAL',9X,'ANNUAL')
975   FORMAT(3X,'BN',3X,'EN',11X,'VM',13X,'FM',11X,'RECON',10X,'RESURF')
976   FORMAT(2I5,7X,'$',F7.2,7X,'$',F7.2,7X,'$',F7.2,7X,'$',F7.2)
      WRITE(3,974)
      WRITE(3,975)
      T=.TRUE.
      WRITE(3,961)
      WRITE(3,961)
      CLOSE(4,STATUS='KEEP')
      CLOSE(2,STATUS='KEEP')
      DO 90 I=1,NR
        IF(IBN(I).GT.IEN(I)) GO TO 89
         READ(5,505,REC=K) DIST,SURF,LA,LW
        L=NP+2
        IF(NA.EQ.0) GO TO 112
        DO 111 J=1,NA
           READ(5,510,REC=L) IT,IL
           IF((IBN(I).EQ.IT).AND.(IEN(I).EQ.IL)) THEN
             AFACT=(DIST/100.0)*((8*VL)-(ROW*AI))
             TVL=TVL+AFACT
             GO TO 89
           ENDIF
           L=L+1
510        FORMAT(10X,2I15)
111     CONTINUE
112     CONTINUE
        IF(NP.EQ.0) GO TO 116
           DO 121 JJ=1,JH
              IF((IBN(I).EQ.KJ(JJ)).AND.(IEN(I).EQ.KL(JJ))) GO TO 88
              IF((IEN(I).EQ.KJ(JJ)).AND.(IBN(I).EQ.KL(JJ))) GO TO 88
121        CONTINUE
116      FM=0.0
         VM=0.0
         RECON=0.0
         RESURF=0.0
         IF(SURF.EQ.6) GO TO 89
         IF(SURF.EQ.1) GO TO 89
         IF(SURF.EQ.5) GO TO 89
C     ***************************************************************
         IF(SURF.EQ.2) THEN
           ATOT=KTOT(I)/365.0
           VM=ATOT*DIST*GV/100.0
           FM=DIST*GF/100.0
           IF(ATOT.LE.25) THEN
             RECON=(DIST*GC1*2/100.0)*AGRC
             RESURF=(DIST*GS1*2/100.0)*AGRS
           ENDIF
```

```
          IF((ATOT.GT.25).AND.(ATOT.LE.62.5)) THEN
          RECON=(DIST*2/100.0*(((GC2-GC1)/37.5)*(ATOT-25)+GC1))*AGRC
         RESURF=(DIST*2/100.0*(((GS2-GS1)/37.5)*(ATOT-25)+GS1))*AGRS
          ENDIF
          IF(ATOT.GT.62.5) THEN
         RECON=(DIST*2/100.0*(((GC3-GC2)/187.5)*(ATOT-62.5)+GC2))*AGRC
        RESURF=(DIST*2/100.0*(((GS3-GS2)/187.5)*(ATOT-62.5)+GS2))*AGRS
          ENDIF
        ENDIF
C     ****************************************************************
        IF(SURF.EQ.3) THEN
          ATOT=KTOT(I)/365.0
          VM=ATOT*DIST*DV/100.0
          FM=DIST*DF/100.0
          IF(ATOT.LE.25) THEN
            RECON=(DIST*GC1*2/100.0)*ADRC
          ENDIF
          IF((ATOT.GT.25).AND.(ATOT.LE.62.5)) THEN
            RECON=(DIST*2/100.0*(((GC2-GC1)/37.5)*(ATOT-25)+GC1))*ADRC
          ENDIF
          IF(ATOT.GT.62.5) THEN
         RECON=(DIST*2/100.0*(((GC3-GC2)/187.5)*(ATOT-62.5)+GC2))*ADRC
          ENDIF
        ENDIF
C     ****************************************************************
        IF(SURF.EQ.1) THEN
          RESUR=(DIST*PS1*2/100.0)*APRS
          ATOT=KTOT(I)/365.0
          FM=DIST*PF/100.0
          VM=ATOT*DIST*PV/100.0
       IF(PV.EQ.0.0) CALL KIP(IBN(I),IEN(I),RESUR,VM,DIST,IN,NP,NR)
          IF(ATOT.LT.100) THEN
            RECON=(DIST*PC1*2/100.0)*APRC
            RESURF=(DIST*PS1*2/100.0)*APRS
```

```
          ENDIF
          IF((ATOT.GE.400).AND.(ATOT.LE.950)) THEN
         RECON=(DIST*2/100.0*(((PC2-PC1)/550)*(ATOT-400)+PC1))*APRC
        RESURF=(DIST*2/100.0*(((PS2-PS1)/550)*(ATOT-400)+PS1))*APRS
          ENDIF
          IF(ATOT.GT.950) THEN
         RECON=(DIST*2/100.0*(((PC3-PC2)/2300)*(ATOT-950)+PC2))*APRC
        RESURF=(DIST*2/100.0*(((PS3-PS2)/2300)*(ATOT-950)+PS2))*APRS
          ENDIF
        ENDIF
       GO TO 87
C     ***************************************************************
 88     MZ=KN(JJ)
        IF(MZ.EQ.1) FM=DIST*14.31
        IF(MZ.EQ.2) FM=DIST*15.09
        IF(MZ.EQ.3) FM=DIST*23.92
        IF(MZ.EQ.4) FM=DIST*4.60
        RECON=(DIST*GC1*2/100.0)*ADRC
        PMCB=PMCB+(LA*LW*BMC)
        PREC=PREC+RECON
        PFM=PFM+FM
        GO TO 89
 87     TVM=TVM+VM
        TFM=TFM+FM
        TRC=TRC+RECON
        TRS=TRS+RESURF
        IF(T) THEN
          WRITE(3,976) IBN(I),IEN(I),VM,FM,RECON,RESURF
          T=.FALSE.
        GO TO 89
        ENDIF
        WRITE(3,506) IBN(I),IEN(I),VM,FM,RECON,RESURF
         TMCB=TMCB+(LA*LW*BMC)
 89      K=K+1
 90   CONTINUE
      WRITE(3,961)
      WRITE(3,961)
      WRITE(3,507) TVM,TFM,TRC,TRS
 506  FORMAT(2I5,4F15.2)
 507  FORMAT(5X,'TOTAL',6X,'$',F8.2,6X,'$',F8.2,6X,'$',F8.2,6X,'$',F8.2)
      WRITE(3,961)
      WRITE(3,961)
      IG=NA+NP
      IF(IG.EQ.0) THEN
      WRITE(3,600) TMCB
 600  FORMAT('TOTAL BRIDGE MAINTENANCE COST',15X,3X,'$',F11.2)
      WRITE(3,961)
      WRITE(3,601) TVL
 601  FORMAT('TOTAL VALUE OF LAND',25X,F15.2)
      WRITE(3,961)
      WRITE(3,602) PFM
 602  FORMAT('TOTAL PRIVATE DRIVE MAINTENANCE COST',8X,F15.2)
      WRITE(3,961)
      WRITE(3,603) PREC
```

```
 603  FORMAT('TOTAL PRIVATE DRIVE RECONSTRUCTION COST',5X,F15.2)
      WRITE(3,961)
      WRITE(3,604) PMCB
 604  FORMAT('TOTAL PRIVATE DRIVE BRIDGE MAINTENANCE COST ',F15.2)
      ENDIF
      IF(IG.NE.0) CALL BC(TVM,TFM,TRC,TRS,TVL,TMCB,CTOT,PMCB,PREC,PFM)
      STOP 'PASS THREE COMPLETED'
      END
C
C
C
      SUBROUTINE ABANDON
      CHARACTER*15 FNAME,GNAME,HNAME,INAME
      COMMON /A1/L,NR,LNUM,IN,NA,NP,N9,IB,IE,I,J,MM,IC,NUM,NVEH
      COMMON /A2/ KTOT(1000) /A3/ IBN(1000) /A4/ IEN(1000)
      COMMON /A5/ NAME(1000,20) /A6/ KDATA(1000,4)
      COMMON /B1/ FNAME,GNAME,HNAME,INAME
      COMMON /B2/ CVEH(70) /B3/ JVEH(70) /B4/ SUM(70,2) /B5/ATOT,CTOT
      COMMON /C1/ KJ(22),KL(22),JH
 961  FORMAT(5X)
      WRITE(3,961)
      WRITE(3,961)
      WRITE(3,982)
 982  FORMAT('  THE ABANDONED ROAD SEGMENTS')
      WRITE(3,961)
      L=NR+2
      DO 70 J=1,NA
         READ(5,505,REC=L) IB,IE
 505     FORMAT(10X,2I15)
         WRITE(3,506) IB,IE
 506     FORMAT(2I5)
         L=L+1
 70   CONTINUE
      RETURN
      END
C
C
C
      SUBROUTINE PRIVATE
      CHARACTER*15 FNAME,GNAME,HNAME,INAME
      COMMON /A1/L,NR,LNUM,IN,NA,NP,N9,IB,IE,I,J,MM,IC,NUM,NVEH
      COMMON /A2/ KTOT(1000) /A3/ IBN(1000) /A4/ IEN(1000)
      COMMON /A5/ NAME(1000,20) /A6/ KDATA(1000,4)
      COMMON /B1/ FNAME,GNAME,HNAME,INAME
      COMMON /B2/ CVEH(70) /B3/ JVEH(70) /B4/ SUM(70,2) /B5/ATOT,CTOT
      COMMON /C1/ KJ(22),KL(22),JH
 961  FORMAT(5X)
      WRITE(3,961)
      WRITE(3,961)
      WRITE(3,984)
```

```
 984  FORMAT('  THE ROAD SEGMENTS CONVERTED TO PRIVATE OWNERSHIP')
      WRITE(3,961)
         DO 81 NZ=1,JH
            WRITE(3,506) KJ(NZ),KL(NZ)
 506        FORMAT(2I5)
 81       CONTINUE
      RETURN
      END
C
C
      SUBROUTINE KIP(N1,N2,RESURF,VM,DIST,IN,NP,NR)
      DIMENSION I3(20),I4(20)
      CHARACTER*15 FNAME
      LOGICAL*2 Y,Z,Z1,Z2
      INTEGER*2 DIST
      REWIND 1
      OPEN(6,FILE='WEIGHTS.GRP',STATUS='OLD',ACCESS='DIRECT',FORM='FORMA
     +TTED',RECL=20)
      OPEN(7,FILE='TABLES',STATUS='OLD',ACCESS='DIRECT',FORM='FORMATTED'
     +,RECL=72)
      OPEN(9,FILE='PAVEMENT')
      READ(9,600) AVPMC
 600  FORMAT(F25.2)
 30   READ(9,601) M1,M2,Y,NS,DT
 601   FORMAT(2I5,4X,L1,I5,F5.1)
      IF(M1.GT.M2) THEN
        J3=M1
        M1=M2
        M2=J3
      ENDIF
      IF(M1.NE.N1) GO TO 30
      IF(M2.NE.N2) GO TO 30
      INN=IN+1
      YA=0.0
      CALL TERM(YA,DT,Y)
      IC=IN+(NP*IN)
      PVMC=0.0
 10   CONTINUE
      Z2=.FALSE.
      READ(1,'(A15)') FNAME
           JO=0
           MO=0
      DO 10 I=1,IC
         READ(1,'(A15)') FNAME
         OPEN(2,FILE=FNAME)
         READ(2,502) LNUM,NV
 502     FORMAT(30X,I10,10X,I10)
         READ(1,'(A15)') FNAME
         OPEN(4,FILE=FNAME,ACCESS='DIRECT',FORM='FORMATTED',RECL=170)
           IF(I.EQ.1) CALL FINDEM(N1,N2,JO,MO,LNUM,NV,NR)
         L=NV+LNUM+JO
         READ(4,503,REC=L) (I3(I1),I1=1,NV)
```

```
503     FORMAT(10X,20I3)
        L=NV+LNUM+MD
        READ(4,503,REC=L) (I4(I1),I1=1,NV)
        DO 25 I1=1,NV
           I3(I1)=I3(I1)+I4(I1)
25      CONTINUE
        IF(I.EQ.INN) THEN
          REWIND 6
          INN=INN+3
        ENDIF
        DO 40 I1=1,NV
           READ(6,506) INA
506        FORMAT(10X,I10)
           CIP1=0.0
           DO 50 I2=1,INA
              CIP=0.0
              READ(6,507) KWAIT,Z
507           FORMAT(I10,9X,L1)
              IF(Y.AND.Z) THEN
                 L2=8
                 NS1=NS-5
              ENDIF
              IF(Y.AND.(.NOT.Z)) THEN
                 L2=19
                 NS1=NS-5
              ENDIF
              IF((.NOT.Y).AND.Z) THEN
                NS1=NS
                 L2=37
              ENDIF
              IF((.NOT.Y).AND.(.NOT.Z)) THEN
                NS1=NS
                 L2=48
              ENDIF
              CALL AKIP(L2,KWAIT,NS1,CIP)
              CIP1=CIP1+CIP
50         CONTINUE
           PVMC1=(CIP1*I3(I1)*AVPMC/YA)*DIST/100.0
            VM =PVMC1+ VM
40      CONTINUE
        IF(VM.GT.RESURF) THEN
         VM=0.0
          PVMC=RESURF
          YA=25000.00
          NS=6
          Y=.TRUE.
          INN=IN+1
          Z2=.TRUE.
          REWIND 1
          REWIND 6
        ENDIF
        IF(Z2) GO TO 18
```

```
 10    CONTINUE
         VN=VM+PVMC
       CLOSE(4,STATUS='KEEP')
       CLOSE(2,STATUS='KEEP')
       RETURN
       END
C
C
C
       SUBROUTINE AKIP(L2,KWAIT,NS1,CIP)
       DIMENSION  TABLE(2,10)
 5     L2=L2+1
       READ(7,510,REC=L2) K1
 510   FORMAT(21X,I2)
 511   FORMAT(30X,6F7.4)
       K2=K1*1000
       IF(K2.LT.KWAIT) GO TO 5
       L1=L2-1
 543   FORMAT(2I10)
       READ(7,511,REC=L2) (TABLE(1,J),J=1,6)
       READ(7,511,REC=L1) (TABLE(2,J),J=1,6)
       R1=((KWAIT-K2)/2000.0)+1.0
       R2=(K2-KWAIT)/2000.0
       CIP=(R1*TABLE(1,NS1))+(R2*TABLE(2;NS1))
 531   FORMAT(F25.4)
       RETURN
       END
C
C
C
       SUBROUTINE FINDEM(N1,N2,JJ,MM,LNUM,NV,NR)
       L=LNUM+NV+1
 505   FORMAT(2I5)
       DO 20 J=1,NR
          READ(4,505,REC=L) M1,M2
          L=L+1
          IF(N1.NE.M1) GO TO 20
          IF(N2.NE.M2) GO TO 20
          GO TO 22
 20    CONTINUE
 22    JJ=L-1-LNUM-NV
       L=LNUM+NV+1
       DO 30 M=1,NR
          READ(4,505,REC=L) M1,M2
          L=L+1
          IF(N1.NE.M2) GO TO 30
          IF(N2.NE.M1) GO TO 30
          GO TO 32
 30    CONTINUE
 32    MM=L-1-LNUM-NV
       RETURN
       END
```

```
C
C
C
      SUBROUTINE TERM(YA,DT,Y)
      DIMENSION NTABLE(2,10)
      LOGICAL*2 Y
      DT1=DT*10.0
      IDT=INT(DT1)
      IDT1=INT(DT)*10
      ICOL=IDT+1-IDT1
      IF(Y) THEN
        L2=(IDT/10)-5
      ELSE
        IDT=(IDT/10)-1
        L2=66+IDT
      ENDIF
      READ(7,520,REC=L2) (NTABLE(1,J),J=1,10)
  520 FORMAT(2X,10I7)
      IF(Y) YA=NTABLE(1,ICOL)*1000.0/20.0
      IF(.NOT.Y) YA=NTABLE(1,ICOL)/20.0
      RETURN
      END
C
C
C
      SUBROUTINE BC(TVM,TFM,TRC,TRS,TVL,TMCB,CTOT,PMCB,PREC,PFM)
      WRITE(*,900)
  900 FORMAT(' ENTER THE TOTAL VARIABLE MAINTENANCE COST FROM THE PREVIO
     +US SOLUTION')
      READ(*,*) TVM1
      CALL MOVE
      WRITE(*,901)
  901 FORMAT(' ENTER THE TOTAL FIXED MAINTENANCE COST FROM THE PREVIOUS
     +SOLUTION')
      READ(*,*) TFM1
      CALL MOVE
      WRITE(*,902)
  902 FORMAT(' ENTER THE TOTAL RECONSTRUCTION COST FROM THE PREVIOUS SOL
     +UTION')
      READ(*,*) TRC1
      CALL MOVE
      WRITE(*,903)
  903 FORMAT(' ENTER THE TOTAL RESURFACING COST FROM THE PREVIOUS SOLUTI
     +ON')
      READ(*,*) TRS1
      CALL MOVE
      WRITE(*,904)
  904 FORMAT(' ENTER THE TOTAL VALUE OF LAND FROM THE PREVIOUS SOLUTION'
     +)
      READ(*,*) TVL1
      CALL MOVE
      WRITE(*,905)
  905 FORMAT(' ENTER THE TOTAL BRIDGE MAINTENANCE COST FROM THE PREVIOUS
     + SOLUTION')
      READ(*,*) TMCB1
      CALL MOVE
      WRITE(*,904)
```

```
906   FORMAT(' ENTER THE TOTAL TRAVEL COST FROM THE PREVIOUS SOLUTION')
      READ(*,*) CTOT1
      CALL MOVE
      WRITE(*,890)
890   FORMAT(' ENTER THE PRIVATE DRIVE MAINTENANCE COST FROM THE PREVIOU
     +S SOLUTION')
      READ(*,*) PFM1
      CALL MOVE
      WRITE(*,891)
891   FORMAT(' ENTER THE PRIVATE DRIVE RECONSTRUCTION COST FROM THE PREV
     +IOUS SOLUTION')
      READ(*,*) PREC1
      CALL MOVE
      WRITE(*,892)
892   FORMAT(' ENTER THE PRIVATE DRIVE BRIDGE MAINTENANCE COST FROM THE
     +PREVIOUS SOLUTION')
      READ(*,*) PMCB1
      CALL MOVE
      DMCB=TMCB1-TMCB
      DVM=TVM1-TVM
      DFM=TFM1-TFM
      DRC=TRC1-TRC
      DRS=TRS1-TRS
      TC1=TVM1+TFM1+TRC1+TMCB1+TRS1
      TC=TVM+TFM+TRC+TMCB+TRS
      DC=TC1-TC
      DPFM=PFM1-PFM
      DPREC=PREC1-PREC
      DPMCB=PMCB1-PMCB
      TPD1=PFM1+PREC1+PMCB1
      TPD=PFM+PREC+PMCB
      TD=TPD1-TPD
      DVL=TVL-TVL1
      CT1=TC1+TPD1+TVL1
      CT=TC+TPD+TVL
      DCT=DC+TD+DVL
      DTOT=CTOT-CTOT1
      RAT=DTOT/DCT
      WRITE(3,907)
907   FORMAT('ANNUAL COSTS OF KEEPING THE ROADS',9X,'PREVIOUS',8X,'CURRE
     +NT',9X,'CHANGE')
961   FORMAT(5X)
      WRITE(3,961)
      WRITE(3,909)
```

```
908  FORMAT(' COSTS TO THE COUNTY')
     WRITE(3,961)
     WRITE(3,909) TVM1,TVM,DVM
909  FORMAT(3X,'TOTAL VARIABLE MAINTENANCE COST ',3X,'$',F11.2,3X,'$',F
    +11.2,3X,'$',F11.2)
     WRITE(3,910) TFM1,TFM,DFM
910  FORMAT(3X,'TOTAL FIXED MAINTENANCE COST',4X,3F15.2)
     WRITE(3,911) TRC1,TRC,DRC
911  FORMAT(3X,'TOTAL RECONSTRUCTION COST',7X,3F15.2)
     WRITE(3,912) TRS1,TRS,DRS
912  FORMAT(3X,'TOTAL RESURFACING COST',10X,3F15.2)
     WRITE(3,913) TMCB1,TMCB,DMCB
913  FORMAT(3X,'TOTAL BRIDGE MAINTENANCE COST',3X,3F15.2)
     WRITE(3,961)
     WRITE(3,914) TC1,TC,DC
914  FORMAT(7X,'TOTAL COST TO THE COUNTY',4X,3X,'$',F11.2,3X,'$',F11.2,
    +3X,'$',F11.2)
     WRITE(3,961)
     WRITE(3,915)
915  FORMAT(' COSTS TO PRIVATE DRIVES')
     WRITE(3,961)
     WRITE(3,916) PFM1,PFM,DPFM
916  FORMAT(3X,'TOTAL MAINTENANCE COST',10X,3X,'$',F11.2,3X,'$',F11.2,3
    +X,'$',F11.2)
     WRITE(3,917) PREC1,PREC,DPREC
917  FORMAT(3X,'TOTAL RECONSTRUCTION COST',7X,3F15.2)
     WRITE(3,918) PMCB1,PMCB,DPMCB
918  FORMAT(3X,'TOTAL BRIDGE MAINTENANCE COST',3X,3F15.2)
     WRITE(3,961)
     WRITE(3,919) TPD1,TPD,TD
919  FORMAT(7X,'TOTAL COST TO PRIVATE DRIVES',3X,'$',F11.2,3X,'$',F11.2
    +,3X,'$',F11.2)
     WRITE(3,961)
     WRITE(3,921) TVL1,TVL,DVL
921  FORMAT(' TOTAL NET VALUE OF LAND',11X,3X,'$',F11.2,3X,'$',F11.2,3X
    +,'$',F11.2)
     WRITE(3,961)
     WRITE(3,961)
     WRITE(3,922) DCT
922  FORMAT('CHANGE IN TOTAL COST OF KEEPING THE ROADS',24X,3X,'$',F11.
    +2)
     WRITE(3,961)
     WRITE(3,961)
     WRITE(3,961)
     WRITE(3,923)
923  FORMAT('ANNUAL BENEFITS OF KEEPING THE ROADS',7X,'CURRENT',7X,'PRE
    +VIOUS',9X,'CHANGE')
     WRITE(3,961)
     WRITE(3,924) CTOT,CTOT1,DTOT
924  FORMAT(3X,'TOTAL TRAVEL COST',15X,3X,'$',F11.2,3X,'$',F11.2,3X,F11
    +.2)
     WRITE(3,961)
     WRITE(3,961)
     WRITE(3,961)
     WRITE(3,925)
```

```
  925  FORMAT('BENEFIT',5X,'CHANGE IN TRAVEL COST')
       WRITE(3,926)
  926  FORMAT('-------  -  ----------------------------------------')
       WRITE(3,927)
  927  FORMAT('COST',8X,'CHANGE IN THE COST OF KEEPING THE ROADS')
       WRITE(3,941)
       WRITE(3,928) DTOT
  928  FORMAT(12X,F15.2)
       WRITE(3,929)
  929  FORMAT(9X,'-  ---------------')
       WRITE(3,930) DCT
  930  FORMAT(12X,F15.2)
       WRITE(3,941)
       WRITE(3,931) RAT
       WRITE(3,941)
       WRITE(3,941)
       WRITE(3,941)
       WRITE(3,932)
  932  FORMAT('IF THE BENEFIT-COST RATIO IS GREATER THAN ONE, THE VALUE O
      +F OF THE ROAD(S) TO THE TRAVELING PUBLIC EXCEED THE COST OF KEEPIN
      +G THE ROADS(S).')
       WRITE(3,941)
       WRITE(3,933)
  933  FORMAT('IF THE BENEFIT-COST RATIO IS LESS THAN ONE, THE VALUE OF T
      +HE ROAD(S) TO THE TRAVELING PUBLIC IS LESS THAN THE COST OF KEEPIN
      +G THE ROADS(S).')
  931  FORMAT(9X,'=  ',F10.2)
       RETURN
       END
C
C
C
       SUBROUTINE MOVE
       DO 10 I=1,25
          WRITE(*,596)
  596     FORMAT(5X)
  10   CONTINUE
       RETURN
       END
```

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