SUPPLEMENTARY REPORT

submitted to

VERMONT LEGISLATIVE COUNCIL

HIGHWAY COST ALLOCATION STUDY

Review of Recommendations on User Taxes and Fees

Analysis of Special Excess Weight Permit Vehicle Fees

Additional Documentation of Cost Allocation Spreadsheets

Prepared by

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February 1993

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February 23, 1993

Ms. Anne Winchester
Vermont Legislative Council
State House
Montpelier, Vermont 05602

Dear Anne:

We are please to submit this supplementary report for the Vermont Highway Cost Allocation Study. It covers the three items requested in your August work program:

1. A brief review and update of the recommendations we made on user taxes and fees and weight limits

2. A special analysis of the revenues and cost responsibility for permit vehicles in comparison with Federal weight limits

3. Additional documentation of the spreadsheets developed and installed on your computer as part of the 1990 cost allocation study

You will be pleased to hear that we were able to dust off the old computer package, after almost three years, and successfully run the programs with the guidance of the May 1990 documentation report, with just a few hours of agonizing false starts.

Please give me a call if you have any questions or need clarification of anything in this report.

Sincerely,

Joseph R. Stowers
President

cc: Tony Redington

TABLE OF CONTENTS

REVIEW OF RECOMMENDATIONS ON USER TAXES AND FEES

We have reviewed the key recommendations made in our 1990 Final Report of the Vermont Highway Cost Allocation Study in light of the new findings contained in this report, recent experience in other states, and national and international developments in surface transportation finance. The general conclusion reached is that the 1990 recommendations are even more valid and supportable today.

The most important recommendation in the 1990 report, and the one recommendation addressed by the analysis done for this report, was that "fees should be increased for the heaviest three-axle single unit trucks and the heaviest five-or-more-axle combination trucks."[1] Six alternatives were evaluated, resulting in a recommendation that Vermont establish a special permit program with fees based on axle loading and mileage. The reasons for recommending this alternative over the other five are even more valid now than in 1990. The findings described below show that these heavy trucks cause even more pavement damage than estimated in 1990. Also, we have recently become familiar with related types of mileage-based fees for heavy trucks in two state (Oregon and Idaho) that have positive experience in administering and enforcing such taxes. We suggest that Vermont contact responsible officials in these and perhaps other states as a first step toward implementing a more rational excess weight permit fee structure.

We are currently involved in a major research project for the National Cooperative Highway Research Program on future directions for surface transportation finance in the U.S. -- a project that has been initiated by the chief administrative officers of the American Association of State Highway and Transportation Officials. Although it is too early to cite recommendations from this study,

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[1]Sydec, Inc.; Highway Cost Allocation Study; March 1990; pages 1-3.

we are confident that that project will result in recommendations that will be quite supportive of our recommendation to Vermont.

A variety of major trends and developments all suggest a long-term transition toward mileage-based taxes and fees in various forms, including such factors as the development of alternative fuels, new vehicle monitoring technologies, computerized base state tax systems, environmental impacts of vehicle use, and evolving multi-state organizational structures for collection and administration of transportation taxes.

ANALYSIS OF SPECIAL EXCESS WEIGHT PERMIT FEES

Findings

This section presents the results of a more detailed assessment of the cost responsibility of heavy trucks than was done for the 1990 Vermont Highway Cost Allocation Study (HCAS). The spreadsheet package developed for that study was designed to assess the tax receipts and cost responsibility of nine vehicle classes. However, that system was not specifically designed to evaluate any subsets of these nine vehicle classes, such as those with the heaviest axle loads or highest gross weights.

The results that were presented in the 1990 Final Report for the heaviest vehicles were considered approximate and were based in part on a special analysis we had previously performed as part of the California HCAS. In that study we had carefully analyzed the way in which California revenues and cost responsibility varied as a function of both gross weight and annual miles traveled in California. We had used these relationships to develop the estimates for Vermont presented on pages 45-47 of the Final Report.

Subsequently, as part of our work on the Minnesota HCAS, we developed a spreadsheet package similar to the Vermont package and also developed an approach for using the spreadsheets to perform selected special vehicle analyses. In brief, the approach involves substituting vehicle characteristics for a particular special vehicle on the spreadsheets for one of the main vehicle classes (ten classes were used in Minnesota). In order to minimize the effects that this would have on the revenue and cost responsibility shares estimated for the other main vehicle classes, only a small number of vehicles in the special vehicle class were used and the class selected for being replaced by the special vehicles was motorcycles -- one of the smallest classes in terms of many vehicle characteristics. (Three axle combinations would also have been an acceptable choice to replace.) This has to be done rather than

simply adding extra rows in the many tables for a special vehicle class on the spreadsheets because the spreadsheets are unfortunately very difficult to reformat in terms of number of vehicle classes in the tables.

The special vehicle analysis approach developed in the Minnesota HCAS has been used for this analysis. A slight refinement was made to eliminate an apparent problem encountered in the Minnesota application -- i.e., an initial run of the spreadsheet package was performed as a base case test, using a few vehicles with exactly the same vehicle characteristics as a main vehicle class (e.g., 5+ axle combinations), to assure that results are obtained that are the same in terms of the revenue-to-cost-responsibility ratios. This is done for each main vehicle class from which selected special vehicle classes are to be analyzed (i.e., 3+ axle single unit trucks and 5+ axle combinations in this analysis).

The precise steps involved in performing the analyses are documented in the section that follows.

Exhibit 1 presents the results of ten runs of the special vehicle analysis for the FY 1991-93 period, and Exhibit 2 presents the same data for the FY 1994-2000 period. For each of the two main vehicle classes (3+ axle single unit trucks and 5+ axle combinations), the rows of the exhibits present results for the following five weight limit cases:

1. Current conditions: using the complete axle weight distributions as obtained from the most recent Truck Weight Study data

2. Federal limit enforcement: using weight distributions for single and tandem axles that are truncated at the Federal limits of 20 and 34 thousand pounds, thus implicitly assuming perfect enforcement

3. Operation at the special excess weight limit for 50 percent of the mileage and empty for the other 50 percent, with no change in the distribution of mileage among functional classes of highway

EXHIBIT 1 FY 1991-93 RESULTS

REVENUE AND COST RESPONSIBILITY FOR SELECTED VEHICLES

Vehicle Class and Weight Limit Changes	Revenue Per Mile	Cost Responsibility Per Mile		Revenue-to-Cost Responsibility Ratio	
		Federal Method	Incremental Method	Federal Method	Incremental Method
Five Axle Combinations:					
Current conditions all 5+ axle	7.1¢/mi.	7.4	6.5	0.95	1.10
Federal limit enforcement	7.1¢/mi.	6.5	6.2	1.08	1.14
90,000 GVW, 50% empty, 50% fully loaded	7.2¢/mi.	14.4	7.6	0.50	0.95
90,000 GVW, 100% loaded	7.2¢/mi.	18.0	10.0	0.40	0.72
90,000 GVW, 50% empty, 50% loaded, no Interstate travel	7.2¢/mi.	17.1	8.4	0.42	0.86
Three Axle Single Unit Trucks:					
Current conditions all 3+ axle	9.1¢/mi.	11.1	7.7	0.82	1.19
Federal limit enforcement	9.1¢/mi.	9.5	7.1	0.96	1.28
60,000 GVW, 50% empty, 50% fully loaded	9.5¢/mi.	17.5	9.2	0.54	1.03
60,000 GVW, 100% loaded	9.5¢/mi.	18.2	11.7	0.52	0.81
60,000 GVW, 50% empty, 50% loaded, no Interstate travel	9.5¢/mi.	20.6	11.7	0.46	0.81

EXHIBIT 2 FY 1994-2000 RESULTS

REVENUE AND COST RESPONSIBILITY FOR SELECTED VEHICLES

Vehicle Class and Weight Limit Changes	Revenue Per Mile	Cost Responsibility Per Mile		Revenue-to-Cost Responsibility Ratio	
		Federal Method	Incremental Method	Federal Method	Incremental Method
Five Axle Combinations:					
Current conditions all 5+ axle	6.8¢/mi.	7.4	6.4	0.92	1.06
Federal limit enforcement	6.8¢/mi.	6.5	6.2	1.04	1.09
90,000 GVW, 50% empty, 50% fully loaded	6.9¢/mi.	13.6	7.5	0.51	0.92
90,000 GVW, 100% loaded	6.9¢/mi.	16.4	9.5	0.42	0.73
90,000 GVW, 50% empty, 50% loaded, no Interstate travel	6.9¢/mi.	16.0	8.2	0.43	0.84
Three Axle Single Unit Trucks:					
Current conditions all 3+ axle	9.1¢/mi.	11.4	8.1	0.80	1.12
Federal limit enforcement	9.1¢/mi.	9.8	7.5	0.93	1.21
60,000 GVW, 50% empty, 50% fully loaded	9.4¢/mi.	17.4	9.7	0.54	0.98
60,000 GVW, 100% loaded	9.4¢/mi.	17.4	11.2	0.54	0.84
60,000 GVW, 50% empty, 50% loaded, no Interstate travel	9.4¢/mi.	20.9	12.4	0.45	0.76

4. Operation at the special excess weight limit for 100 percent of the mileage, with no change in the distribution of mileage among functional classes of highway

5. The same as #3, except that all travel on the Urban and Rural Interstate is shifted to Urban and Rural Other Principal Arterials respectively

For the first two cases, the revenue per vehicle mile is based on current tax and fee rates, including the recent increase in registration fee rates, as built into the spreadsheets. For the other three cases, the current $72.50 annual permit fee is added. Note that the revenues per vehicle mile increase only very slightly, assuming that the permit vehicles travel the same annual mileage in Vermont.

In contrast, the cost responsibility per mile changes quite substantially in the exhibits. Under the Federal Method, the cost responsibility of permit vehicles approximately doubles for five-or-more-axle combinations and increases by about 50 percent for three-or-more-axle single unit trucks. Combining the changes in revenue and cost responsibility per mile shows that revenue-to-cost-responsibility ratios (or "equity ratios") decrease greatly for the permit vehicles. They pay only about half of their cost responsibility under the Federal Method.

The additional cost responsibility for FY 1991-93 under the Federal Method, assuming no Interstate travel and the same total mileage in Vermont is as follows:

5+ axle combinations: 9.7¢/mile or $5,700/year
3+ axle single units: 9.5¢/mile or $2,100/year

Under the same assumptions and conditions, the additional revenue required to meet cost responsibility is:

5+ axle combinations: 9.9¢/mile or $5,900/year
3+ axle single units: 11.1¢/mile or $2,400/year

These last values are the best current estimates of the per mile or per year permit fees that would have to be charged to cover cost responsibility, under the above assumptions and conditions. Note that these are roughly double the estimates in the 1990 Final Report.

Step by Step Procedures Used in the Analysis

The procedures required to perform the analysis completed for this report can be simplified by breaking them into two parts (a) the steps required to run the spreadsheet package, and (b) the changes required in various locations on the spreadsheets to properly represent the special vehicles analyzed.

Steps Required to Run the Spreadsheet Package

The steps outlined below are essentially a listing of steps that are described in various locations in the May 1990 documentation report. Some of these steps, however, were not explicitly described in the report because we had not had occasion to use the package in this manner at the time the report was prepared.

Please review the discussion of the sequence of running the spreadsheets on pages 2 and 3 of the report. Note that not all spreadsheets need to be rerun for any given analysis, depending on what changes are being made. Steps listed below are required only if a change is being made on that spreadsheet or on a spreadsheet that feeds into that spreadsheet as shown on the flow chart on page A-1 of the report.

1. Copy all eight spreadsheets onto a directory called LOTUS. (See page 1 of the report regarding the disabling of the UNDO command.)

2. Load PAVERUR.WK1, press F9 (calculate) and ALT G (a macro that requires some time to run), then save the spreadsheet after the macro has run.[1]

3. Load COSTMAST.WK1, press F9, and save.

4. If VMT data are changed on COSTMAST.WK1, load PAVERUR.WK1 again and repeat #2, otherwise skip to #5.

5. Load PAVEURB.WK1, press F9 and ALT G, then save the spreadsheet after the macro has run.

6. Load PAV#.WK1, press F9 and ALT S, then F9 again after the macro has run, then save.

7. Load BRIDGE.WK1, press ALT S, then save.

8. Load GRADROW#.WK1, press ALT S, then save.

9. Load TBLMAST.WK1 and save.

10. Before making additional runs with different inputs, copy TBLMAST.WK1 to a different directory, under a unique name if desired (e.g., TBLMAST1.WK1, TBLMAST2,WK1, etc.), if the results are to be saved. Alternatively, selected summary tables can be extracted as different spreadsheets or print files.

Note that one spreadsheet, REVMAST.WK1 is not included in the above list of steps. As described further below, we found it much easier to edit the revenue summary tables near the end of TBLMAST.WK1 than to edit the very detailed revenue analyses in REVMAST.WK1. However, for some types of analyses, such as a change in tax rates or fees, REVMAST.WK1 will have to be rerun by loading it, pressing F9, and saving. This can be done at any time prior to loading TBLMAST.WK1.

All the results used in Exhibits 1 and 2 can be developed from tables near the end of TBLMAST.WK1. The two final summary tables at A600..V611 (FY 1991-93) and A620..V631 (FY 1994-2000) show the revenue-to-cost responsibility ratios for the two forecast periods

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[1]F9 (calculate) is required to be pressed in the steps indicated and at any other time that the CALC indicator appears on the screen after loading a spreadsheet, making any changes on the spreadsheet, or after running the spreadsheet using a macro.

for both the Federal and Incremental Methods. These ratios are a compromise used in the original study based on the average of (a) results using a vehicle width cost allocation analysis, and (b) results not using a width cost allocation analysis. They include cost responsibility for both direct state expenditures and local expenditures of state assistance -- as was done in the original study report.

Revenues, revenue per mile, number of vehicles, and vehicle miles of travel (VMT) data for both periods are contained in tables at A335..F374 and A401..F439. Cost responsibility per mile, revenue per vehicle, and cost responsibility per vehicle can be calculated easily for each vehicle class from these data and the two final tables at A600..V611 and A620..V631.

Changes Required in the Spreadsheets for This Analysis

All of the changes required for the analyses covered in this report are listed below. As noted previously, the changes made all involved substituting selected vehicle characteristics for the motorcycle vehicle class. A total of ten runs were required to produce the data reported in Exhibits 1 and 2. Five runs were required for each of the two vehicle classes (3 axle or more single unit trucks and 5 or more axle combinations) -- one for a base case to assure that the results were the same as for the original vehicle class and one for each of the four other weight limit changes shown in the exhibits. Each run produces results for both forecast periods, FY 1991-93 and FY 1994-2000. A complete run of the several spreadsheets affected by the changes assumed is required to produce results for each row of the exhibits.

REVMAST.WK1 No changes were made for any of the runs. Revenue changes were all made on TBLMAST.WK1 as described below, except that the $72.50 annual permit fee was added by hand after completion of the runs.

COSTMAST.WK1 VMT for the special vehicles (i.e., the "motorcycle" rows) were changed to either 1/1000 of 5+ axle combinations and 1/100 of 3+ axle single unit trucks in the rows at AB44.. and AB122.. for each run, except that in the "no Interstate travel" case, VMT for the special vehicles was set to zero for both Rural and Urban Interstates and VMT on these highways was shifted to Rural and Urban Other Principal Arterials (i.e., added to the VMT in those cells, with all values multiplied by either the 1/1000 or 1/100 factor). In addition, the special vehicles were given either 3+ axle or 5+ axle characteristics depending on the run, for various factors by copying the appropriate rows to the special vehicle ("motorcycle") rows at B414.., B583.., B652.., and J652... These data describe such characteristics as the width distributions of vehicle classes and their weight-to-horsepower ratios.

PAVERUR.WK1 and PAVEURB.WK1 The axle weight distribution columns for either 3+ axle or 5+ axle vehicles, depending on the run, were copied to the special vehicle ("motorcycle") column @ C49.. for single axles and C142.. for tandem axles for the "current conditions" case. For the "Federal limit enforcement" case, all cells above 20 and 34 thousand pounds for single and tandem axles were set to zero and the remaining cells' values were increased proportionally to add to the original total of the axle weight distributions. This keeps the total number of single and tandem axles per vehicle fixed at very slightly more than 3.0 and 5.0 axles for the two classes of vehicles, and it implicitly assumes 100 percent enforcement of the Federal axle limits.

Exhibit 3 summarizes the axle weight distributions assumed for each of the computer runs. The "current conditions" case uses the complete distribution from the Truck Weight Study without change. A substantial proportion of all tandem axles are above the Federal limit of 34,000 pounds in this distribution, and results in an overall average gross vehicle weight (GVW) of about 48,000 and 33,000 pounds for the 5+ and 3+ classes respectively. Truncating these distributions as described above results in reducing the average GVWs to about 45,000 and 27,000 pounds respectively.

EXHIBIT 3

AXLE WEIGHT DISTRIBUTIONS ASSUMED FOR THE SPECIAL VEHICLE ANALYSES

Vehicle Class and Weight Limit Changes	Numbers of Axles and Weight in Thousands of Pounds		Gross Weight (000 lbs.)
	Single Axles	Tandem Axles	
Five Axle Combinations:			
Current conditions	Complete distribution from Truck Weight Study		48 (Avg.)
Federal limit enforcement	None above 20	None above 34	45 (Avg.)
90,000 GVW, 50% empty, 50% fully loaded*	0.5 @ 8 0.5 @ 14	1 @ 11 1 @ 38	(30 + 90)/2 = 60 (Avg.)
90,000 GVW, 100% loaded	1 @ 14	2 @ 38	90
Three Axle Single Unit Trucks:			
Current conditions	Complete distribution from Truck Weight Study		33 (Avg.)
Federal limit enforcement	None above 20	None above 34	27 (Avg.)
60,000 GVW, 50% empty, 50% fully loaded	0.5 @ 10 0.5 @ 20	0.5 @ 14 0.5 @ 40	(24 + 60)/2 = 42 (Avg.)
60,000 GVW, 100% loaded	1 @ 20	1 @ 40	60

* Applies to both the case which allows special permit vehicles on the Interstate system and the case which prohibits them on the Interstate system.

The other runs each eliminate the detailed distributions and substitute weights for illustrative vehicles. The simplest of these is the 100% loaded case with representative axle weights that add to the special permit vehicle limits of 90,000 and 60,000 pounds respectively. The other cases assume representative axle weights for vehicles that are empty for half their mileage, adding to 30,000 and 24,000 pounds respectively, and fully loaded for the other half of their mileage. This results in average GVWs of 60,000 and 42,000 pounds for the 5+ and 3+ axle classes respectively.

GRADROW#.WK1 Truck/no truck switches were switched from 0 to 1 at B381 and G481.

TBLMAST.WK1 Each category of revenue, vehicles, and VMT for special vehicles ("motorcycles") was changed to 1/100 of that for 3+ axle single unit trucks or 1/1000 of that for 5+ axle combinations, depending on the run, in all of the six revenue summary tables beginning at A335.

ADDITIONAL DOCUMENTATION OF COST ALLOCATION SPREADSHEETS

COSTMAST.WK1:

This spreadsheet contains most of the data used in the Vermont Cost Allocation Study. The data sections are:

1. Pavement Analysis:
   a. Pavement rehabilitation/resurfacing projects -- pavement costs and percent distributions by functional highway system and frost depth (A5.S42)

      Source: Representative pavement projects in Vermont

   b. New Facilities pavement projects -- pavement, bridge and grading costs and percent distributions by functional highway system and frost depth (A45.S54)

      Source: Representative new facilities projects in Vermont

   c. Reconstruction projects -- pavement, bridge and grading costs and percent distributions by functional highway system and frost depth (A59.V90)

      Source: Representative reconstruction projects in Vermont

   d. Pavement design tables -- development of load-related and non-load-related pavement costs by functional class for minimum pavement and required pavement. Some of the parameters contained in these tables are: design frost depth; inches of asphalt, subbase, and sand borrow; and cost per linear square foot (Z193.AO216, Z219.AT274)

      Sources: Average frost depth is based on Vermont pavement design policy.

      Pavement layer thickness for minimum pavement is based on Vermont recommendations.

      Minimum and required pavement quantities are estimated from typical pavement cross sections provided by Vermont.

      Costs per linear foot are based on 1989 average low bid prices.

      Required structural numbers are from the AASHTO Interim Guide.

Required pavement thicknesses are based on Vermont pavement design guidelines.

Required and minimum overlay thicknesses are based on Vermont pavement design standards.

Linkage: Linked to PAVERUR.WK1 and PAVEURB.WK1 (AN202.AN214)

e. ESAL Analysis

ESALs per vehicle (computed in the PAVERUR.WK1 spreadsheet and linked to this spreadsheet) and 20 year ESAL miles by functional highway system (BE1.BS33)

20 year average ESALs by functional highway system (AR196.AV216)

Linkage: Linked to GRADROW#.WK1 and PAV#.WK1 (BF5.BF13)

f. Number of axles per vehicle (computed in the PAVERUR.WK1 spreadsheet and linked to this spreadsheet) (BU3.BW13)

Linkage: Linked to GRADROW#.WK1 (BW5.BW13)

2. VMT Analysis:

VMT for 1988, 1992 & 1997 for State Highways and all highways in Vermont by functional highway system and vehicle type (Z1.BB186)

Sources: Vermont reports for the Highway Performance Monitoring System

Growth rates from Vermont Agency of Transportation report "Regression Analysis for Traffic Projection Based on Traffic Data Through 1988."

Linkage: Linked to GRADROW#.WK1 & BRIDGE#.WK1 (AP5.BA13, AP20.BA28, AN5.AN13, AN20.AN28)

Linked to GRADROW#.WK1 (AB5.AM13, AB20.AM28)

Linked to PAVERUR.WK1 and PAVEURB.WK1 (AB61.AM69)

Linked to PAV#.WK1 (AB43.AM51, AB57.AM57, AB73.AM73, AB74.AM74, AB75.AM75, AB121.AM129, AB135.AM135)

3. Expenditure Analysis:

a. Parameters for converting 3 year capital improvement program and 7 year program plan into categories of construction work (A96.O113)

b. Forecasts of expenditures for FY 1991-1993 and FY 1994-2000 based on 3 year program and 7 year plan (Q99.W113)

c. Expenditures for base year and forecast period for capital improvement and non-capital programs (A120.O165)

d. Conversion of FY 1990-1999 expenditures to FY 1991-2000 (R120.X133)

e. Summary of expenditures to be allocated by various cost allocation procedures for FY 1991-1993 and FY 1994-2000 (A169.L184)

f. Expenditures of transportation funds for non-highway-related program for FY 1991-1993 and FY 1994-2000 (Q150.X164)

g. Distribution of local expenditures by construction category from State and Federal sources (Q169.U181)

h. Distribution of State expenditures by functional class and construction category for FY 1991-1993 and FY 1994-2000 (A187.X245)

i. Summary of costs by construction category and functional highway system for FY 1991-1993 and FY 1994-2000. The construction categories are ROW & Misc., grading, bridge rehabilitation/replacement, new bridge, bridge repair, new pavement, rehabilitated pavement, maintenance and non-capital program. (A246.P406)

Sources:
1. Vermont FY 1990 budget
2. Draft annual report
3. Approved Annual Report to the General Assembly
4. Appendix VIII of the Transportation Fund Study Committee
5. Local breakdowns of expenditures were determined from a Vermont telephone survey

Linkage: Linked to GRADROW#.WK1 (C264.N265, P212, P243, C251.N252, R212, R243, B367.M371, B378.M382, V212, V243, D399.E400)

Linked to BRIDGE#.WK1 (C291.N292, J212, J243, C277.N278, L212, L243, C304.N305, N212, N243)

Linked to PAV#.WK1 (P318.P319, P331.P332, R318.R319, R331.R332)

4. Bridge & Grading Analysis:

   a. Cumulative vehicle miles by vehicle type and bridge design increment (A411.H421)

      Source: Vermont Truck Weight Study for years 1986, 1984 and 1982

      Linkage: Linked to BRIDGE#.WK1 (B413.H421)

   b. Incremental analysis of new bridges and replaced/ rehabilitated bridges. Contains calculations of cost per bridge design increment for new bridges and replaced/ rehabilitated bridges based on count (7 bridge projects were analyzed) and cost (4 bridge projects were analyzed) (A424.H557)

      Source: Sample of Vermont bridge projects

      Vermont bridge inventory

      "Incremental Analysis of Structural Construction Costs" by Benito A. Sinclair

      Linkage: Linked to BRIDGE#.WK1 (B534.H534, B557.H557)

   c. Structures and grading cost by width increment (A560.Q572)

      Source: "Synthesis of Information on Roadway Geometrics Causal Factors" by Jack Leisch

      Linkage: Linked to GRADROW#.WK1 and BRIDGE#.WK1 (B563.G568, K563.P568)

   d. National VMT by weight-horsepower increment and cumulative vehicle miles by weight-horsepower increment (A577.H604)

      Source: Federal Highway Cost Allocation Study, 1977 TIUS

      Linkage: Linked to GRADROW#.WK1 (B596.G604)

   e. Calculation of grading costs by weight-horsepower increments and highway system using the earthwork cost function equation developed by Jack Leisch (A607.L645)

      Source: K factor and earth work cost function equation developed by Jack Leisch for the Federal Highway Cost Allocation Study

      Mileage by terrain type and highway system from FHWA Table 3R entitled "1987 Rural Paved Mileage and Travel by terrain type and Average Highway Speed"

      Linkage: Linked to GRADROW#.WK1 (B627.G632, B635.G640)

f. Cumulative vehicle miles by width increment and vehicle class (A648.O659)

Source: 1985 California Cost Allocation Study by SYDEC

Linkage: Linked to GRADROW#.WK1 and BRIDGE#.WK1 (B651.G659)

Linked to PAVERUR.WK1 and PAVEURB.WK1 (J651.O659)

BRIDGE#.WK1:

a. New bridges and rehabilitated/replaced bridges section:

1. Data linked from COSTMAST.WK1 (A1.Q94)

Includes: 1992 & 1997 VMT, Cumulative Vehicle Miles by Width Increment, Structures Cost by Width Increment, Cumulative Vehicle Miles by Bridge Design Increment, New Bridge Costs by Bridge Design Increment, Rehabilitated/Replaced Bridge Costs by Bridge Design Increment

2. Bridge cost allocation analysis (A96.BB155)

3. Bridge revenue analysis (A158.Q184)

Includes revenue data linked from COSTMAST.WK1: New bridge revenue by highway system, and Rehabilitated/ Replaced bridge revenue by highway system

4. New bridge expenditure summary tables linked to TBLMAST.WK1 (A187.AK277)

5. Bridge macros (A281.H355)

b. Bridge Repair section:

1. Federal Method analysis (A357.R400)

Includes bridge repair revenue by highway system linked from COSTMAST.WK1

2. Federal Method bridge repair revenue summary tables linked to TBLMAST.WK1 (A402.R430)

3. Incremental Method analysis (A434.S502)

4. Incremental Method bridge repair revenue summary tables linked to TBLMAST.WK1 (A443.S502)

GRADROW#.WK1:

a. Grading section:

1. Data linked from COSTMAST.WK1 (A1.Q85)

   Includes: 1992 & 1997 VMT, Cumulative Vehicle Miles by Width Increment, Structures and Grading Cost by Width Increment, Cumulative Vehicle Miles by Weight-Horsepower Increment, Grading Costs by Weight-Horsepower Increment

2. Grading cost allocation analysis (A87.BA146)

3. Grading revenue analysis (A149.Q168)

   Includes grading revenue by highway system linked from COSTMAST.WK1

4. Grading expenditure summary tables linked to TBLMAST.WK1 (A170.AK198)

5. Grading macros (A201.D242)

b. ROW and misc. section:

1. ROW and misc. revenue by highway system linked from COSTMAST.WK1 (A248.R252)

2. ROW and misc cost allocation analysis (A256.O290)

3. ROW and misc. expenditure summary tables linked to TBLMAST.WK1 (A293.P318)

c. State Non-Capital costs section:

1. State Non-Capital revenue by allocation factor linked from COSTMAST.WK1 (A324.F329)

2. State Non-Capital cost allocation analysis (A331.I420)

3. State Non-Capital expenditure summary tables linked to TBLMAST.WK1 (A423.H448)

d. Maintenance allocation section:

1. Data linked from COSTMAST.WK1 (A454.R518)

   Includes: Maintenance revenue by highway system and maintenance allocator, axles per vehicle, ESALs per vehicle, and VMT on the state system

2. Maintenance cost allocation analysis (A521.P565)

3. Maintenance expenditure summary tables linked to TBLMAST.WK1 (A567.P593)

4. Maintenance macros (A595.H621)

e. Macro to run entire spreadsheet (A624.D626)

PAVERUR.WK1 and PAVEURB.WK1:

a. Data linked from COSTMAST.WK1 (A1.G12, J1.O3, X1.AC10)

Includes: VMT, minimum pavement cost percents, and cumulative VMT by width increment

b. Data linked to COSTMAST.WK1 (from PAVERUR.WK1 only)

1. ESALS per vehicle (AE1.AE10)

Source: 1972 AASHTO Interim Guide for Design of Pavement Structures

2. Axles per vehicle (AG2.AG10)

c. Pavement cost allocation analysis (A14.BX768)

d. Single axle weight distributions by vehicle class (A46.K88) and tandem axle weight distributions (A90.K145) from Truck Weight Study data

e. Pavement macros (CA134.CE283, AA350.AE427, BR60.BU103)

f. Pavement cost shares (percentages) by vehicle class and highway class for the minimum pavement thickness method and the Incremental Method linked to PAV#.WK1 (CA13.CG131)

PAV#.WK1

a. Pavement data linked from COSTMAST.WK1 (A1.O104, AD1.AD15, AC19.AD28, B175.B183)

Includes: VMT, minimum pavement cost percents, new pavement revenue, and rehabilitated pavement revenue

b. Pavement cost shares linked from PAVERUR.WK1 and PAVEURB.WK1 (A399.BM433)

c. Pavement cost allocation analysis (A107.O155, AI5.BB155, A172.BM344)

d. Pavement macros (A349.C380, AA299.AI396)

e. Pavement expenditure summary tables linked to TBLMAST.WK1 (BD5.BY154)

REVMAST.WK1:

a. Purchase and use tax section (A1.V40, X7.AR89)

   Linked to TBLMAST.WK1 (AL45.AL47, AL57.AL59, AK42.AK47, AK54.AK59)

b. Fuel tax section (A45.P217)

   Linked to TBLMAST.WK1 (F172.F180, F188.F196)

c. Registration tax section (A221.EV325, AB326.BQ399)

   Linked to TBLMAST.WK1 (EV234.EV236, EV248.EV250, BP376.BQ384, BP394.BQ395)

d. Drivers license tax section (A328.I368)

   Linked to TBLMAST.WK1 (D358.E366)

e. All other Vermont taxes (A372.T456)

   Linked to TBLMAST.WK1 (J452, L452, J456, L456)

   Sources used in estimating the various Vermont taxes:

   1. Vermont DMV "Revenue Receipts Report"
   2. FHWA fuel efficiency estimates
   3. Argonne National Labs fuel efficiency estimates
   4. The Truck Inventory and Use Survey (TIUS)
   5. Vermont registration data

TBLMAST.WK1:

a. Grading expenditure summary tables, linked from GRADROW#.WK1 (A4.W31)

b. ROW and misc. expenditure summary tables, linked from GRADROW#.WK1 (A34.W46)

c. Maintenance expenditure summary tables, linked from GRADROW#.WK1 (A49.W61)

d. Bridge expenditure summary tables, linked from BRIDGE#.WK1 (A64.W196)

e. State non-capital expenditure summary tables, linked from GRADROW#.WK1 (A199.K211)

f. Pavement expenditure summary tables, linked from PAV#.WK1 (A214.W331)

g. Revenue forecast section (A335.R497)

    1. Revenue data linked from REVMAST.WK1 (D338.R354, D407.R419)

    2. VMT data linked from COSTMAST.WK1 (B364.B372, B429.B437)

    3. Revenue summary tables (A466.E497)

h. Cost responsibility summary tables

    1. For FY 1991-1993 (A505.M522)

    2. For FY 1994-2000 (A547.M564)

i. Revenue-to-cost responsibility ratios

    1. For FY 1991-1993 (A526.M544)

    2. For FY 1994-2000 (A568.M586)

j. Summary of results by program category (A596.V631)