

22096857

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

PERFORMANCE AUDIT PROGRAM

PHASE I

*FINAL REPORT*  
*SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT*

Submitted by

SIMPSON & CURTIN

A Division of Booz, Allen & Hamilton Inc.

and

DAVE CONSULTING, INC.

OCTOBER 1982

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## PERFORMANCE AUDIT PROGRAM

### PHASE I

#### INTRODUCTION

##### TPM and TDA Performance Audit Program

In July 1981, the Los Angeles County Transportation Commission (LACTC) adopted a Transit Performance Measurement (TPM) program requiring transit operators receiving funds through the Commission to collect and report nine non-financial operating statistics. The statistics are reported by five service classifications on an annual basis. From this extensive data base, LACTC will calculate seven performance indicators which will be used to evaluate operator performance. Transit systems completed and submitted TPM reporting forms with their Short Range Transit Plans (SRTP) in February 1982. During this first year of the program, LACTC will review the FY 1981 data for informational purposes only; beginning with FY 1982 data, however, the statistics will form the basis of funding allocation decisions.

In addition to the TPM program, transit operators are obligated to satisfy the reporting requirements of the State of California's Transportation Development Act (TDA). Among its provisions, TDA requires the submittal of five systemwide performance indicators. All but two of the statistics used in the computation of these indicators are included in the TPM program. The statistics used to derive the indicators and the indicators themselves are submitted in the operator's SRTP. A

triennial audit is specified by TDA to verify the statistics and to interpret the meaning of identified performance trends.

### Phase I Objectives

The purposes of this Performance Audit Phase I report are: (1) to verify the accuracy and reliability of the operators' reported TPM and TDA statistics; and (2) to evaluate the five performance indicators required by the California Public Utilities Code. More specifically, the objectives are to:

- Document how data are collected, stored and reported;
- Evaluate and verify data collection and reporting procedures;
- Identify potential procedural problems and recommend improvements;
- Identify trends in operator performance; and
- Assess overall system efficiency and effectiveness.

The data items to be reviewed are presented in Exhibit 1. Nine of the items are required by TPM; five by TDA. The discussion of each operator's data collection procedures is organized by data item, following the order presented in Exhibit 1. For each operator, the following is presented:

- Copies of reporting forms
- Operator definitions of TPM and TDA data items. LACTC and TDA definition of terms are presented in Attachment A and are used as a benchmark for evaluating reported statistics

**EXHIBIT 1**

**PERFORMANCE AUDIT PHASE I  
TPM AND TDA DATA REVIEW**

---

<u>Data Item</u>	<u>Reviewed For</u>	
	<u>TPM<sup>(1)</sup></u>	<u>TDA<sup>(2)</sup></u>
A. Total Vehicle Miles	X	
B. In-Service Vehicle Miles	X	X
C. Total Vehicle Hours	X	
D. In-Service Vehicle Hours	X	X
E. Peak Vehicles	X	
F. Unlinked Passengers	X	X
G. Passenger Revenue	X	
H. Auxiliary Revenue	X	
I. Local Subsidies	X	
J. Total Operating Cost		X
K. Full-Time Equivalent Employees		X

---

(1) *Data are reported by five service classifications: Demand-Based Local; Policy-Based Local; Intra-Community Local; Multiple Stop Express; and Few Stops Express.*

(2) *Data are reported by three service classifications: Express Bus; Local Fixed Route; and Demand Responsive.*

- Description of data collection procedures, including step-by-step flowcharts and tables. A flowchart legend is presented in Attachment B
- Description of verification procedures
- Findings as to the accuracy and reliability of the reported statistics
- Identification of procedural problems
- Recommendations for improving data collection procedures and TPM/TDA data reporting.

The discussion of performance trends is organized by indicator as follows:

- A. Operating Cost per Passenger
- B. Operating Cost per Vehicle Service Hour
- C. Passengers per Vehicle Service Hour
- D. Passengers per Vehicle Service Mile
- E. Vehicle Service Hours per Employee

The analysis for each operator includes the presentation of indicator data for fiscal years 1978 through 1981; a discussion of performance trends; and an assessment of transit system efficiency and effectiveness.

Reports have been prepared for the fourteen fixed route and demand-responsive transit operators in Los Angeles County receiving funds through the Commission. This volume contains the Phase I reports for the Southern California Rapid Transit District.



ATTACHMENT A

TPM AND TDA DATA ELEMENT DEFINITIONS

	<u>LACTC Definitions of Data Reporting Terminology<sup>1</sup></u>	<u>TDA Performance Measure Definitions<sup>2</sup></u>
A. Total Vehicle Miles	The total distance traveled by revenue vehicles, including both revenue miles and deadhead miles.	NA
B. In-Service Vehicle Miles	Total miles traveled by revenue vehicle while in revenue service. Excludes miles traveled to and from storage facilities and other deadhead travel. Same as revenue vehicle miles.	<u>Vehicle Service Miles</u> means total number of miles that each vehicle is in revenue service.
C. Total Vehicle Hours	The total house of travel by revenue vehicles including scheduled hours consumed in passenger service and deadhead travel.	NA
D. In-Service Vehicle Hours	The total number of scheduled hours that a vehicle is in revenue service. Excludes hours consumed while traveling to and from storage facilities and during other deadhead travel.	<u>Vehicle Service Hours</u> means total number of hours that each transit vehicle is in revenue service, including lay-over.

ATTACHMENT A  
TPM AND TDA DATA ELEMENT DEFINITIONS  
(Continued)

	<u>LACTC Definitions of Data Reporting Terminology<sup>1</sup></u>	<u>TDA Performance Measure Definitions<sup>2</sup></u>
E. Peak Vehicles	Maximum number of individual revenue vehicles assigned to service during any one period of time	NA
F. Unlinked Passengers	The number of passengers who board public transportation vehicles. Passengers are counted each time they board a vehicle even though it may be on the same journey from origin to destination.	<u>Total Passengers</u> means the number of boarding passengers whether revenue producing or not, carried by the public transportation system.
G. Passenger Revenue	a. Revenue earned from carrying passengers along regularly scheduled routes. Includes base fare, zone and express premiums, extra cost transfers, and park-and-ride revenue.  b. Special transit fares: Revenues earned from subsidies received from agencies or organizations outside the City of agency providing transit service for:	NA

ATTACHMENT A  
TPM AND TDA DATA ELEMENT DEFINITIONS

LACTC Definitions of  
Data Reporting Terminology<sup>1</sup>

TDA Performance Measure  
Definitions<sup>2</sup>

1. Rides given in regular service but paid for by organization other than rider
2. Rides given along special routes for which revenue may be guaranteed

Not general fare assistance. Special transit fares must be applied to specific TPM service classifications.

H. Auxiliary Revenue

Revenues earned from operations closely associated with transportation operations (e.g., advertising, station and vehicle concessions).

NA

I. Local Subsidies

Includes general operating assistance, local special fare assistance and other local sources.

ATTACHMENT A  
TPM AND TDA DATA ELEMENT DEFINITIONS

LACTC Definitions of  
Data Reporting Terminology<sup>1</sup>

TDA Performance Measure  
Definitions<sup>2</sup>

J. Operating Cost

All costs in operating expense object classes exclusive of depreciation and amortization and exclusive of all direct costs for providing charter service.

K. Full-Time Equivalent Employees

N/A

Number of employees employed in connection with the public transportation system, based on the assumption that 2,000 person-hours of work in one year constitute one employee.

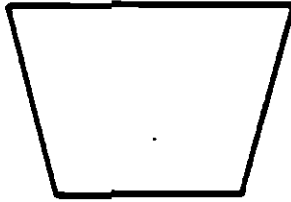
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NA Not Applicable

<sup>1</sup> Technical Advisory Committee, Short Range Transit Plan Guidelines, October 10, 1981.

<sup>2</sup> State of California, Public Utilities Code, Section 99247, Performance Measure Definitions, 1981.

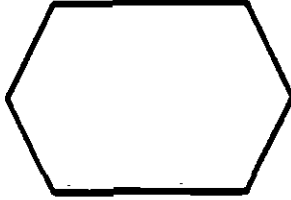
ATTACHMENT B  
FLOWCHART LEGEND



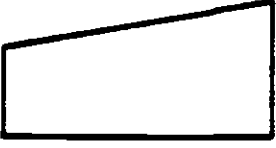
MANUAL  
OPERATION



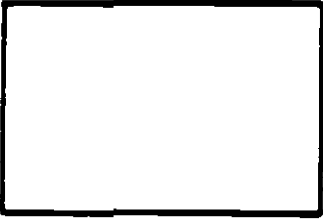
PUNCHED CARD



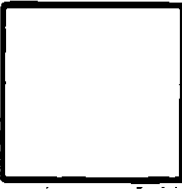
PREPARATION



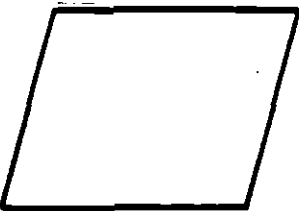
MANUAL INPUT



PROCESS



AUXILIARY  
OPERATION



INPUT/OUTPUT



DOCUMENT

PERFORMANCE AUDIT PROGRAM  
PHASE I

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

1.0 INTRODUCTION

The Southern California Rapid Transit District (SCRTD) is the largest of Los Angeles County's nine fixed route bus operators. During FY 1981, SCRTD provided 85 percent of the County's bus miles of service and carried 87 percent of its transit riders. SCRTD operates 216 regularly scheduled lines in a service area encompassing 2,100 square miles. During the peak period, it schedules service for almost 2,000 buses. According to its own definitions, SCRTD operates six different types of services: local, express, contract, special, subscription and BEEP (Bus Express Employee Program). In FY 1981 these services carried approximately 1.3 million passengers on a typical weekday. The system operates 365 days a year: 255 weekdays, 52 Saturdays and 58 Sundays and holidays.

1.1 TPM AND TDA DATA REVIEW

The purpose of this section of the Phase I report is to verify the accuracy and reliability of SCRTD's reported TPM and TDA statistics. SCRTD's TPM and TDA reporting forms containing the submitted values of the data items to be reviewed are presented in Appendices 1-A and 1-B.

An audit of the eleven statistics comprising this data review requires an understanding of how SCRTD defines, collects, stores, and reports its statistics. To obtain this information, interviews were conducted with SCRTD personnel in the Scheduling and Service Analysis Department and Planning Department. In addition, in-house and published reports were reviewed. A listing of persons contacted and documents reviewed is presented in Appendix 1-C. Preparation and compilation of TPM and TDA statistics were the primary responsibility of the Advance Planning Section of the Planning Department. The Scheduling and Service Analysis Department contributed much of the necessary line specific data.

This examination of SCRTD's data collection procedures is organized by data item. For each item the following is presented:

- TPM and TDA Definitions - The accuracy of reported statistics depends in large measure on the use of correct definitions. SCRTD's terminology definitions are presented herein.
- TPM and TDA Data Collection Procedures - SCRTD's procedures for collecting raw data and processing the data into TPM and TDA statistics are presented in flowchart form, where appropriate. The step-by-step flowcharts are of assistance in identifying areas of concern and will be of use in performing a verification analysis. The flowcharts are accompanied by narrative descriptions of key procedures and input/output documents and files. Where flowcharts are inappropriate, procedures are described in narrative form.

Analysis and Verification - The data collection procedures are analyzed to assess the accuracy and reliability of the statistics reported, and to identify potential problem areas requiring further examination. Considerations in this analysis include:

- Correct definition of terms
- Applicability of procedure
- Use of adjustment, expansion and conversion factors
- Timeliness of collection and processing
- Internal consistency
- Completeness

The operator's application of prescribed procedures is also reviewed. Major considerations include: mathematical accuracy; recording and transcribing accuracy; consistency of application; and adherence to assumptions.

### Service Classifications

The TPM program requires that statistics be reported for each of five service classifications. These include local demand-based headways; local policy-based headways; local intra-community; express multiple local stops; and express few local stops. The initial assignment of its lines to these service classifications was performed by SCRTD in 1980. Since that time, it has notified the LACTC of its proposed service classification changes reflecting service and line numbering revisions and additions. All reclassification requests were approved. A listing of SCRTD lines by service classification is presented as Exhibit 1-1. Note, the following special service lines, as of December 1980, were excluded from the TPM classifications:



**EXHIBIT 1-1  
SCRTD DATA REVIEW**

**SERVICE CLASSIFICATIONS — FY 1981**

<u>Local Demand 1A</u>	<u>Local Policy 1B</u>	<u>Local Community 1C</u>	<u>Express Multi-Stop 2A</u>	<u>Express Limited-Stop 2B</u>
2, 3, 4, 5, 6, 7, 8, 9,	10, 16, 17, 18, 73, 76, 81,	15, 78, 87, 114, 183,	35, 88, 93, 401, 456,	122, 123, 144, 176,
12, 24, 25, 26, 28,	97, 103, 142, 151, 152,	201, 206, 306, 451,	480, 482, 483, 484,	492, 494, 495, 512,
29, 32, 33, 34, 39,	153, 154, 156, 157, 158,	452, 872, 874	486, 487, 488, 490,	514, 601, 602, 604,
41, 42, 44, 47, 49,	159, 160, 161, 163, 165,	..... n = 12	493, 607, 801, 810,	605, 606, 608, 716,
50, 56, 75, 83, 84,	168, 169, 175, 232, 354,		813, 820	721, 737, 755, 758,
86, 89, 91, 92, 94,	356, 359, 423, 424, 425,		..... n = 19	760, 762, 764, 814
96, 105, 204, 210, 212,	430, 431, 433, 434, 435,			..... n = 24
420, 422, 426, 428,	436, 438, 440, 441, 445,			
432, 832, 834, 836,	446, 447, 822, 825, 826,			
841, 871	827, 828, 829, 831, 838,			
..... n = 48	840, 842, 844, 846, 849,			
	861, 867, 869, 877			
	..... n = 61			

**EXHIBIT 1-1  
SCRTD DATA REVIEW**

**SERVICE CLASSIFICATIONS — FY 1981**

Local Demand 1A	Local Policy 1B	Local Community 1C	Express Multi-Stop 2A	Express Limited-Stop 2B
2, 3, 4, 5, 6, 7, 8, 9,	10, 16, 17, 18, 73, 76, 81,	15, 78, 87, 114, 183,	35, 88, 93, 401, 456,	122, 123, 144 176,
12, 24, 25, 26, 28,	97, 103, 142, 151, 152,	201, 206, 306, 451,	480, 482, 483, 484,	492, 494, 495, 512,
29, 32, 33, 34, 39,	153, 154, 156, 157, 158,	452, 872, 874	486, 487, 488, 490,	514, 601, 602, 604,
41, 42, 44, 47, 49,	159, 160, 161, 163, 165,	..... n = 12	493, 607, 801, 810,	605, 606, 608, 716,
50, 56, 75, 83, 84,	168, 169, 175, 232, 354,		813, 820	721, 737, 755, 758,
86, 89, 91, 92, 94,	356, 359, 423, 424, 425,		..... n = 19	760, 762, 764, 814
96, 105, 204, 210, 212,	430, 431, 433, 434, 435,			..... n = 24
420, 422, 426, 428,	436, 438, 440, 441, 445,			
432, 832, 834, 836,	446, 447, 822, 825, 826,			
841, 871	827, 828, 829, 831, 838,			
..... n = 48	840, 842, 844, 846, 849,			
	861, 867, 869, 877			
	..... n = 61			

- . Contract lines (8 lines)
- . Special event (15 lines)
- . Subscription (9 lines)
- . BEEP (25 lines).

TDA statistics are reported for two service classifications: express bus and local fixed route.

Schedules of service actually operated during FY 1981 were reviewed to verify that all service was accounted for in the TPM and TDA data base. Each line was cross checked among three sources: 4-24 Reports, TPM line data, and TDA line data. It is concluded that all regularly scheduled lines are included in both data bases; however, as mentioned above, contract, subscription and BEEP service are excluded from the TPM statistics. An estimate of the total annual service represented by these special services is as follows:

Total Vehicle Miles:	3,618,000
Total Vehicle Hours:	184,000
Peak Vehicles:	69

These and any other special services should be reported under the "Other" column of the TPM reporting form.

A line-by-line review also indicates that the classification of lines as express and local services are identical for both data sets. Because of SCRTD's major renumbering program throughout the course of the year, several lines had to be cross-referenced to new line assignments. For example, Line 434 is classified as a local route for TPM purposes and as an express line for TDA reporting. This is because service on

Line 608, classified as a TPM express line, was renumbered as the 434 in June 1981, and thus the 434 became an express line. At the same time, service on the old 434, a local line prior to June 1981, was renumbered as Line 177 and will be reported as local TPM service in FY 1982.

A. Total Vehicle Miles

TPM Definition - Total vehicle miles are defined as the total scheduled distance traveled by revenue vehicles, including all non-revenue miles (e.g., pull-out, pull-in, and off-route travel) and revenue miles.

TPM Data Collection Procedure - The numbers of total weekday vehicle miles shown on the TPM reporting form are the summation of individual line mileage statistics. The line statistics represent a predetermined number of revenue and non-revenue miles scheduled for the day on which a ride check was conducted, expanded to an annual value.

The key source document for scheduled line mileage and other service statistics was the 4-24 Report - - Scheduled Service Operating Cost Factors by Line. Prepared by the Scheduling Department for each service period, or shake-up as it is commonly known, this document and file itemizes each line's equipment needs for a.m. rush, day base, p.m. rush and owl; interline equipment savings; total and revenue vehicle hours; and total and revenue vehicle miles. Shake-ups generally occur in September, December and June. The Service Analysis Section retrieved FY 1981 4-24 Report data file, merged selected data elements with other information (e.g., boarding counts), and produced Line Performance Trends data

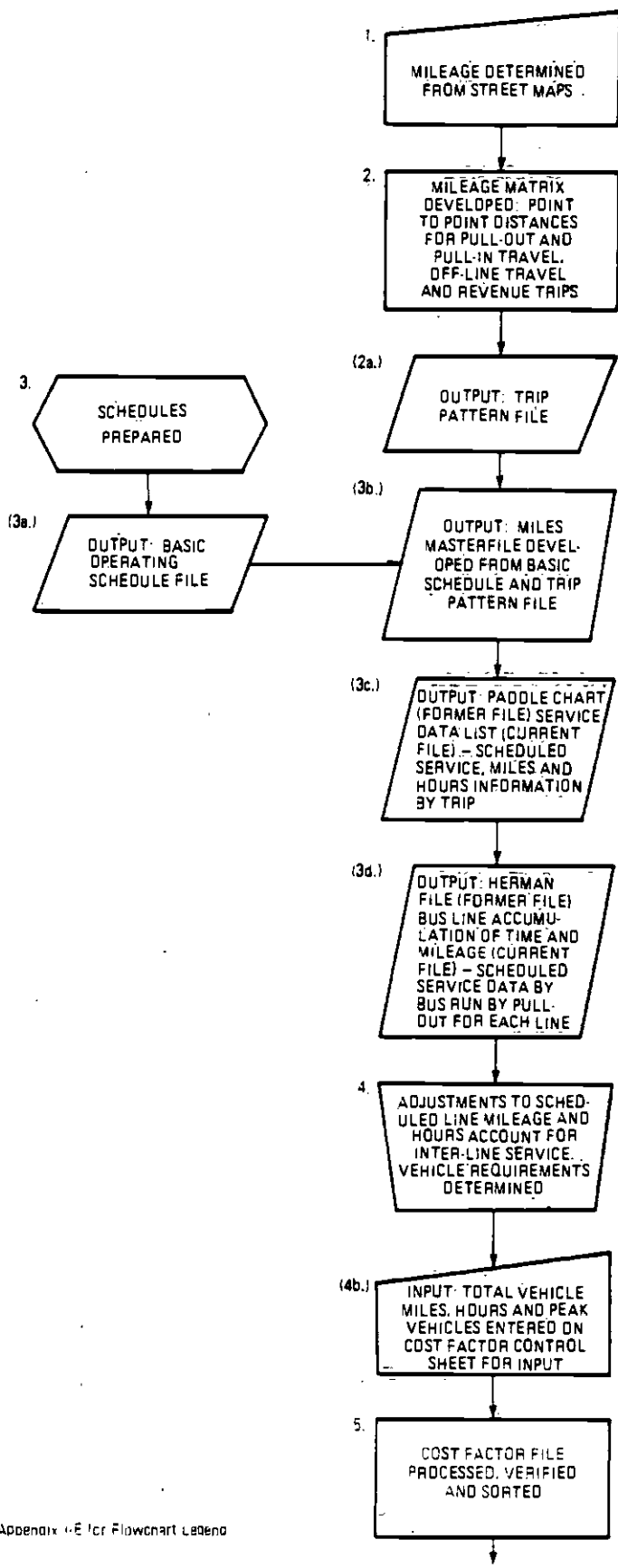
files (LPT). The definition and development of selected data elements in the LPT file is the subject of this report. Following the development of the data files, the Advance Planning Section of the Planning Department assumed the responsibility of developing assumptions and methodologies for compiling the daily statistics into annual values. It also completed the TPM reporting form and submitted it to LACTC with SCRTD's Short-Range Transit Plan.

A detailed outline of the process by which total vehicle miles, hours, and peak vehicles were derived is depicted on Exhibit 1-2. Those steps related to the derivation of vehicle miles and the contents of key input and output items are discussed below.

- Steps 1 through 3 - The key scheduling source document is the Basic Operating Schedule (Step 3A). Scheduled service for each bus trip to be operated on a line by direction of travel is described in detail, as shown by Exhibit 1-3. By processing the "Basic" with the distance information contained in the Trip Pattern File (Step 2A), total scheduled vehicle miles, together with its revenue and non-revenue components, are produced on to a Miles Master File (Step 3C). This file's disaggregate trip level information is condensed into a series of reports and files (Steps 3C and 3D). Until recently, the Herman File (Step 3D) was the most useful of these for preparing the 4-24 Report. Since the development of the Bus Line Accumulation of Time and Mileage (BLT), it has been used for obtaining line mileage. Examples of these reports are presented in Exhibits 1-4 and 1-5. As shown, these reports summarize service statistics by bus run rather than by individual trip.

**EXHIBIT 1-2  
SCR TD DATA REVIEW**

**TOTAL VEHICLE MILES, TOTAL VEHICLE HOURS, AND PEAK VEHICLES**



Note: See Appendix "E" for Flowchart Legend

**EXHIBIT 1-2  
SCRTD DATA REVIEW**

**TOTAL VEHICLE MILES, TOTAL VEHICLE HOURS, AND PEAK VEHICLES  
(Continued)**

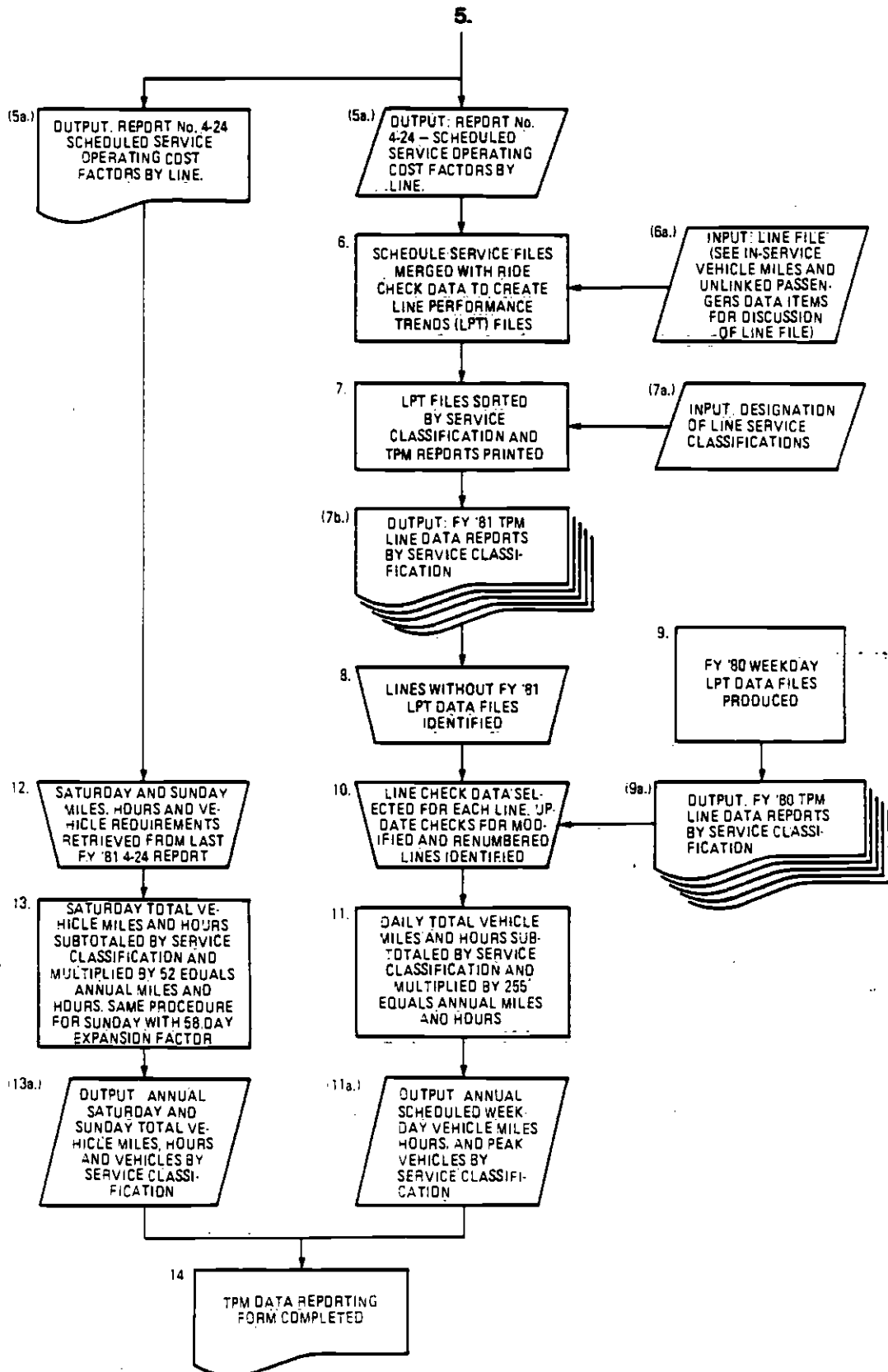


EXHIBIT 1-3  
SCRTD DATA REVIEW

EXAMPLE BASIC OPERATING SCHEDULE

15-28 REV 100      SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT      BASIC OPERATING SCHEDULE

FILE DATE: 03-17-82      LINE 432 LIS ANGELES-ARCADIA VIA HUNTINGTON DR.      SCHEDULE NUMBER 80650      EASTBOUND 02  
DAILY EXCEPT SATURDAY & SUNDAY      IN EFFECT 12-21-80      REVISED 3-14-82

TIME	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>	13 <sup>th</sup>	14 <sup>th</sup>	15 <sup>th</sup>	16 <sup>th</sup>	17 <sup>th</sup>	18 <sup>th</sup>	19 <sup>th</sup>	20 <sup>th</sup>	STATION	ARRIVAL	DEPART	STATION	ARRIVAL	DEPART
	TERMINAL	JIVE		SPR	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	USPH					
	20	VEN		ING	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	NGTN	L					
	28	ICE		1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	1ST	L					
0990																										
1010	1	□		553	555		605	618		623		629	634				643						650		13	705
1030	3	□		638	640		650	703		708		714	719				728						735		13	800
1035																										
1050	6	□		703	705		716	729		734		741	746				755						803		13	820
1070	4	□		723	725		736	749		754		801	806				815						823		13	840
1090	7	□		743	745		756	809		814		821	826				835						843		13	900
1110	5	□		803	805		816	829		834		841	846				855						903		13	920
1130	1	□		823	825		836	849		854		901	906				915						923		13	950
1150	8	□		843	845		856	909		914		921	926				935						943		9	1001
1170	2	□		903	905		916	929		934		941	946				955						1003		13	1020
1175																										
1210	3	□		933	935		945	957		1002		1008	1014				1023						1031		13	1050
1230	4	□		1003	1005		1015	1027		1032		1038	1044				1053						1101		13	1120
1250	5	□		1033	1035		1045	1057		1102		1108	1114				1123						1131		13	1150
1275																										
1290	1	□		1103	1105		1116	1128		1133		1140	1146				1155						1203		13	1220
1330	2	□		1133	1135		1146	1158		1203		1210	1216				1225						1233		13	1250
1350	3	□		1203	1205		1216	1228		1233		1240	1246				1255						1303		13	120
1390	4	□		1233	1235		1246	1258		1303		1310	1316				1325						1333		13	150
1410	5	□		1303	1305		1316	1328		1333		1340	1346				1355						1403		13	220
1430	6/253	9	□	1373	1375		1386	1398		1403		1410	1416				1425						1433		13	240

□ - INDICATES ACCESSIBLE BUS TRIP  
9 - G.E. RADIO USE CHANNEL 7



## EXHIBIT 1-3 SCRTD DATA REVIEW

### EXAMPLE BASIC OPERATING SCHEDULE

FILE DATE		LINE 432 LOS ANGELES-ARCADIA VIA HUNTINGTON OR.													SCHEDULE NUMBER 80650		EASTBOUND 02				
03-17-82		DAILY EXCEPT SATURDAY & SUNDAY													IN EFFECT 12-21-80		REVISED 3-14-82				
TIME	STATION	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>	13 <sup>th</sup>	ST. JSPH C	13	TIME				
		TERMINAL	UL-IVE		SPR	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	HUNT	ST. JSPH C						
		28	VENICE		ING E 1ST	NGTN HUNT EREY	NGTN HUNT MAYC REST	NGTN HUNT C MAIN	NGTN HUNT GARF IELO	NGTN HUNT SAN MARI				NGTN HUNT BALO MIN							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0990			CL. 1																		
1010	1		553	555		605	618		623		629	634		643		650		13	705		
1030	3	NO	638	640		650	703		708		714	719		728		735		13	800		
1035			CL. 2																		
1050	6		703	705		716	729		734		741	746		755		803		13	820		
1070	4		723	725		736	749		754		801	806		815		823		13	840		
1090	7		743	745		756	809		814		821	826		835		843		13	900		
1110	5		803	805		816	829		834		841	846		855		903		13	920		
1130	1		823	825		836	849		854		901	906		915		923		13	950		
1150	8		843	845		856	909		914		921	926		935		943		9	1001		
1170	2		903	905		916	929		934		941	946		955		1003		13	1020		
1175			CL. 3																		
1210	3		933	935		945	957		1002		1008	1014		1023		1031		13	1050		
1230	4		1003	1005		1015	1027		1032		1038	1044		1053		1101		13	1120		
1250	5		1033	1035		1045	1057		1102		1108	1114		1123		1131		13	1150		
1275			CL. 4																		
1290	1		1103	1105		1116	1128		1133		1140	1146		1155		1203		13	1220		
1330	2		1133	1135		1146	1158		1203		1210	1216		1225		1233		13	1250		
1350	3		1203	1205		1216	1228		1233		1240	1246		1255		1303		13	1320		
1390	4		1233	1235		1246	1258		1303		1310	1316		1325		1333		13	1350		
1410	5		1303	1305		1316	1328		1333		1340	1346		1355		1403		13	1420		
1430	6 1253 9		1323	1325		1336	1348		1353		1400	1406		1415		1423		13	1440		

□ - INDICATES ACCESSIBLE BUS TRIP  
 \* - G.E. RADIO USE CHANNEL 7

**EXHIBIT 1-4  
SCRTD DATA REVIEW**

**EXAMPLE HERMAN REPORT**

VEHICLE TIME AND MILEAGE  
WEDNESDAY  
EFFECTIVE DATE 06/20/82

PAGE 88

RUN DATE 06/16/82  
DIVISION NO. 9

2	:30	16.0	:10	2.8	:00	:00	0.0	:40	18.8	1:17	32.3
3	:04	0.2	:25	15.3	:12	:00	0.0	:41	15.5	2:00	49.4
<b>LINE TOTAL</b>	<b>1:34</b>	<b>47.5</b>	<b>1:28</b>	<b>50.0</b>	<b>:12</b>	<b>:00</b>	<b>0.0</b>	<b>3:14</b>	<b>97.5</b>	<b>5:53</b>	<b>147.6</b>

LINE NO. 493 L.A.-EL MONTE-MONROVIA

NON REVENUE

REVENUE

BUS RUN	PULL OUT		PULL IN		LAYOVER		OFF ROUTE		TOTAL		IN SERVICE	
	TIME	MILES	TIME	MILES	TIME	TIME	MILES	TIME	MILES	TIME	MILES	
1	:04	0.2	:02	0.2	2:31	1:29	30.2	4:06	30.6	9:38	194.2	
2	:04	0.2	:00	0.0	1:35	:00	0.0	1:39	0.2	:25	7.4	
3	:04	0.2	:02	17.7	:07	:00	0.0	:13	17.9	1:58	42.4	
3	:30	15.1	:02	0.2	:44	:00	0.0	1:16	15.3	2:20	44.6	
4	:21	16.9	:02	0.2	:10	:30	14.7	1:03	31.8	2:05	46.2	
4	:30	15.1	:18	7.7	:00	:00	0.0	:48	22.8	1:05	22.4	
<b>LINE TOTAL</b>	<b>1:33</b>	<b>47.7</b>	<b>:26</b>	<b>26.0</b>	<b>5:07</b>	<b>1:59</b>	<b>44.9</b>	<b>9:05</b>	<b>118.6</b>	<b>17:31</b>	<b>357.2</b>	

LINE NO. 494 L.A.-EL MONTE-MONROVIA-GLENDORA

NON REVENUE

REVENUE

BUS RUN	PULL OUT		PULL IN		LAYOVER		OFF ROUTE		TOTAL		IN SERVICE	
	TIME	MILES	TIME	MILES	TIME	TIME	MILES	TIME	MILES	TIME	MILES	
1	:25	14.3	:10	3.6	:00	:00	0.0	:35	17.9	1:16	31.5	
2	:25	14.3	:25	14.5	:00	:00	0.0	:50	28.8	1:16	31.5	
<b>LINE TOTAL</b>	<b>:50</b>	<b>28.6</b>	<b>:35</b>	<b>18.1</b>	<b>:00</b>	<b>:00</b>	<b>0.0</b>	<b>1:25</b>	<b>46.7</b>	<b>2:32</b>	<b>63.0</b>	

LINE NO. 501 FULLERTON-BREA-FINANCIAL CENTER

**EXHIBIT 1-5  
SCRTD DATA REVIEW**

**EXAMPLE BUS LINE ACCUMULATION OF TIME AND MILEAGE REPORT**

FILE DATE  
7- 7-82

LINE 487 L.A.-SAN GABRIEL-EL MONTE-SIERRA MADRE  
DAILY EXCEPT SATURDAY & SUNDAY

SCHEDULE NUMBER 81315

IN EFFECT 12-20-81

REVISED 7-25-82

SCHEDULED SERVICE DATA BY BUS-RUN, BY PULL-OUT

BSRN TH NO. PRO	PULL-OUT		PULL-IN		OFF-ROUTE		NON-REVENUE		REVENUE HOURS			TOTAL		DAYS OF OPERATION	
	MILES	HOURS	MILES	HOURS	MILES	HOURS	MILES	HOURS	REVENUE MILES	IN-SER	L/O	TOTAL	MILES		HOURS
1 AM	.2	1:04	9.7	1:27			9.9	1:31	273.9	12:06	2:49	14:55	283.8	15:26	23456
2 AM	.2	1:04	.2	1:02			.4	1:06	250.3	11:47	2:39	14:26	250.7	14:32	23456
3 AM	4.2	1:15	9.7	1:27			13.9	1:42	235.0	11:15	2:57	14:12	248.9	14:54	23456
4 AM	4.2	1:15	10.2	1:25			14.4	1:40	213.8	10:22	2:07	12:29	228.2	13:09	23456
5 AM	3.0	1:09	.2	1:02			3.2	1:11	205.0	9:37	2:45	12:22	208.2	12:33	23456
6 AM	.2	1:04	4.3	1:10			4.5	1:14	29.8	1:28	1:08	1:36	34.3	1:50	23456
6 PM	3.0	1:15	9.7	1:27			12.7	1:42	22.9	1:01		1:01	35.6	1:43	23456
7 AM	8.2	1:30	4.3	1:10			12.5	1:40	23.0	1:00		1:00	35.5	1:40	23456
7 PM	3.0	1:15	10.2	1:25			13.2	1:40	20.5	1:06		1:06	33.7	1:46	23456
8 AM	.2	1:04	14.5	1:25			14.7	1:29	59.7	2:18	1:20	2:38	74.4	3:07	23456
8 PM	3.0	1:09	9.7	1:27			12.7	1:36	94.9	4:24	1:35	4:59	107.6	5:35	23456
9 AM	.2	1:04	14.5	1:25			14.7	1:29	70.9	3:08	1:22	3:30	85.6	3:59	23456
9 PM	3.0	1:09	.2	1:02			3.2	1:11	57.1	2:56	1:34	3:30	60.3	3:41	23456
10 AM	8.2	1:30	9.7	1:27	22.4	1:42	40.3	1:39	67.7	2:54	1:12	3:06	108.0	4:45	23456
10 PM	.2	1:04	4.5	1:15			4.7	1:19	137.0	6:29	1:09	7:38	141.7	7:57	23456
11 AM	.2	1:04	14.5	1:25			14.7	1:29	74.5	3:15	1:28	3:43	89.2	4:12	23456
11 PM	3.0	1:09	9.7	1:27			12.7	1:36	50.2	2:28	1:31	2:59	62.9	3:35	23456
12 AM	.2	1:04	14.5	1:25	20.4	1:57	35.1	1:26	51.5	2:23	1:05	2:28	86.6	3:54	23456
12 PM	14.3	1:30	10.2	1:25			24.5	1:55	65.2	3:08	1:23	3:31	89.7	4:26	23456
13 AM	3.0	1:09	14.5	1:25			17.5	1:34	68.4	3:18	1:36	3:54	85.9	4:28	23456
13 PM	14.3	1:30			10.0	1:18	24.3	1:48	20.5	1:04		1:04	44.8	1:52	23456
14 AM	3.0	1:09	14.5	1:25			17.5	1:34	27.3	1:24	1:10	1:34	44.8	2:08	23456
14 PM	14.3	1:30	10.2	1:25			24.5	1:55	65.2	3:06	1:22	3:28	89.7	4:23	23456
15 AM	.2	1:04	14.5	1:25			14.7	1:29	74.4	3:18	1:36	3:54	89.1	4:23	23456
15 PM	8.0	1:25	.2	1:02			8.2	1:27	156.0	7:12	1:24	8:36	164.2	9:03	23456
16 AM	4.2	1:15	.2	1:02			4.4	1:17	62.2	2:48	1:32	3:20	66.6	3:37	23456
17 AM	.2	1:04	4.3	1:15			4.5	1:19	29.8	1:28	1:05	1:33	34.3	1:52	23456
17 PM	3.0	1:15	9.7	1:27			12.7	1:42	21.7	1:02		1:02	34.4	1:44	23456
18 AM	3.0	1:09	14.5	1:25			17.5	1:34	27.3	1:24	1:11	1:35	44.8	2:09	23456
18 PM	14.3	1:50	9.7	1:27			24.0	1:17	22.9	1:01		1:01	46.9	2:18	23456
19 AM	.2	1:04	14.5	1:25			14.7	1:29	29.8	1:28	1:08	1:36	44.5	2:05	23456
19 PM	14.3	1:30	10.2	1:25			24.5	1:55	20.5	1:10		1:10	45.0	2:05	23456
20 AM	14.3	1:30	14.5	1:25			28.8	1:55	44.6	1:57	1:05	2:02	73.4	2:57	23456
20 PM	14.3	1:30	9.7	1:27			24.0	1:57	22.9	1:59		1:59	46.9	1:56	23456
21 PM			.2	1:02	17.6	1:28	17.8	1:30	134.0	5:51	1:50	6:41	151.8	7:11	23456
<b>TOTALS:</b>															
	169.3	8:32	301.9	11:20	70.4	2:25	541.6	22:17	2830.4	131:35	23:03	154:38	3372.0	176:55	2
	169.3	8:32	301.9	11:20	70.4	2:25	541.6	22:17	2830.4	131:35	23:03	154:38	3372.0	176:55	3
	169.3	8:32	301.9	11:20	70.4	2:25	541.6	22:17	2830.4	131:35	23:03	154:38	3372.0	176:55	4
	169.3	8:32	301.9	11:20	70.4	2:25	541.6	22:17	2830.4	131:35	23:03	154:38	3372.0	176:55	5
	169.3	8:32	301.9	11:20	70.4	2:25	541.6	22:17	2830.4	131:35	23:03	154:38	3372.0	176:55	6
<b>FOREIGN LINE OPERATIONS:</b>															
LN. 494			16.6	1:24	10.0	1:18	26.6	1:42	33.6	1:24		1:24	60.2	2:06	23456
LN. 764	20.1	1:40			17.6	1:28	37.7	1:08	39.8	1:19		1:19	77.5	2:27	23456

487  
M

Steps 4 and 5 - A vehicle assigned to a bus run on a particular line may at sometime during its service period operate on another line. This is commonly referred to as interlining. To obtain an accurate count of the scheduled number of miles to be operated on one specific line, adjustments for interline service must be made to account for those portions of runs serving other lines (subtract miles) and for service provided by other foreign line bus runs (add miles). Prior to the issuance of the BLT, the mileage statistics on the Herman Reports were manually adjusted to account for interline service. The new BLT identifies and adjusts for service going into foreign line operations; service coming from another line, however, must be manually added to line totals. The worksheet for interline operation adjustments is the Cost Factor Control Sheet, as shown in Exhibit 1-6. Manually prepared for each line, these sheets provide the necessary input for computer preparation of the 4-24 Report. A sample page of a 4-24 Report is presented as Exhibit 1-7.

With minor exception, Steps 1 through 5 have, are, and will continue to be regularly conducted for each shake-up. The remaining activities, however, were performed specifically for satisfying FY 1981 TPM reporting requirements.

Steps 6 through 9 - Following preparation of the 4-24 Report and files, TPM processing moved to the Service Analysis Section. As shown by the flowchart, weekday scheduled service statistics developed in Steps 1 through 5 were merged with other data items obtained through ride checks. Scheduled service statistics were matched to the date on which the ride check was conducted. The product of this merger was weekday LPT data files. Sorted by service classification, TPM reports were printed itemizing service and use statistics for each line within a classification (Step 7B). An example of a TPM line data report is presented as Exhibit 1-8. The TPM line data reports initially contained only FY 1981 data. Because ride checks were not conducted on all lines during FY 1981, similar TPM files and reports based on FY 1980 data were produced (Steps 9, 9A).

**EXHIBIT 1-6  
SCRTD DATA REVIEW**

**EXAMPLE COST FACTOR WORKSHEET**

FILE DATE - 12/04/81  
CENTRAL TERM SCHED LINE  
DIV DIV NO NO

09 89362 494 BX

DM	REP	SIGN OFF	MISC	WORK	OVER	PREM	PAY
1:09	0:30	0:15	0:00	7:51	0:00	0:00	7:51

**INTERLINE OPERATION**

IN EFFECT 12/20/81  
REVISED / /

HOURS		MILES		
TOTAL	IN SERVICE	TOTAL	IN SERVICE	
42:06	+1:24	+60	+34	IR.13 From 487
+2:06	+1:20	+54	+31	IR.10 From 422
+1:49	+1:15	+56	+31	IR.4 From 493
+6:01	+3:59	+170	+96	= TOTALS

EQUIPMENT				REVENUE	TOTAL	TOTAL
A.M. RUSH	BASE	P.M. RUSH	OWL	MILES	MILES	TRIPS
2	0	1	0	94	166	6

**LINE COMPOSITE**

**EQUIPMENT**

**VEHICLE HOURS**

**VEHICLE MILES**

DIV NO	EQUIPMENT INTERLINE SAVINGS				VEHICLE HOURS				VEHICLE MILES			
	AM RUSH	PM RUSH	BASE	OWL	AM	PM	NON REVENUE	TOTAL	INTERLINE REVENUE	SERVICE NON REVENUE	NON REVENUE	TOTAL
TOTAL												

**SCHEDULED SERVICE OPERATING COSTS**

LINE NO	DIV NO	EQUIPMENT				INTERLINE SAVING		VEHICLE HOURS		VEHICLE MILES	
		A.M. RUSH	DAY BASE	P.M. RUSH	OWL	A.M. P.M.	TOTAL	REVENUE	TOTAL	REVENUE	
		494	9	3	0	3	0	1	2	13:58	9:55

EXHIBIT 1-7  
SCR TD DATA REVIEW

EXAMPLE 4-24 REPORT

REPORT NO. 4-24  
PAGE 6 OF 22

SCHEDULED SERVICE OPERATING COST FACTORS

EFFECTIVE SEPTEMBER 14, 1980

DAILY EXCEPT SATURDAY AND SUNDAY  
SCHOOL DAY - NON-FACT, NON-DOWL SCHEDULES

LINE	EQUIPMENT				INTERLINE		VEHICLE HOURS		VEHICLE MILES	
	A.M. RUSH	DAY BASE	P.M. RUSH	DOWL	A.M. SAYING	P.M.	TOTAL	REVENUE	TOTAL	REVENUE
488	10	3	10				85.13	73.06	1,226	867
490	12	8	13		1		151.26	141.57	2,910	2,568
492	4		4				17.44	12.03	491	313
493	5	2	6		1	2	23.41	17.57	385	290
494	4		4		1	2	18.02	13.04	341	188
495	6	4	8			1	64.47	62.00	1,279	1,235
496	6	6	7				80.45	77.43	2,161	2,143
501	1		1				4.13	2.20	115	57
503	1		1				3.51	2.26	113	71
504	1		1				4.33	2.44	143	60
505	3		3				13.46	8.20	281	174
507	1		1				3.34	1.36	78	36
508	1		1				4.05	1.51	123	61
509	2		2				9.45	4.39	289	144
511	1		1				3.34	2.19	68	59
512	2		2				10.49	4.39	258	150
513	1		1				3.25	1.45	90	49
514	3		3				13.32	6.35	322	147
520	7		7				33.03	21.22	698	326
601	2		2				12.26	10.22	248	202
602	5		4		1		23.21	15.29	451	273
604	8		8		1	2	22.01	10.41	557	339
605	4		4				19.40	13.16	429	308
606	4		4				19.03	10.37	390	206
607	6	7	8				109.26	100.58	2,059	1,805
608	3		3				13.39	6.59	365	189
716	6		6				24.11	12.48	367	159
721	10		12			2	45.21	24.33	1,160	704
737	4		4				16.29	10.20	425	228

EXHIBIT 1-8  
 SCRTD DATA REVIEW

EXAMPLE TPM LINE DATA REPORT

LINE#	DATE OF CHECK	LACTC	Bus Miles		Bus Hours		Total Revenue all Fares		
			Bindings	Sched. In-Service	Sched. In-Service	Done Buses			
@DATA, L FY81-LACTCI.									
DATA 9R1 SL74T9 12/C2/81 10:34:20 (C)									
1.	2	800708	I	15355	3008	2497234.86	179.18	19	4577.91
2.	3	810121	I	33214	4664	4351419.23	346.67	33	10670.49
3.	6	810319	I	20106	3933	252317.46	223.95	24	6434.70
4.	9	810211	I	31036	6234	4925490.20	388.02	43	11007.77
5.	12	810127	I	16405	2506	2022212.16	162.20	20	5454.15
6.	24	800924	I	10639	3861	3235224.36	183.70	20	4444.44
7.	25	810210	I	9377	1497	1739171.16	124.47	15	2990.25
<del>8.</del>	<del>27</del>	<del>801118</del>	<del>I</del>	<del>16754</del>	<del>2481</del>	<del>2319706.65</del>	<del>186.85</del>	<del>16</del>	<del>5225.46</del>
<del>9.</del>	<del>27</del>	<del>801217</del>	<del>I</del>	<del>18059</del>	<del>2491</del>	<del>2295205.65</del>	<del>196.85</del>	<del>18</del>	<del>5249.16</del>
10.	32	810217	I	4934	1075	1012182.65	64.63	6	1743.36
11.	33	800908	I	4315	1733	1479114.85	83.02	9	1824.44
<del>12.</del>	<del>39</del>	<del>800703</del>	<del>I</del>	<del>10883</del>	<del>2747</del>	<del>1998202.15</del>	<del>159.52</del>	<del>18</del>	<del>2971.49</del>
<del>13.</del>	<del>39</del>	<del>810128</del>	<del>I</del>	<del>9721</del>	<del>3945</del>	<del>3285246.58</del>	<del>192.98</del>	<del>21</del>	<del>3423.12</del>
14.	41	800926	I	11485	1021	918118.70	87.43	10	3625.41
15.	42	810506	I	21775	3198	2656304.55	272.68	27	6789.91
16.	47	800715	I	14044	2314	2002203.81	160.52	16	4911.75
17.	56	810113	I	5913	2796	1937157.10	115.73	18	2345.93
18.	84	801113	I	29154	3225	2801289.48	225.92	22	8837.57
<del>19.</del>	<del>86</del>	<del>801124</del>	<del>I</del>	<del>7486</del>	<del>2832</del>	<del>2689176.48</del>	<del>144.75</del>	<del>18</del>	<del>2629.84</del>
<del>20.</del>	<del>86</del>	<del>801218</del>	<del>I</del>	<del>6864</del>	<del>2832</del>	<del>2689176.48</del>	<del>143.77</del>	<del>18</del>	<del>2450.48</del>
21.	86	810410	I	6952	2560	2491161.41	132.78	18	2457.45
22.	89	810317	I	20933	2233	2032249.63	184.33	23	4984.67
23.	92	800730	I	12224	3077	2516244.78	183.40	21	4356.16
24.	94	800627	I	19074	2435	2328235.23	187.80	18	6220.26
<del>25.</del>	<del>105</del>	<del>810218</del>	<del>I</del>	<del>19848</del>	<del>3485</del>	<del>3943288.10</del>	<del>273.58</del>	<del>23</del>	<del>5950.90</del>
26.	105	810520	I	19497	3485	2943289.10	223.58	23	6103.97
27.	204	810408	I	45999	5733	1363487.83	373.05	36	13360.55
<del>28.</del>	<del>210</del>	<del>800729</del>	<del>I</del>	<del>17007</del>	<del>3999</del>	<del>3998306.41</del>	<del>201.48</del>	<del>22</del>	<del>3991.68</del>
29.	210	801015	I	21584	3959	3514306.41	251.72	22	6901.45
<del>30.</del>	<del>212</del>	<del>800709</del>	<del>I</del>	<del>12314</del>	<del>2962</del>	<del>2672227.68</del>	<del>178.38</del>	<del>18</del>	<del>2921.88</del>
31.	212	801007	I	12396	2962	2672227.68	178.38	16	3944.58
32.	420	810421	I	6834	1713	1500131.18	97.63	10	2324.41
33.	426	800911	I	7505	2108	1813147.50	116.03	12	2763.00
<del>34.</del>	<del>428</del>	<del>800918</del>	<del>I</del>	<del>4079</del>	<del>1923</del>	<del>1663122.51</del>	<del>96.28</del>	<del>11</del>	<del>1728.10</del>
35.	428	810316	I	4931	1911	1609122.51	93.87	11	1716.80
36.	432	810223	I	3133	1645	1408114.51	79.33	8	1154.13
37.	834	801230	I	6191	1594	1385115.76	82.30	7	2325.73
<del>38.</del>	<del>836</del>	<del>800904</del>	<del>I</del>	<del>7987</del>	<del>3957</del>	<del>2639181.73</del>	<del>111.82</del>	<del>12</del>	<del>3277.11</del>
39.	836	810106	I	8674	3057	2611181.73	140.43	12	3435.58
40.	871	810519	I	3438	2213	1866148.01	111.42	11	1280.79

END DATA. ERRORS: NONE. TIME: 0.711 SEC. IMAGE COUNT: 40

Steps 10 through 14 - At this point, the Advance Planning Section assumed data processing responsibility. TPM data reports were reviewed and a dataset was selected for each line. A set of guidelines were developed and used for selecting the date of the dataset and for making adjustments to lines which were modified during the course of the year. The first task was to identify lines which assumed new numbers at some point in FY 1981. A Line History Report listing new line numbers and when service began under the new line was used for this purpose. The second task was to identify lines which underwent service modifications, whether in terms of alignment or service levels. The third task was to inspect the TPM line data reports to determine whether more than one line check was available for the modified lines. If so, the statistics were manually prorated and expanded to annual statistics according to the service periods in which they would have applied; e.g., three months for data from the first check and nine months for data from the second check. Counts made of the number of weekdays, Saturdays, and Sundays within each service period were used to factor the daily statistics to annual values. If only one check was available, the data were used as reported in the single TPM line data file without adjustment. Changes which went into effect as of June 21, 1981 were not incorporated into the analysis since the 1981 fiscal year ended on June 30.

For those lines not requiring adjustment and for which more than one ride check was conducted during FY 1981, data from the most recent check were selected. If FY 1981 data were not available, data were retrieved from the last conducted ride check, whether it was from FY 1980 or earlier. Once selected, total annual weekday vehicle miles were manually computed by multiplying daily miles by 255 weekdays.

Weekend annual vehicle miles were also estimated from data provided by the 4-24 Report. Rather than being linked to a ride check dataset, however, all Saturday and Sunday mileage statistics were manually obtained from the last 4-24 Report of FY 1981. Saturday mileage was multiplied by 52 days; Sunday mileage was multiplied by 58 days to account for all Sunday and holiday service.



Analysis and Verification - Two definitional and procedural problems have been identified which could potentially affect the accuracy of the data base. The first concerns the definition of total vehicle miles. Although both revenue and non-revenue mileage are included, the statistics reflect scheduled miles rather than actual miles traveled. The processing procedure does not allow for adjustments to account for non-scheduled changes, such as road calls, missed runs, or extra trips.

To assess the impact on the FY 1981 data base, a study performed by the Mileage Section was reviewed. It was conducted to determine the difference between actual and scheduled miles of service. From July 1, 1980 to June 30, 1981, all non-scheduled added miles, cancellations, and temporary scheduled miles were processed each day to establish actual daily miles. On an annual systemwide basis, the results were as follows:

Scheduled Miles:	105,159,971 <sup>(1)</sup>
Actual Miles:	105,661,540
Difference:	501,569
Percent Difference:	+0.48%

Although the impact on any particular line may be significant, the overall systemwide difference between actual and scheduled mileage is small. The report also indicated that the

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(1) This figure does not match either the TPM or TDA total vehicle miles statistic because it includes special services and is derived from a cumulative count rather than a factoring procedure.

calculation of actual miles required approximately 1,000 man-hours. From the results of the Mileage Section's study, the scheduled service statistics, without adjustment for non-scheduled changes, reasonably represent operated service levels.

A second potential problem concerns the lack of any adjustments to account for seasonal variations in service levels. As calculated for FY 1981, the daily weekday vehicle miles statistic reflects service which was scheduled for the day on which a ride check was conducted. In this way, the daily vehicle mileage in effect during one service period was factored to an annual value without consideration of service levels in the three other periods. Weekend statistics based solely on the mileage statistics reported for the last shake-up period in FY 1981, are also suspect of this problem.

To assess the impact of SCRTD's procedure on the data base, annual weekday vehicle miles for a sample of lines were independently calculated. The verification process consisted of: (1) selecting a minimum 10 percent sample of lines by service classification; (2) retrieving the daily vehicle mile statistics from TPM reports and multiplying by 255; (3) retrieving daily vehicle mile statistics from 4-24 Reports for each service period in FY 1981 and multiplying by the appropriate number of weekdays, Saturdays and Sundays; and (4) comparing the results of the two procedures. The results of this verification process are presented in Exhibit 1-9.

As shown, the two procedures yield different annual statistics. The most significant differences were found to be in 1C-Local Community and 1A-Local Demand classifications.

**EXHIBIT 1-9  
SCRTD DATA REVIEW**

**VERIFICATION OF TOTAL VEHICLE MILES**

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<u>Service Classification</u>	<u>Number of Lines in Sample</u>	<u>Vehicle Miles in Sample/ Vehicle Miles in Classification</u>	<u>Annual Weekday Total Vehicle Miles</u>		
			<u>TPM Procedure</u>	<u>Verification Procedure</u>	<u>Difference</u>
1A Local Demand	5	13%	5,113,260	5,233,365	120,105 2.3%
1B Local Policy	6	8%	1,644,750	1,645,074	324 1.0%
1C Local Community	6	60%	927,435	964,410	36,975 4.0%
2A Express Multi-Stop	10	66%	9,784,350	9,838,436	54,086 1.0%
2B Express Limited Stop	12	43%	1,859,970	1,869,543	9,573 1.0%

---

The latter accounts for almost 50 percent of weekday service. If the sample's 2.3 percent variance were to be applied to the total vehicle miles in the 1A classification, the discrepancy between TPM factored and actual scheduled service would total over one million miles. It is therefore recommended that the TPM data be collected separately for each service period in order to account for service changes in particular lines or groups of lines and seasonal variations in service levels.

An additional issue, that of internal consistency and timeliness of the data base is discussed in F. Unlinked Passengers.

B. In-Service Vehicle Miles

TPM Definition - In-service vehicle miles are defined as the actual distance traveled between the first and last stop on a route; it excludes all deadhead mileage.

TDA Definition - Vehicle service miles are defined as scheduled revenue bus miles of operation exclusive of pull-out, pull-in and interline deadhead mileage.

TPM Data Collection Procedure - The numbers of in-service vehicle miles shown on the TPM reporting form are the summation of individual line in-service mileage statistics. Week-day in-service vehicle miles were derived from data collected during ride checks. A ride check is performed by a checker traveling on-board all bus trips scheduled for a line on a single day. Among other items, the checker records every timepoint location served by the bus. Actual miles traveled

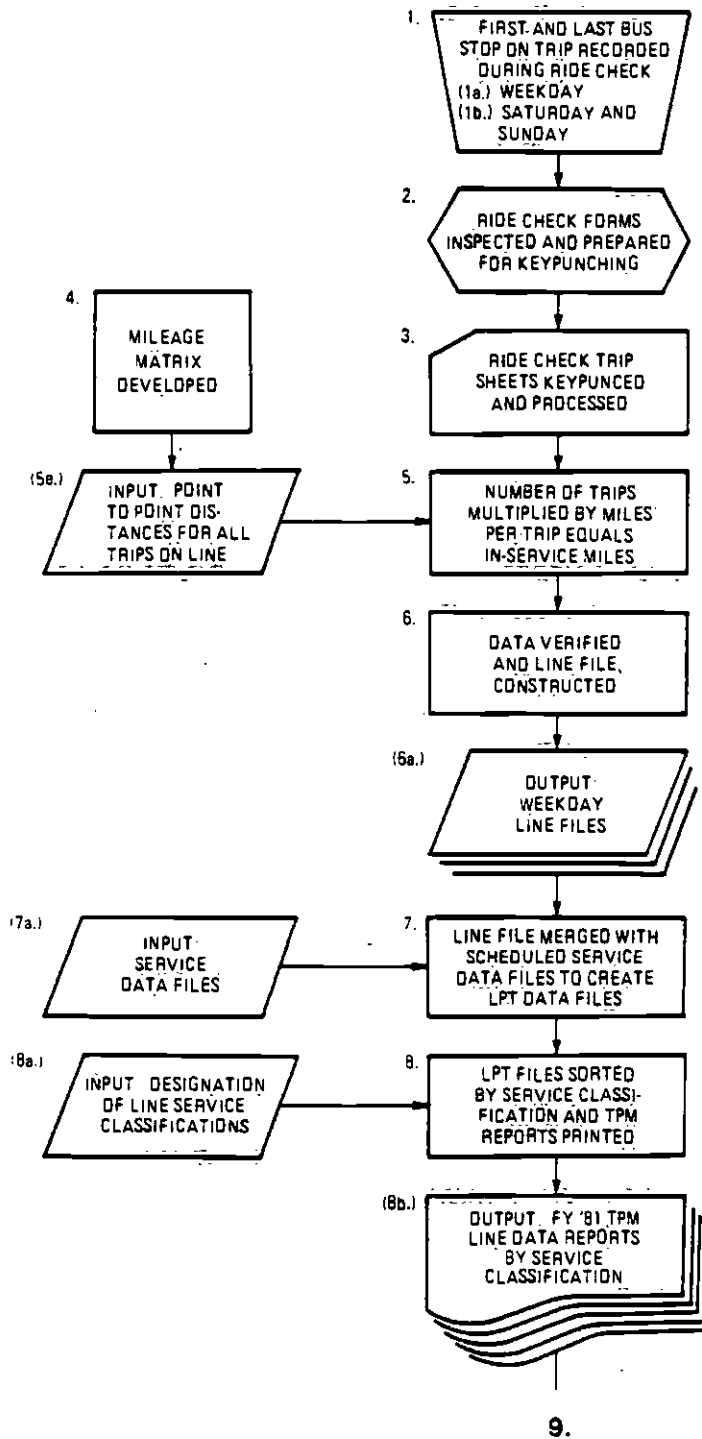
while in-service are calculated by computer with the assistance of a mileage matrix. The Service Analysis Section is responsible for processing this information and constructing Line Files which contain all ride check data. LPT data files were constructed from these Line Files together with scheduled service statistics matched to the date of the ride check. The Advance Planning Section of the Planning Department used computer-generated line data reports to manually compile in-service mileage statistics for the TPM reporting form. Saturday and Sunday statistics were obtained directly from 4-24 Reports published for the last schedule period in FY 1981.

A representation of the steps which were followed to derive in-service vehicle miles is presented as Exhibit 1-10. Additional discussion of particular steps follows.

Steps 1 through 6 - Ride checks record what actually occurs on the street for one complete service day. Lines are selected for ride checks on the basis of the Scheduling Department's receipt of requests for information about particular lines. A systematic updating of old data has been given a low priority. Thus, all lines were not surveyed in FY 1981, although some were checked more than once.

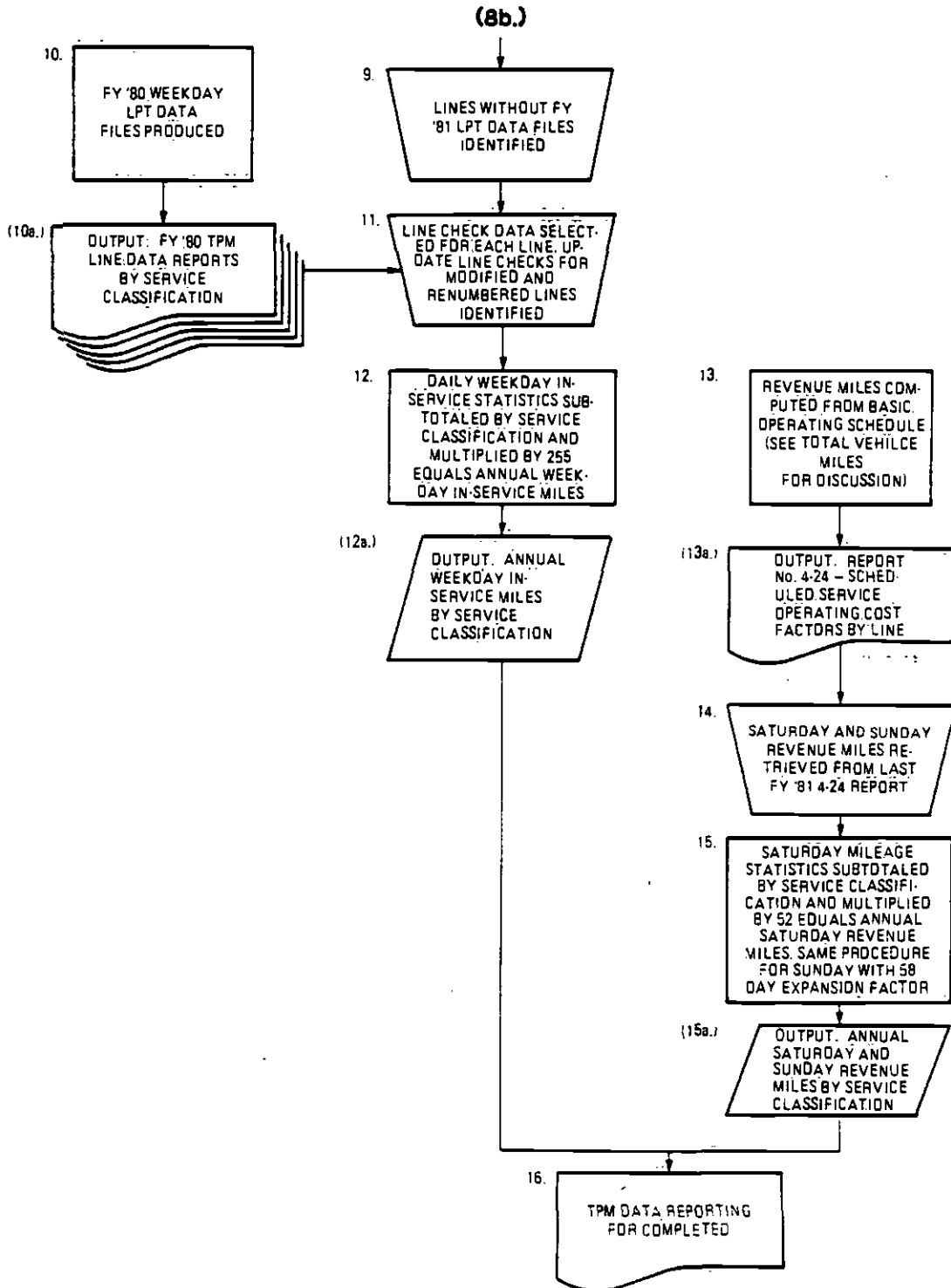
Once the checks are performed for a line, the Scheduling Department assembles all ride check forms and sends them to Service Analysis where a data technician is assigned the responsibility of constructing a Line File. The data technician checks for the reasonableness and completeness of the trip sheets and adds information necessary for data processing (Step 2). Information is directly keypunched off the trip sheets and processed (Step 3). The data technician checks the suitability of the existing mileage matrix which contains

**EXHIBIT 1-10**  
**SCRTD DATA REVIEW**  
**IN-SERVICE VEHICLE MILES**



Note: See Appendix I-E for Flowchart Legend

**EXHIBIT 1-10  
SCRTD DATA REVIEW  
IN-SERVICE VEHICLE MILES  
(Continued)**



point-to-point distances for all types of trips on the line. If route alignment has not changed since the previous ride check, the existing distances on file would be used. If routing has changed, however, revised point-to-point distances would be entered. The data technician then runs through several stages of verification checks.

. Steps 7 through 16 - See discussion under A. Total Vehicle Miles, Steps 6-14.

TDA Data Collection Procedure - The number of revenue bus miles reported for TDA audit purposes (See Appendix 1-B) are the summation of individual line mileage statistics. The line statistics represent scheduled revenue miles as reported in the 4-24 Report, expanded to annual values. Based on the statistics provided in three 4-24 Reports issued for FY 1981 (June, September, and April), a weighted daily average revenue hours value was computed for each line. Annual weekday, Saturday, and Sunday statistics were factored from the average daily values using 255, 52, and 58 day expansion factors respectively. Based on the Planning Department's assignment, lines were divided into express and local classifications. A ratio of express to local mileage was computed based on mileage statistics reported in the June 4-24 Report. This ratio was then applied to the derived annual systemwide statistic to estimate local and express revenue miles, respectively.

Analysis and Verification - Although the definitions of TPM In-Service Vehicle Miles and TDA Vehicle Service Miles are similar (See Attachment B), SCRTD elected to collect and process the data using two different methods. Reported TPM



mileage statistics reflect the expansion of actual daily in-service data, as recorded by a ride checker, to annual values. Two potential concerns with this approach have been identified. The first is that some portion of a line's mileage may have been excluded from the daily ride check count. Bus trips operated by a foreign line vehicle may not have had a ride checker on-board. Thus, the in-service mileage calculated for a line which uses foreign line buses, would have been underestimated. The Service Analysis Section is currently instituting procedures to adjust line statistics to account for any unchecked bus trips. The second concern pertains to the expansion of a single day's statistics to annual values without adjustments to account for unscheduled operating changes, e.g., missed trips and extra trips and scheduled seasonal variations in service levels. As discussed under A. Total Vehicle Miles, however, the impact of unscheduled operating changes on total systemwide statistics is very small.

Reported TDA mileage was developed by expanding scheduled daily revenue miles to annual values. As discussed previously, the use of scheduled service statistics without adjustment, does not account for unscheduled operating changes. In addition, revenue miles as reported on the 4-24 Report include within-line deadhead travel. (It excludes pull-out, pull-in and off-route deadhead travel). By TDA definition, all deadhead travel should be excluded.

A sample of lines was examined to determine the impact of within-line deadhead on the in-service statistics. Because the incidence of within-line deadhead or off-route travel is greater on express lines, these services were reviewed more extensively. For local services within-line deadhead travel

accounted for 1 to 3 percent of sampled in-service vehicle miles. For express services, it accounted for 2 percent of Multi-Stop (2A) in-service miles, and 9 percent of Few-Stop (2B) in-service miles, as shown by Exhibit 1-11. The source of the information presented in the exhibit is the previously referenced Bus Line Accumulation of Time and Mileage Report. According to these reports, the majority of off-route mileage is operated within a single line rather than interlined between two lines and that the impact of including deadhead in Classification 2B's statistics is fairly significant.

A comparison of TPM and TDA in-service mileage statistics reveals a difference of almost 4 million annual miles. Reported annual in-service miles are as follows:

TPM:	84,754,382 miles
TPM Adjusted for Special Services:	87,865,861 miles
TDA:	91,611,000 miles
Difference:	3,745,139 or 4.3% of TPM mileage

In addition the allocation of miles to local and express service classification varies by report. The data processing procedures used for TPM purposes result in the assignment of 78 percent of systemwide in-service miles to local service; whereas, TDA procedures result in 75 percent to local services. To ensure consistency among reported service statistics, both in terms of total miles and allocation to service classifications, a single approach should be adopted for the collection and processing of service statistics.

EXHIBIT 1-11  
SCRTD DATA REVIEW

VERIFICATION OF TDA IN-SERVICE MILES

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	<u>2A</u> <u>Express Multi-Stop</u>	<u>2B</u> <u>Express Limited-Stop</u>
Sample Lines/ Total Lines by Classification	90%	63%
Daily within Line Deadhead Miles	730	379
Within Line Miles/ Off-Route Miles	73%	85%
Within Line Miles/ In-Service Miles	2%	9%

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Source: *Bus Line Accumulation of Time and Mileage Report.*

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C. Total Vehicle Hours

TPM Definition - Total scheduled vehicle hours includes all pull-out, pull-in, and off-route non-revenue time and in-service and layover revenue time.

TPM Data Collection Procedure - The number of total weekday vehicle hours shown on the TPM reporting form are the summation of individual line time statistics. The line statistics represent a predetermined number of revenue and non-revenue hours scheduled for the day on which a ride check was conducted, expanded to an annual value. The steps involved in this process are depicted in Exhibit 1-2. As discussed under A. Total Vehicle Miles, the key source for scheduled vehicle hour statistics was the Scheduling Department's 4-24 Report and its associated CFS data file. For weekday data needs, the Service Analysis Section merged this file with use statistics from its Line File. The results were TPM line data reports by service classification. A planner from the Advance Planning Section subsequently selected the most appropriate dataset and applied annual expansion factors to the daily statistics. Information was then recorded in the TPM reporting forms.

Saturday and Sunday total vehicle hour statistics were manually obtained from the last 4-24 Report of FY 1981. The daily statistics were factored to annual values using 52 Saturdays and 58 Sundays and holidays.

Analysis and Verification - The same concerns described for total vehicle miles apply for total vehicle hours. In summary these are: (1) scheduled vehicle hours do not account

for unscheduled operating changes which occur every day; and (2) vehicle hours for one service period do not account for scheduled service changes which occur in the other service periods.

D. In-Service Vehicle Hours

TPM Definition - In-service vehicle hours are most similar to SCRTD's definition of revenue hours. Based on scheduled service, it includes in-service, layover, and within-line deadhead travel time. It excludes pull-out, pull-in, and between-line deadhead time.

TDA Definition - Vehicle service hours are defined as scheduled revenue bus hours of operation including in-service, layover, and within-line deadhead and excluding pull-out, pull-in and interline deadhead hours.

TPM Data Collection Procedure - In-service vehicle hours reported for the TPM program are based on a systemwide ratio of the number of revenue hours to total hours. At SCRTD, the rule of thumb is that weekday revenue hours constitute 92 percent of total vehicle hours. In-service hours were derived by multiplying total vehicle hours for each service classification by a constant 92 percent. For the weekend, in-service vehicle hours were computed as 96 percent of total vehicle hours.

TDA Data Collection Procedure - The number of revenue bus hours reported for TDA audit purposes are the summation of individual line hour statistics. The line statistics

represent scheduled revenue hours as reported on the 4-24 Report, expanded to annual values. Based on the 4-24 Reports issued for service in FY 1981, a weighted daily average revenue hours value was computed for each line. Annual weekday, Saturday and Sunday statistics were factored from the average daily values and added together to equal annual systemwide revenue hours. A ratio, developed on the basis of a count of local and express miles (See B. In-service Vehicle Miles), was applied to total systemwide revenue hours to estimate local and express components.

Analysis and Verification - Weekday TPM in-service vehicle hours for all service classifications were estimated on the basis of a flat 92 percent of total vehicle hours; for weekend data, a 96 percent factor was used. Although this procedure provides a fairly accurate estimate of total systemwide in-service miles, it does not account for differences in operating practices among the five service classifications. For example, it would be reasonable to suspect that this factor would be less than 92 percent for express routes because a large proportion of its daily service is concentrated in the peak period. Pull-out and pull-in deadhead travel time could thus constitute a larger percent of an express line's total daily vehicle hours than that for a local all day service line.

To assess the impact of using a 92 percent weekday factor and a 96 percent weekend factor for all service classifications, vehicle hours were examined for a sample of lines. The results are presented in Exhibit 1-12. As shown, the total systemwide percentages are almost identical to those used by SCRTD staff, but the variation among the classifications is

EXHIBIT 1-12  
SCRTD DATA REVIEW

VERIFICATION OF TPM IN-SERVICE VEHICLE HOURS

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<u>Service Classification</u>	<u>Percent Revenue of Total Vehicle Hours</u>	
	<u>Weekday</u>	<u>Saturday</u>
1A Local Demand	94	96
1B Local Policy	94	95
1C Local Community	97	97
2A Express Multi-Stop	90	96
2B Express Limited-Stop	66	No Service in Sample Lines
Average	91	96

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Source: "Scheduled Service Operating Cost Factors," Report No. 4-24, June 1980 – April 1981.

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significant for weekday service. In service classification 2B-Express Limited Stop, just 66 percent of sampled total vehicle hours is operated as revenue service. This percentage is even less if one considers that within-line deadhead travel time is included in the calculation of Report No. 4-24's revenue hours. On an annual basis, scheduled in-service vehicle hours for Classification 2B would therefore be closer to 125,924 than the reported 175,529 - - a difference of almost 50,000 hours.

#### E. Peak Vehicles

TPM Definition - Peak vehicles are defined as the maximum number of vehicles necessary to provide scheduled service.

TPM Data Collection Procedure - The numbers of peak vehicles presented on the TPM reporting form are the summation of individual line equipment requirements. A flowchart of the data collection procedure is presented as Exhibit 1-2. As shown, the 4-24 files provided the necessary vehicle statistics (Step 5A, Exhibit 1-2). As part of the 4-24 preparation process, vehicle requirements were manually determined from scheduled bus run information provided on the Herman Reports; Bus Line Accumulation of Time and Mileage Reports are currently used. This vehicle count identifies the total number of buses required to operate an individual line's scheduled service by time period; including a.m. peak, day base, p.m. peak, and owl. On the 4-24 Report, these statistics are reported under the heading "Gross Equipment." Gross equipment does not account for equipment savings realized by operating some trips on two or more lines with one vehicle.



EXHIBIT 1-13  
SCRTD DATA REVIEW

PEAK VEHICLE VERIFICATION

	Operating Schedule		
	<u>June 1980</u>	<u>September 1980</u>	<u>April 1981</u>
Gross PM Peak Vehicle Requirements	1,999	2,016	2,053
Less Interline Savings	<u>48</u>	<u>60</u>	<u>65</u>
Net PM Peak Vehicle Requirements	1,951	1,956	1,988

Such savings are listed separately on the 4-24 Report as "Interline Savings." As a result, peak gross equipment statistics double count all buses which operate on two or more lines. Net vehicles, or actual peak fleet requirements, can be computed by subtracting interline savings equipment from gross vehicles.

Similar to the other scheduled service statistics of total miles and hours, gross peak vehicle requirements are processed into the 4-24 Report and the TPM line data reports. The line statistics are retrieved by the Planning Department, subtotaled, and included in the TPM Reporting Form.

Analysis and Verification - Data entered into the TPM line data reports are soft in three primary areas. First, as described above, gross vehicle requirements double count vehicles assigned to more than one line during any given peak period. Second, rather than a snapshot of peak vehicle needs at any one point in time, vehicle requirements are estimated for a period stretching close to two years. This occurs because service data files are selected to match the date on which a ride check was conducted. Within two years, many scheduling changes could occur which could go unnoticed by the TPM data collection process. Third, unscheduled operating changes are not incorporated into the data base.

For TPM requirements, SCRTD should report the maximum number of vehicles required for peak period operations. The number of P.M. peak vehicles required for the three operating schedules in FY 1981 is shown on Exhibit 1-13. The P.M. peak period equipment requirements are used because they are greater than A.M. peak period needs. As shown, the maximum

number of vehicles are required in the April 1981 schedule. Its vehicle requirement was 1,988 as compared to 1,907 vehicles reported for FY 1981 on the TPM form. This figure is to be used in the development of a three-variable cost allocation model.

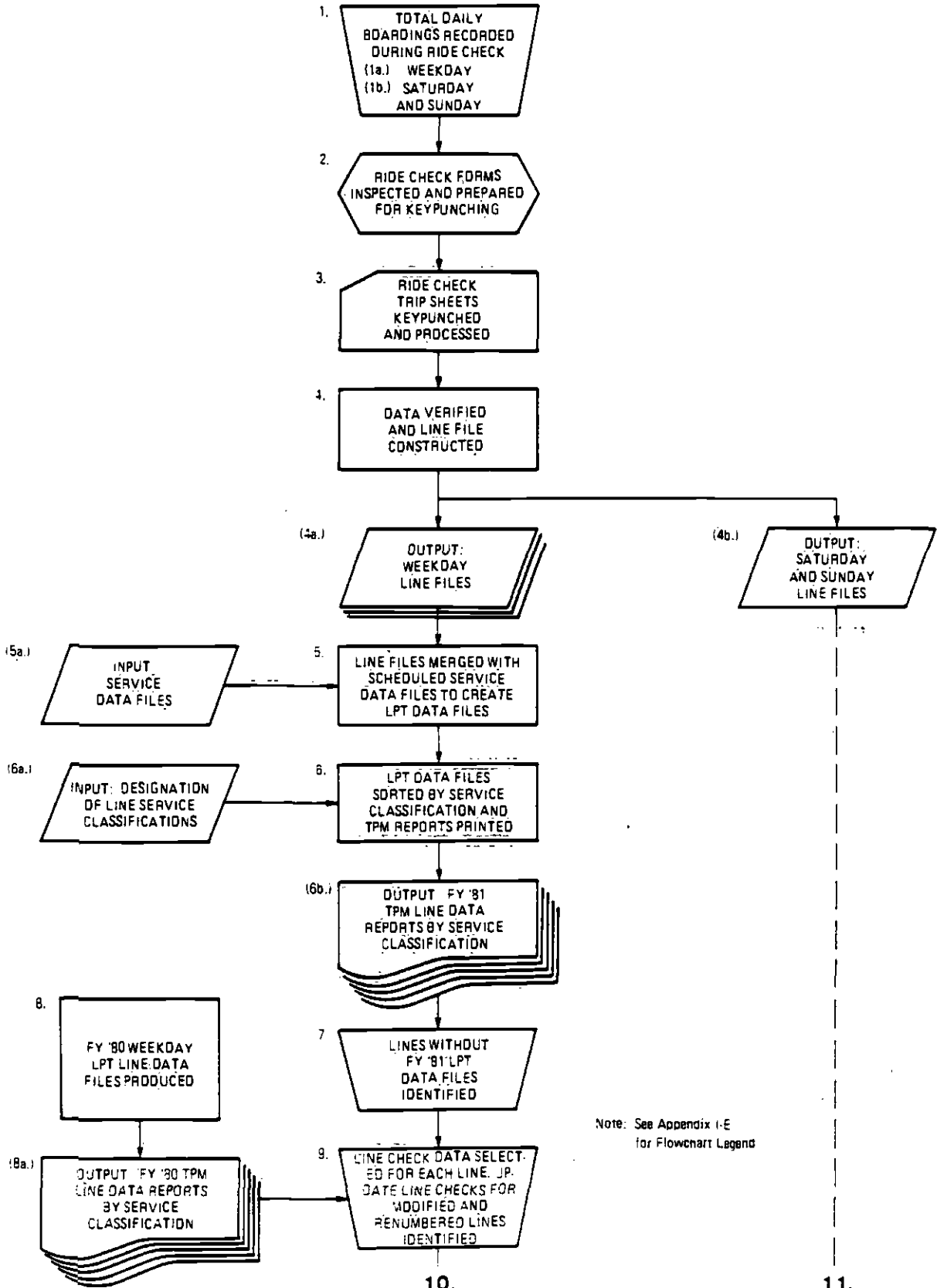
F. Unlinked Passengers

TPM and TDA Definition - Unlinked passengers are counted as total boardings.

TPM Data Collection Procedure - Unlinked passengers reported on the TPM form are the summation of annual boardings estimated for individual lines. The procedure for developing the passenger statistics is depicted as Exhibit 1-14. A more detailed description of particular steps in the process follows.

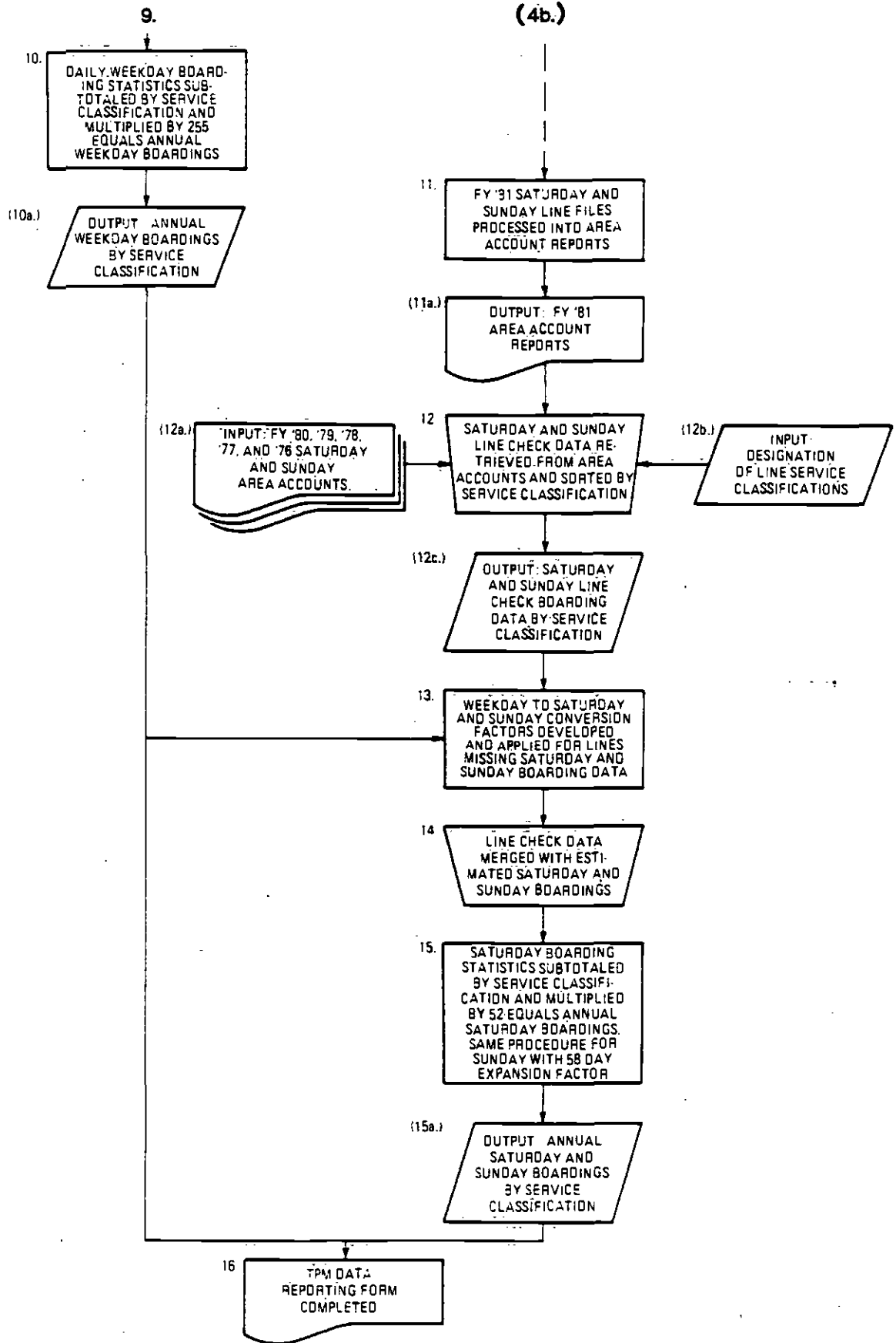
Steps 1 through 10 - Total boardings are recorded by ride checkers on all scheduled trips for the selected check day. A sample 1982 ride check form is presented as Exhibit 1-15. Similar forms were used in FY 1981. Passenger alightings are also recorded on the form. During data verification (Step 4), the balance between total passenger boardings and alightings is evaluated to determine the accuracy and reliability of reported data. Adjustments to the data base are made as necessary. A data technician also verifies that trip sheets were turned in for all scheduled trips. For FY 1981, weekday passenger boarding data were processed into Line Files and subsequently into LPT data files as described previously in A. Total Vehicle Miles and B. In-Service Vehicle Miles (Steps 4-10).

**EXHIBIT 1-14  
SCRTD DATA REVIEW  
UNLINKED PASSENGERS**



**EXHIBIT 1-14  
SCRTD DATA REVIEW**

**UNLINKED PASSENGERS  
(Continued)**





Steps 11-16 - Saturday and Sunday unlinked passengers were treated differently because of the low frequency of weekend ride checks. Because very few weekend ride checks are made each year, it was decided that boarding data would be retrieved from earlier ride checks dating as far back as 1976. As a result, computer-processed LPT data files were not developed for weekend statistics. Boarding counts reported in previously processed Area Account Reports were manually retrieved and recorded by a Planning staff member. The Service Analysis Section prepares the Area Account Reports which merge line check data with geographic and socioeconomic data. Line-specific Saturday and Sunday passenger statistics were sorted by service classification and inventoried to identify those lines lacking information.

Due to the large number of lines for which boarding counts had not been conducted, a procedure was developed to estimate Saturday and Sunday boardings from weekday data. An average ratio was developed between weekend and weekday ridership. Averages were determined on the basis of data available for four representative lines in each service classification. The ratios, expressed as percentages, were then applied to the weekday boarding counts of those lines missing actual weekend ridership data. The percentages used in this procedure are presented in Exhibit 1-16. The estimated Saturday and Sunday boardings were merged with the line check data and factored to annual passengers.

TDA Data Collection Procedure - Total systemwide ridership statistics were retrieved from SCRTD's quarterly Statistical Digest. Total passenger boardings were derived from farebox revenue counts with the use of a quarterly fare survey and an in-house patronage model. Systemwide ridership was apportioned to local and express service on the basis of ratios developed from TPM reported ridership levels. For

**EXHIBIT 1-16**  
**SCR TD DATA REVIEW**  
**WEEKDAY TO WEEKEND**  
**UNLINKED PASSENGER CONVERSION FACTORS**

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<u>Service Classification</u>	<u>Saturday as a Percent of Weekday</u>	<u>Sunday as a Percent of Weekday</u>
Demand-Based Service	57%	34%
Policy-Based Service	46%	24%
Express—Local Stops	44%	30%

---



FY 1981 data, 90.6 percent of total ridership (397,000,000 unlinked passengers) was allocated to local service; 9.6 percent to express service.

Analysis and Verification - Ride checks conducted during FY 1981, 1980 and 1979 provided the raw line-specific weekday ridership data which were factored to annual values. For weekend statistics, ride checks dated back to 1976. Several problems are inherent to the use of the described procedures. The first of these is the timeliness of the data base. To determine the extent of this problem, the years in which the ride checks were performed were analyzed, as shown by Exhibit 1-17. In Classification 2B-Express Limited Stop, almost one-half of the lines relied on checks performed in FY 1980. On weekends the age of the data base is a more critical problem. Less than one-half of the lines had FY 1981 weekend ride check data available; data for the remaining lines were retrieved from prior years or were based on weekday-to-weekend conversion factors.

A second problem stems from the ride check's inability to ascertain between day (Monday through Friday) and seasonal (July versus October) variations in ridership levels. By multiplying a weekday count by 255 days, it is assumed that the ridership recorded on that single day was typical or average for that line throughout FY 1981. There is no statistical sampling evidence to support that claim. The impacts of other external factors which can influence ridership levels during the course of a year were also excluded from the ridership estimates; these include, population or employment growth, and fuel availability and price.

**EXHIBIT 1-17  
SCRTD DATA REVIEW**

**UNLINKED PASSENGER VERIFICATION**

**Percent of Lines by Year of Ride Check Data**

	<u>FY 1981</u>	<u>FY 1980</u>	<u>FY 1979</u>	<u>Prior Years</u>	<u>No Check</u>	<u>Total</u>
<b>Weekday</b>						
<b>1A Local Demand</b>	69%	27%	4%	0%		100%
<b>1B Local Policy</b>	82%	18%	0%	0%		100%
<b>1C Local Community</b>	83%	17%	0%	0%		100%
<b>2A Express Multi-Stop</b>	74%	26%	0%	0%		100%
<b>2B Express Limited Stop</b>	54%	46%	0%	0%		100%
<b>Total</b>	<b>73%</b>	<b>26%</b>	<b>1%</b>	<b>0%</b>		<b>100%</b>
<b>Weekend</b>						
<b>1A Local Demand</b>	42%	19%	16%	2%	21%	100%
<b>1B Local Policy</b>	43%	16%	5%	8%	28%	100%

The treatment of Saturday and Sunday ridership statistics also requires further examination. Two problems are the timeliness of the data base and the use of weekday to weekend conversion factors. Of the 48 local demand lines, almost one-third relied on the weekday to weekend conversion ratio. Approaches to use current weekend systemwide ridership estimates or to update the Line File data base need to be explored.

To estimate the impact of using out-of-date and factored data, other sources of passenger boarding statistics were consulted and compared to the TPM values, as listed below:

TPM Annual Unlinked Passengers:	368,821,873
Plus Estimated Passengers on Special Services:	4,000,000
Adjusted TPM Annual Unlinked Passengers:	372,821,873
SCRTD Statistical Digest and TDA:	397,000,000
Consultant Tabulation of Daily Ridership Estimates:	396,225,000
Difference between Adjusted TPM and TDA Reported Unlinked Passengers:	24,178,000

The difference between the TPM and TDA data set is over 24 million annual passengers or 6.5 percent of the TPM ridership value.

TDA unlinked passenger statistics rely on systemwide ridership estimates developed on the basis of farebox receipts and a fairly complex and continuously evolving patronage model. The formula for daily patronage estimation is as follows:

System Patronage =

(Actual Farebox Revenue X Revenue per  
Non-Pass Boarding Factor) +

(Regular Pass Sales X Regular Uses Per Day) +

(Discount Pass Sales X Discount Pass Uses  
Per Day) +

(Student and Youth Pass Sales X Student and  
Youth Pass Uses Per Day) +

(College Pass Sales X College Pass Uses Per Day)

To verify the accuracy of the model, its patronage statistics can be factored back up to farebox receipts. A comparison of actual to estimated farebox revenue derived from the model's output indicates that it yields reasonably accurate weekday ridership information, but is less reliable for weekends, as shown by Exhibit 1-18. As the model has been refined, the difference between actual and estimated weekday revenues has steadily declined to less than one percent. Sampling errors and lack of historical information have hampered the development of accurate weekend data.

#### G. Passenger Revenue

TPM Definition - Reported passenger revenue includes fare payments made by cash, passes, tickets, tokens, and transfers.

**EXHIBIT 1-18  
S CRTD DATA REVIEW**

**COMPARISON OF ACTUAL AND ESTIMATED FAREBOX REVENUE**

	Weekdays			Saturdays			Sundays		
	Actual	Est.	Difference	Actual	Est.	Difference	Actual	Est.	Difference
Mar 1981	\$280,318	\$274,909	1.9%	\$186,100	\$236,741	27.2%	\$129,495	\$121,002	7.6%
Jul 1981	318,920	312,650	2.0%	191,255	212,391	11.1%	138,638	135,044	2.6%
Oct 1981	329,327	333,636	1.3%	201,728	191,174	5.2%	140,861	115,428	18.1%
Feb 1982	331,857	330,719	0.3%	193,070	217,221	12.5%	139,419	130,452	6.4%

Source: *Memo from Ann Huck to Ed Vandeventer, "Patronage Estimation," April 26, 1982.*

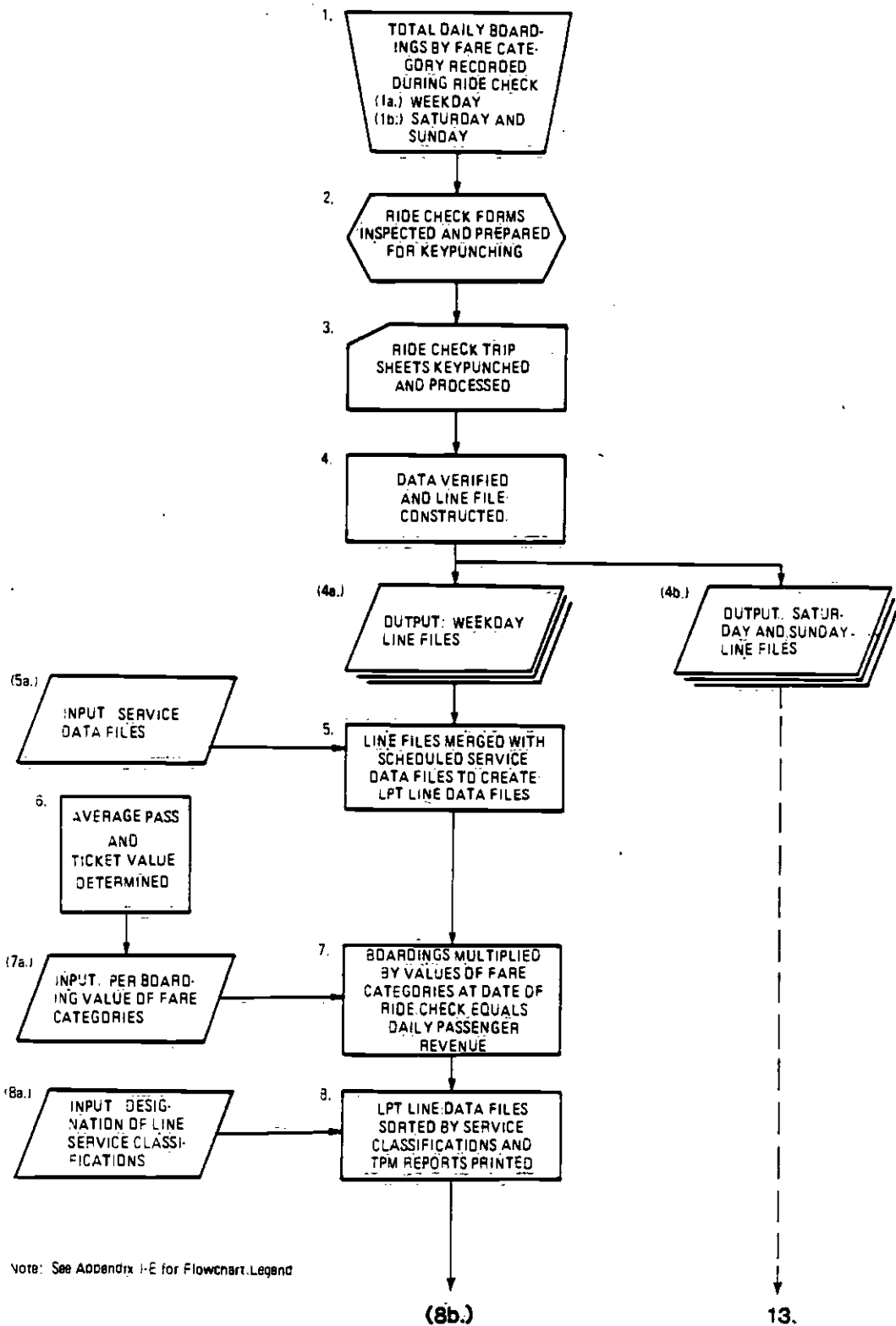
TPM Data Collection Procedure - TPM reported passenger revenue statistics are the summation of revenues attributed to individual lines. Line-specific revenues are estimated from boarding information obtained during ride checks, and cash or equivalent values of fares as shown by Exhibit 1-19. The computation of passenger revenues was and continues to be an integral part of SCRTD's ongoing ride check data processing procedures. In addition to its other uses, the information could be used in preparing TPM revenue statistics. Due to the limited availability of similar dataset for weekend service, Saturday and Sunday revenues were manually computed under a different set of assumptions designed specifically for TPM purposes. Once derived, daily passenger revenues were processed in accordance with the procedures outlined for F. Unlinked Passengers. The methodology for deriving per boarding fare values is discussed below.

- . Steps 1 through 7 - Daily passenger revenue is the sum of total daily passenger boardings by fare category multiplied by the respective cash value of each fare category. During ride checks, checkers record the type of fare paid by each boarding passenger, as shown by the sample form in Exhibit 1-15. Fare categories include four cash levels, three pass levels, transfers, tickets and tokens, and four additional revenue categories. In this way, SCRTD collects a line's total daily number of passengers by fare category on a preselected representative day.

The next processing step is to determine per boarding value of each fare category. For cash fares, the answer is straightforward. FY 1981 cash values were as follows:

Regular	\$0.65
Handicapped Persons	0.30
Senior	0.30
Students	0.50
Express Service Increments	0.30

**EXHIBIT 1-19  
SCR TD DATA REVIEW  
PASSENGER REVENUE**



Note: See Appendix I-E for Flowchart Legend

**EXHIBIT 1-19**  
**SCRTD DATA REVIEW**  
**PASSENGER REVENUE**  
**(Continued)**

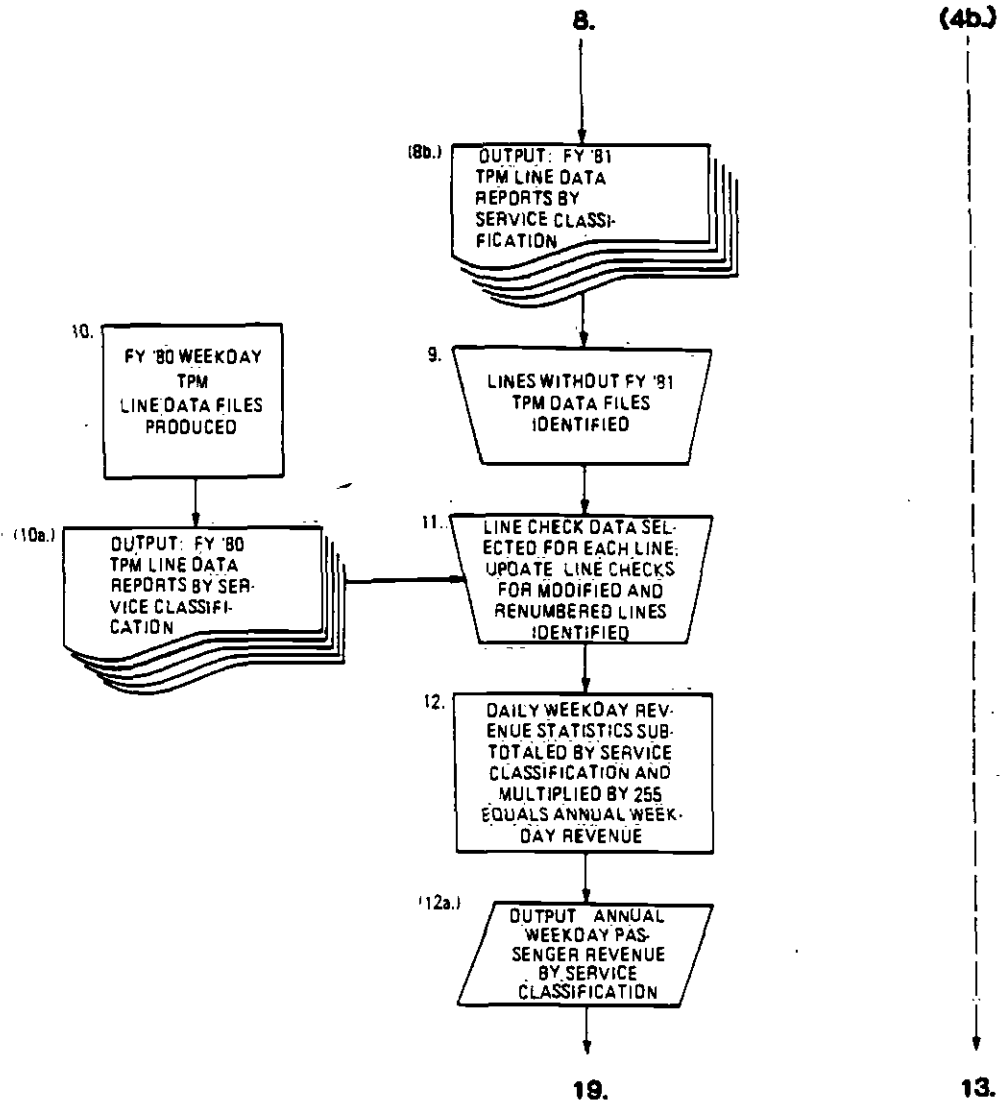
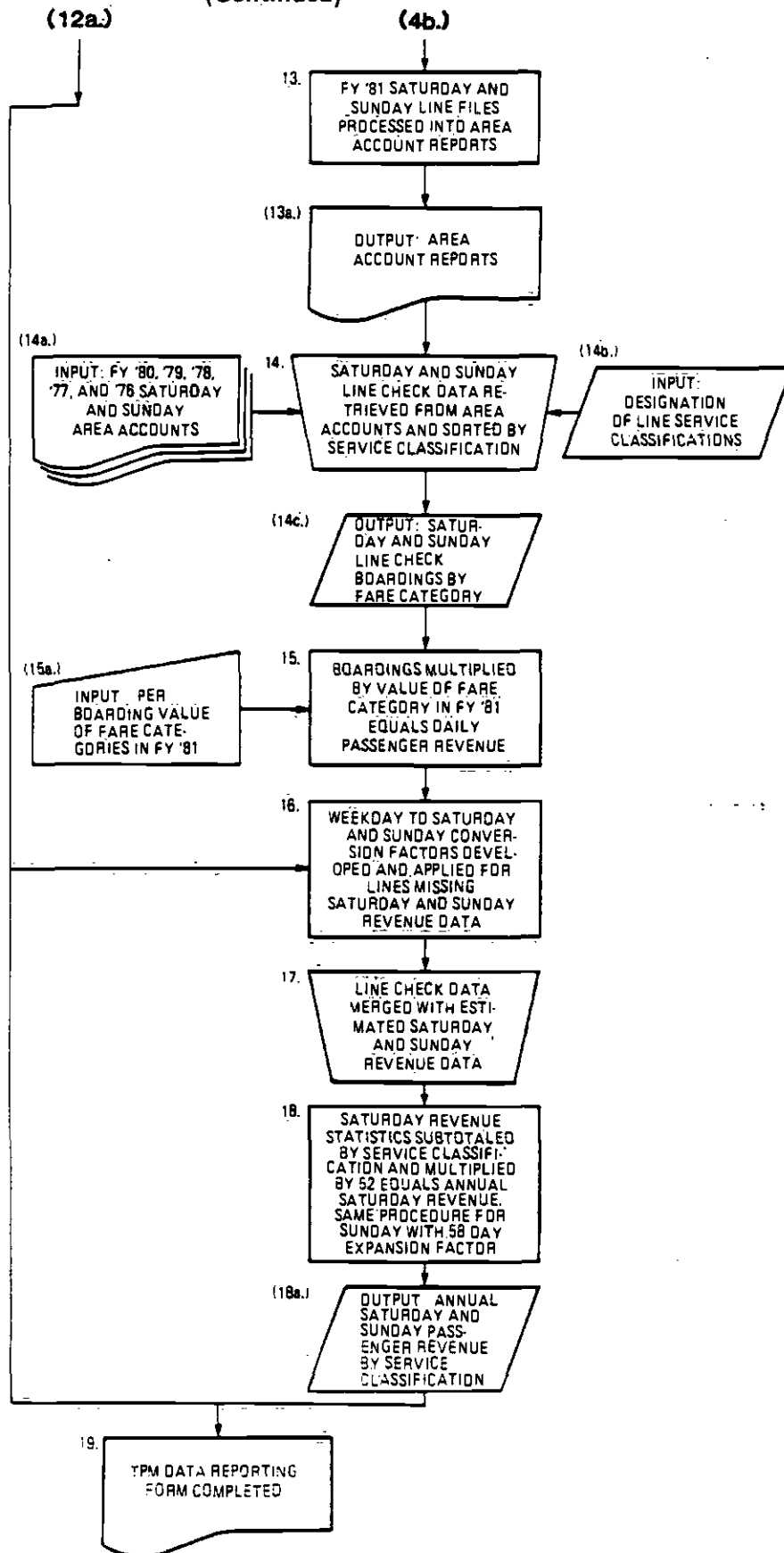




EXHIBIT 1-19  
 SCR TD DATA REVIEW

PASSENGER REVENUE  
 (Continued)



Similar determinations for other payment methods are more complex. Guidelines used to determine their cash value equivalents are as follows:

- Transfers: The value of a transfer is credited to the line on which payment is made.
- Tickets - Although tickets can assume numerous values, the ride check allows only for identification that some type of ticket was used. It is assumed, therefore, that the distribution of weekday ticket cash values parallels that of cash fares. Thus, if 60 percent of cash paying passengers deposit regular fares of \$0.65, it is assumed that 60 percent of ticket users do likewise. For TPM reporting purposes only, tickets deposited on weekends were all assumed to be valued at \$0.65.
- Passes - For weekdays, the per boarding cash equivalent of pass use is determined by the Service Analysis Section's separate Fare Survey. Conducted quarterly, the survey is completed for a random, stratified sample of bus runs. On-board checkers record payment methods, including passes. Sampled pass use by type, e.g., student, senior, regular, is expanded to systemwide use levels. From this information, average systemwide weekday, Saturday, and Sunday pass use by type is computed. The next step is to count the number of weekdays, Saturdays, and Sundays in the month. Total number of pass boardings per month are computed by multiplying average weekday, Saturday, and Sunday pass use by the number of respective days in the month. Because passes are generally purchased during the first 10 days of the month, an allowance for the phase-in of pass use is programmed into the calculations. The product is the total number of pass boardings per month which, when divided into the total value of pass sales for the month, results in

the average pass value per boarding for that particular month. In Line Performance Trend files, the cash equivalent value of a pass reflects the month in which the ride check was performed.

Weekend pass use values were manually derived without the benefit of the Fare Survey. The first step in this procedure was to sum the value of the four monthly pass types (regular, senior, students 19 and over, students under 19) and to divide by four to compute an average monthly pass value. It was assumed that pass use per day averaged 2.5 and that there were 30 days of pass use per month. Thus, each pass was estimated to be used 75 times in the course of a month. Average monthly pass value, determined to be \$17 in FY 1981, was divided by 75 to equal \$.225 per boarding value.

Steps 15 and 16 - As mentioned, the derivation of Saturday and Sunday revenue statistics varied from weekday procedures. Actual and estimated FY 1981 per use values of all fare categories were manually multiplied by the numbers of riders reported in each. If weekend ride checks had not been conducted for a line, its weekend revenue was estimated from its computed weekday revenue. From a sample of four lines in each service classification, which had both weekday and weekend data, a ratio was developed between weekday and Saturday and Sunday amounts. The ratios, expressed as percentages, were then applied to the weekday revenue counts of those lines missing actual weekend ridership data. The percentages used in this procedure are presented in Exhibit 1-20. The estimated Saturday and Sunday passenger revenue statistics were merged with the line check data and factored to annual revenue levels.

Analysis and Verification - Ride checks again provide the necessary data for developing the TPM statistics. Problems associated with the use of the ride check data base, as previously described, also apply to the passenger revenue statistics. These include the timeliness and consistency of the data, and implicit assumptions made in the expansion of daily statistics to annual values.

Additional concerns pertain to the fare levels used to compute passenger revenue. As mentioned, in the Local Demand Classification alone, ridership data for fifteen lines were based on FY 1980 or 1979 checks. The passenger revenues for these lines were also based on FY 1980 or 1979 fare levels. As a result, reported weekday revenue statistics are not reflective of FY 1981 fare collections.

Weekday and weekend pass and pass values were computed using different methods. Weekday cash values were based on the results of an extensive and rigorous Fare Survey. Weekend values were derived using some questionable assumptions, although the computed \$0.225 per boarding value was judged to be consistent with SCRTD's internal rules of thumb.

Passenger revenue for those lines missing ride checks, even for as far back as 1976, was derived from weekday revenue with the use of conversion factors. The derivation and application of the weekend conversion factors also require more consideration. One simple improvement would be to increase the number of lines in the sample which is used to develop the conversion factors.

Total system annual passenger revenue reported for the TPM program is significantly lower than that reported by other in-house sources, as presented below:

EXHIBIT 1-20  
S CRTD DATA REVIEW

WEEKDAY TO WEEKEND  
PASSENGER REVENUE CONVERSION FACTORS

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<u>Service Classification</u>	<u>Saturday as a Percent of Weekday</u>	<u>Sunday as a Percent of Weekday</u>
Demand-Based Service	67%	41%
Policy-Based Service	67%	31%
Express—Local Stops	25%	17%

---

TPM Passenger Revenue:	118,954,666
S RTP Table 3 Historical Financial Status:	137,806,000
Section 15 Report:	140,335,582
SCRTD 1981 Annual Report:	140,336,000

The difference between TPM reported revenue and audited Section 15 passenger revenue is over \$21 million, or 18 percent. The actual discrepancy is somewhat less than \$21 million since SCRTD's TPM reporting form does not specify passenger revenues earned on special service lines; e.g., contract, subscription, etc.

#### H. Auxiliary Revenue

Definition - None reported

Analysis and Verification - Although SCRTD chose not to report auxiliary revenue, \$1.4 million of auxiliary transportation revenues were reported in the agency's Section 15 Report, Annual Report and SRTP. It would be to SCRTD's benefit to report these revenues in its TPM report.

#### I. Local Subsidies

Definition - None reported.

Analysis and Verification - All local cash grants and reimbursements are assigned to special services classified as "Other."

J. Total Operating Cost

TDA Definition - Total operating costs include all costs in operating expense object classes, exclusive of depreciation and amortization. SCRTD does not operate charter service.

TDA Data Collection Procedure - Total system operating costs reported in SCRTD's SRTP (Table 2 - Historical Financial Status, p. 58) correspond to the cost figures initially presented in the agency's Section 15 Report (Form No. 301 - Expenses Classified by Function). The Section 15 Report was reviewed, and in the opinion of a certified public accounting firm, judged to be in conformance in all material respects with the accounting requirements of the Urban Mass Transportation Administration as set forth in its applicable Uniform System of Accounts, Records and Reporting System. (Letter from Coopers & Lybrand, October 16, 1981). Depreciation and amortization expenses were deducted, as instructed. All other expense categories were properly treated. Total operating costs are also in full agreement with figures presented in SCRTD's audited 1980-1981 Annual Report.

Total operating costs were divided into express and local services according to the total miles attributed to each category. In 1981, 25 percent of total costs were allocated to express services; the remaining 75 percent to local fixed route service.

Analysis and Verification - The primary concern about the operating cost statistic pertains to its allocation to express and local service solely on the basis of total miles. This allocation rule does not account for several operational factors, among which are the following:

- Labor costs, the primary operating cost component, are more directly tied to hours of service than to miles of service;
- Differences in vehicle utilization; and
- Differences in labor utilization between peak and off-peak service periods.

A three-variable cost allocation model was developed to determine the impact of the SCRTD's cost allocation procedure. The model's unit costs and results are depicted in Exhibit 1-21. The unit costs were developed on the basis of TDA reported operating statistics and Section 15 reported operating costs. Using the three-variable model, 78 percent of total system costs are allocated to local service, as opposed to 75 percent as reported by the TDA statistics. In terms of dollars, this amounts to \$12 million. On the other hand, the three-variable model reduces the costs attributed to express service by \$12 million. Rather than 25 percent of system costs attributed to express service, the model allocates 22 percent. In future reporting SCRTD's own cost model, a basic three variable cost allocations model, or a peak/base model should be investigated to improve the allocation of operating costs.

K. Full-Time Equivalent Employees

TDA Definition - Total personnel as of June 30, 1981 include all full-time and part-time operators, mechanics and maintenance employees, clerks and non-contract employees.



**EXHIBIT 1-21  
SCRTD DATA REVIEW**

**THREE-VARIABLE COST ALLOCATION MODEL**

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	<u>Vehicle Miles</u>	<u>Vehicle Hours</u>	<u>Peak Vehicles</u>	<u>Three-Variable Model Total Annual Operating Cost (including Depreciation)</u>	<u>TDA Reported Total Annual Operating Cost</u>	
<b>Unit Cost</b>	\$ 1.33	\$ 21.19	\$ 29,180	---	---	
<b>Annual: Local Service (\$000)</b>	\$103,959.4	\$127,754.5	\$43,945.1	\$275,659.0	\$249,747.0	excluding depreciation including depreciation
<b>Annual Express Service (\$000)</b>	\$ 34,653.2	\$ 28,034.4	\$ 13,131.0	\$ 75,818.6	\$ 83,249.0	excluding depreciation including depreciation
<b>Total (\$000)</b>	\$138,612.6	\$155,788.9	\$57,076.1	\$351,477.6 est.	\$332,996.0	excluding depreciation including depreciation

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TDA Data Collection Procedures - A total system personnel statistic was retrieved from SCRTD's Facts at a Glance report (August 17, 1981). Employees were divided into express and local services on the basis of the number of vehicle hours assigned to each service classification.

Analysis and Verification - The reported number of employees reflect a head count of all SCRTD personnel rather than full-time equivalent (FTE) employees. The 8,102 personnel published in Facts at a Glance equal the sum of listed full-time and part-time employees, excluding part-time transit police on June 30, 1981. For comparison, other sources of personnel statistics were checked. The Section 15 Form 404-Transit Employee Count Schedule identifies an annual average of 7,910 full-time equivalents. Part-time drivers and transit police are treated as half-time employees.

A more accurate method of determining FTE employees would be to total all employee hours worked during the year and to divide by 2,000 hours. Total employee work hours would include all overtime work hours and the precise number of hours worked by part-time employees. The data for this calculation should be available in payroll records.

## 1.2 DATA COLLECTION CONCLUSIONS AND RECOMMENDATIONS

To large measure, SCRTD has the data available to accurately and reliably fulfill TPM and TDA reporting requirements. The major strength of the agency's ongoing data collection and internal reporting procedures is that service and use statistics are electronically processed and maintained for individual lines by day of the week; i.e., weekday, Saturday, and Sunday/Holiday. Statistics for the TPM data items can therefore be computed by adding together the values for all lines within any of the five service classifications. This bottom-up approach eliminates the need to estimate each service classification's proportion of systemwide data or to estimate weekday and weekend proportions of service and ridership. Other strengths of SCRTD's data collection program include the conduct of comprehensive ride checks; procedures undertaken to improve the accuracy of reported scheduled service statistics; and the integration of service, use, and revenue data files.

The analysis of data collection procedures and verification of reported statistics, as reported in Section 1.1, identified several weak areas, most of which SCRTD is aware and for which improved procedures are being developed.

Among the more significant findings are the following:

- . Scheduled vehicle miles and hours are not adjusted to reflect actually operated service levels. An in-house study reported a difference of less than 0.5 percent between total annual scheduled and actual miles traveled.

- . Weekday service, vehicle, ridership, and passenger revenue statistics for 25 percent of SCRTD's lines are based on FY 1980 data. For weekends, statistics for more than 50 percent of the lines are based on FY 1980 or prior years' data.
- . Scheduled and seasonal variations in service levels, ridership, and passenger revenue are not accounted for in the daily to annual factoring procedure.
- . TPM and TDA data processing activities are not coordinated with each other. This results in discrepancies in the reporting of identical statistics for TPM and TDA.
- . Vehicle service miles and hours, by definition, should exclude all deadhead travel. SCRTD's reported TDA vehicle service miles and hours include within-line deadhead travel.
- . Estimated TPM in-service vehicle hours do not reflect differences in operating practices among the five service classifications. Based on a sample of lines, revenue hours as a percent of total vehicle hours range from 97 percent for Local Community service to 66 percent for Express Multi-Stop service.
- . Current procedures double count peak vehicles assigned to more than one line during the peak period.
- . The difference between TPM and TDA reported unlinked passengers is over 24 million passengers.
- . The difference between TPM and Section 15 reported passenger revenue is over \$21 million.
- . Applicable auxiliary revenues are not reported.
- . The allocation of operating costs to express and local services on the basis of total miles does not account for operational variations between the service types.

Full-Time Equivalent Employees are overstated by almost 200 hundred employees.

Based on these findings, several recommendations have been developed to strengthen the accuracy of SCRTD's data collection and compilation procedures, as described below.

#### Update Collected Data

The major criticisms of the submitted data base revolve around the age of the statistics and its inconsistency with total system figures. Currently, TPM ridership and passenger revenue statistics are expanded directly from ride check data; service statistics (miles, hours, and peak vehicles) are also linked to the date of the performed ride check. In recent years, SCRTD has not conducted annual weekday/weekend ride checks on all its lines. In 1981, for example, weekday data for more than 25 percent of its lines reflect FY 1980 levels. In part, these problems stem from the large resource requirements needed to conduct ride checks of all lines on both weekdays and weekends each year. Because 84 percent of total weekly ridership occurs Monday through Friday, ride check resources should be directed at conducting at least one weekday ride check per line per year. Other approaches for improving the timeliness of the data base are discussed below.

First, ridership data collected by point checks could be used to update ride check information. SCRTD has instituted a point check program to monitor its high ridership lines and to ensure compliance with adopted standards for adding Proposi-

tion A service.<sup>(2)</sup> Consideration should be given to expanding the point check program to checking loads on those lines having ride check data older than one year, as is the case with almost 60 percent of weekend lines. Point checks could also be used to monitor ridership levels to determine whether use levels have significantly changed since the last ride check, even if it was performed within the last year, and whether another ride check is warranted. For example, if ridership at a specific load point is shown to have increased or decreased by 20 percent between the dates of the ride check and point check, another ride check would be conducted. If ridership fluctuations are less than 20 percent, total 24-hour boardings from an earlier ride check could be adjusted using point check information and the following procedure:

$$\begin{array}{rcl}
 \begin{array}{l}
 \text{Point Check} \\
 \text{Total Point Load} \\
 \text{AM and PM Peak} \\
 \text{2 Directions } T_2 \\
 \hline
 \text{Ride Check}
 \end{array} & \times & \begin{array}{l}
 \text{Ride Check} \\
 \text{24 Hour Passenger} \\
 \text{Boardings } T_1
 \end{array} = \begin{array}{l}
 \text{Estimated 24-Hour} \\
 \text{Boardings } T_2
 \end{array} \\
 \begin{array}{l}
 \text{Total Point Load} \\
 \text{AM and PM Peak} \\
 \text{2 Directions } T_1
 \end{array} & &
 \end{array}$$

Given each line's total daily passengers, collected either from ride checks or derived from updated point checks, its proportion of total system ridership could be derived for the date of the check. SCRTD currently estimates daily systemwide ridership from farebox receipts with the use of its

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(2) See Memo from Rex Gephart to all schedulers, "Standards for Adding Proposition A Service, July 12, 1982.

patronage model. To verify the model's accuracy, estimates of farebox revenue were compared to collected revenues. The model's estimates were found to be within less than 0.5 percent of actual. Thus, on the day of any ride check or point check, each line's share of total ridership could be fairly accurately computed. By adding together the percentages for all lines within a service classification and with some adjustment, each classification's approximate share of total system ridership could be computed. Estimates of daily ridership for each of the five TPM classifications could then be computed by multiplying its share of total system ridership (expressed in percent) by each day's total estimated patronage.

This procedure would provide for consistency between total system and TPM disaggregate databases. Up-to-date point checks and ride checks would ensure the accurate distribution of ridership to the individual service classifications. Annual weekday and weekend statistics would be the summation of estimated daily statistics. In addition to TPM, SCAG's TDA reporting requirements could be satisfied by adding together the appropriate TPM classifications to compute local and express subtotals. As a result, TPM, TDA, and system-reported passenger statistics would be uniform.

A similar procedure could be used to estimate passenger revenue. Integrated into the processing of ride check data is the calculation of passenger revenue. As described for ridership, each line's percentage of total system revenue could be computed using the ride check data. Load point checks by monitoring ridership levels could also be used to monitor total revenue levels; however, once past a designated threshold of change, another ride check should be conducted.

As currently performed, revenue estimates should include values for cash, tickets, and passes.

The second approach to updating the TPM database pertains to service statistics. In order to account for scheduled changes in service levels occurring three or four times a year, miles and hours should be computed for each schedule period. For example, rather than multiplying the total mileage reported for Line 20 on the weekday of its ride check by 255, mileage issued for Line 20 on each 4-24 Report should be multiplied by the number of days the schedule is in effect. Service data computed in this manner will be consistent with ridership and revenue data because both data sets will reflect an accumulation of service and use levels incurred throughout the fiscal year.

#### Submit Complete Statistics

Inconsistencies between TPM and TDA statistics were also caused by the omission of particular lines in the TPM data base. This discrepancy can easily be corrected by completion of the "Other" column on the TPM reporting form. "Other" should include contract, subscription, and special services. In this way, all services would be accounted for and the sum total of all Service Classifications plus "Other" would approximate total system-derived statistics.

Another omission which can easily be corrected pertains to auxiliary revenue. SCRTD reports its auxiliary revenue on its Section 15 submittal; this entry need only be allocated among the service classifications and reported.



## Revise Computation Methodology

Inaccuracies resulted in several statistics due to methodological errors. Corrections should be made to the computational procedures for the following data items:

- . Vehicle Service Miles (also In-Service Vehicle Miles) - By definition, all deadhead travel should be excluded from this statistic. Should the 4-24 Report's Revenue Miles be used to compute vehicle service miles, some adjustment is needed to delete within-line deadhead travel from scheduled revenue miles.
  
- . Vehicle Service Hours (also In-Service Vehicle Hours) - This statistic should be computed for each line for each service period. Individual line data should be added together to compute values for the service classifications. As cautioned above, Revenue Hours as reported by the 4-24 Report includes within-line deadhead travel time. Adjustment is needed to delete this time from scheduled revenue hours.
  
- . Peak Vehicles - The summation of peak vehicles required by each service classification should equal total system net peak requirements. Gross vehicles as currently reported should be adjusted to account for interline savings. Net equipment needs should be reported for the operating schedule requiring the maximum number of vehicles.
  
- . Full-Time Equivalent Employees - This statistic should be developed by summing all employee hours worked during the fiscal year and dividing by 2,000 hours. Full-time equivalent employees is not a head count.

## Document Data Collection, Processing and Reporting Procedures

Written documentation describing procedures and assumptions will benefit SCRTD, assist future audits, and establish confidence in reported figures. Documentation should address the following items:

- . Describe all computations required to prepare TPM and TDA data. A step-by-step preparation guide is recommended.
- . Describe and identify source(s) of all assumptions.
- . Maintain clearly labeled worksheets: identify person responsible for completing forms, mark material with effective date and/or date created.
- . Identify title and date of all source documents.
- . Define terms; e.g., revenue hours includes in-service and layover time.
- . All corrections should be clearly made and annotated as to the reason for change, date, and responsible person.

The benefits of formal written documentation include helping to maintain a consistent set of reported statistics from year to year; establishing an audit trail for internal and external verification of data accuracy and reliability; and contributing to regional uniformity in reported data.

SCRTD should also consider designing step-by-step preparation guidelines and/or standard data computation forms or worksheets. These will simplify data handling, establish and enforce documentation, facilitate internal checking and future audits, and reduce preparation time and costs.

Lastly, before the TPM reporting forms are submitted to LACTC, an internal review should be conducted to verify the accuracy and reliability of the statistics. TPM forms, worksheets, and supporting documentation should be reviewed for computational and methodological errors and for consistency with total system statistics.

Several of these recommendations can be fairly easily implemented; others require considerable resources and coordination among data collection efforts. In summary, preparation of the TPM database could make better use of SCRTD's data collection strengths, including its patronage and estimation model, ride and point check program, historical data files, and electronic data processing capabilities. Basic modifications to terminology definitions and computation methodologies are also needed. These, together with the other improvements described above, will considerably increase confidence in the accuracy of the agency's submitted service and use statistics.

### 1.3 TDA INDICATOR ANALYSIS

The TDA mandated triennial performance audit requires the verification and evaluation of the following five performance indicators:

- A. Operating Cost per Passenger
- B. Operating Cost per Vehicle Service Hour
- C. Passengers per Vehicle Service Hour
- D. Passengers per Vehicle Service Mile
- E. Vehicle Service Hours per Employee

Verification of the statistics used to compute these indicators was discussed in Sections 1.1 and 1.2 of this report. The analysis presented in this section establishes performance trends over time, offers interpretations as to their meanings, and proposes hypotheses as to the factors contributing to these trends.

Values for the five indicators for Fiscal Year 1978 through Fiscal Year 1982 are presented in Exhibit 1-22; the percent change from year to year for each indicator and for the Los Angeles Metropolitan Area Consumer Price Index (CPI) are presented in Exhibit 1-23. The reader is cautioned that the indicators are only as valid as the data used to develop them. While the 1981 database has been verified, the procedures and assumptions used to develop previous years' statistics are less apparent. In reviewing the indicators and their trends, several factors should be kept in mind. These are:

- System values are more reliable than those reported for express and local components

**EXHIBIT 1-22**  
**SCRTD TDA PERFORMANCE INDICATORS**  
**HISTORICAL DATA**

	Fiscal Year				
	1978	1979	1980	1981	1982 <sup>(a)</sup>
<b>A Operating Cost per Passenger</b>					
Express			\$ 2.10 <sup>(b)</sup>	\$ 2.23	\$ 2.59
Local			0.62 <sup>(b)</sup>	0.70	0.81
System	\$ 0.64	\$ 0.67	0.76	0.84	0.98
<b>B Operating Cost per Vehicle Service Hour</b>					
Express			\$55.52 <sup>(b)</sup>	\$67.90 <sup>(b)</sup>	\$75.74
Local			36.94 <sup>(b)</sup>	44.70	49.87
System	\$30.63	\$36.19	40.65	48.88	54.54
<b>C Passengers per Vehicle Service Hour</b>					
Express			26.40	30.43	29.16
Local			60.06	64.38	61.69
System	48.14	53.79	53.33	58.27	55.84
<b>D Passengers per Vehicle Service Mile</b>					
Express			1.43	1.63	1.57
Local			4.57	5.23	5.03
System	3.40	3.81	3.75	4.33	4.17
<b>E Vehicle Service Hours per Employee</b>					
Express			855.11	841.10	732.33
Local			855.43	840.06	834.04
System	966.50	829.00	855.37	840.90	813.66

*(a) Estimated.*

*(b) Based on consultant calculations using SCRTD data.*

**EXHIBIT 1-23**  
**SCR TD TDA PERFORMANCE INDICATORS**  
**HISTORICAL TRENDS**

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	Percent Change ( <i>Fiscal Year</i> )			
	1978-1979	1979-1980	1980-1981	1981-1982 <sup>(a)</sup>
<b>A Operating Cost per Passenger</b>				
Express			+ 6.2	+16.1
Local			+12.9	+17.4
System	+ 4.7	+13.4	+10.5	+16.7
<b>B Operating Cost per Vehicle Service Hour</b>				
Express			+22.3	+11.5
Local			+21.0	+11.6
System	+18.2	+12.3	+20.2	+11.6
<b>C Passengers per Vehicle Service Hour</b>				
Express			+15.3	- 4.2
Local			+ 7.2	- 4.2
System	+11.7	- 0.9	+ 9.3	- 4.2
<b>D Passengers per Vehicle Service Mile</b>				
Express			+14.0	- 3.7
Local			+14.4	- 3.8
System	+12.1	- 1.6	+15.5	- 3.7
<b>E Vehicle Service Hour per Employee</b>				
Express			- 1.6	-12.9
Local			- 1.7	- 0.8
System	-14.2	+ 3.2	- 1.7	- 3.2
<b>Los Angeles CPI</b>	+ 9.9	+17.0	+ 7.5	+ 9.0

---

*(a) Estimated*

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- Vehicle Service Miles and Hours may be overstated due to the inclusion of within-line deadhead
- The number of full time equivalent employees is overstated by approximately 200 employees in FY 1981.

#### A. Operating Cost Per Passenger

This first indicator provides an overall view of cost effectiveness by relating cost to units of consumption. Between 1978 and 1981, operating costs increased a total \$0.20 per passenger, for an average annual increase of 9.5 percent. The trend has consistently been upward, with the largest absolute increase of \$0.12 occurring between 1980 and 1981. The trend in this indicator is a reflection of increases in total operating costs rather than any loss in ridership. Total operating costs during the same period increased at an average annual rate of 18 percent; unlinked passengers increased an average 8 percent. Thus, while both operating costs and ridership have grown annually, costs have outpaced passengers by more than 10 percent. The outcome is the resultant upward trend in the operating cost per passenger indicator.

#### B. Operating Costs Per Vehicle Service Hour

This ratio is an efficiency measure which relates the overall cost of providing service to a unit of service output. Between 1978 and 1981, the operating cost per vehicle service indicator increased a total of \$18.25 per vehicle service hour, for an average annual increase approaching 17 percent. The regional Los Angeles Consumer Price Index (CPI) provides a benchmark against which to compare experienced

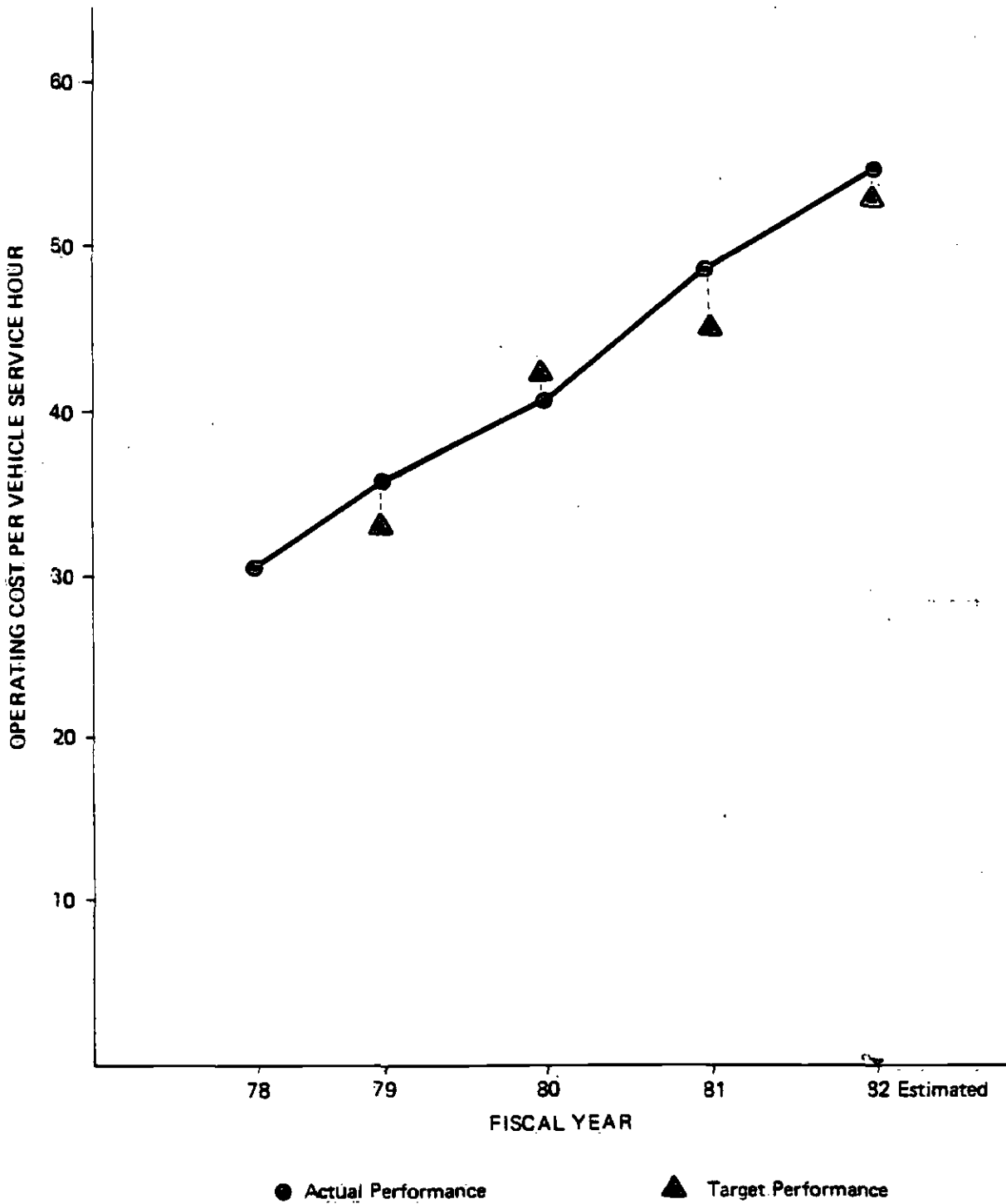
costs, as shown by Exhibit 1-24. The solid line represents the actual trend in the values of the indicator; the triangles represent the previous years' actual performance inflated by the CPI rate of inflation. For example, the 1979 target value of \$33.66 was developed by multiplying \$30.63, the actual 1978 cost, by the 9.9 percent change in the CPI between FY 1978 and 1979. The dotted line drawn between the two values indicates the gap between actual and expected costs.

As shown, costs have increased at a rate greater than that of the CPI in two of the three years for which actual data is available; estimates for 1982 exhibit similar behavior. Only in 1980, when general price inflation peaked did actual costs per hour fall below the benchmark. During the FY 1978-1981 four-year period, actual costs per hour increased at an average annual rate of 17 percent; the CPI grew at an average 11 percent rate. When operating costs per unit of service rise faster than price inflation, the transit system is not efficient since it is not producing the same output measured in service hours, per unit of input, measured in uninflated dollars.

Many possible factors may contribute to extraordinary system cost escalation. An analysis of trends in key operating cost categories can be used to quickly identify those which are driving overall system costs upward, as shown by Exhibit 1-25. Between 1978 and 1981, total operating costs increased 66 percent from \$200.9 million to \$333 million for an average annual rate of growth of 18.3 percent. During the same four year period, service as measured by vehicle service hours, increased a modest 4 percent. The largest cost increase occurred between FY 1980 and 1981 when expenses jumped almost 25 percent while service expanded by only 3 percent.



EXHIBIT 1-24  
SCRTD TDA PERFORMANCE INDICATORS  
TRENDS IN OPERATING COST  
PER VEHICLE SERVICE HOUR



**EXHIBIT 1-25**  
**SCRTD PERFORMANCE INDICATORS**  
**TRENDS IN COST CATEGORIES**

	<u>Fiscal Year</u>				<u>Average Annual Percent Change</u>
	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	
<b>Operating Cost Categories (\$000)</b>					
<b>Labor and Fringes</b>					
Operations		\$125,753	\$130,157	\$152,209	+10.0%
Maintenance		37,324	45,821	59,813	+26.6%
General Administration		16,360	18,970	23,016	+18.6%
Subtotal	\$159,484	\$179,437	\$194,948	\$235,038	+13.8%
<b>Services</b>	\$ 3,527	\$ 3,598	\$ 4,319	\$ 7,600	+29.2%
<b>Materials and Supplies</b>					
Fuel and Lubricants	9,324	11,287	21,251	29,206	+46.3%
Other	9,484	14,235	18,767	26,848	+45.5%
<b>Utilities</b>	1,184	1,183	1,393	2,179	+22.5%
<b>Casualty and Liability</b>	9,495	17,791	23,052	25,783	+39.5%
<b>Leases and Rental</b>	1,832	1,602	3,113	5,055	+40.3%
<b>Other</b>	6,580	1,941	1,956	1,287	-42.0%
Subtotal	\$ 41,426	\$ 51,637	\$ 73,851	\$ 97,958	+33.2%
<b>Total Operating Costs</b>					
Less Depreciation	\$200,910	\$231,074	\$268,799	\$332,996	+18.3%
<b>Los Angeles CPI</b>					+11.3%
<b>Personnel</b>					
Transportation		5,138	5,513	5,338	+ 1.9%
Maintenance		1,421	1,521	1,927	+16.5%
General Administration		425	456	601	+18.9%
Total Personnel <sup>(a)</sup>		6,984	7,490	7,866	+ 6.1%
<b>Total Vehicle Service Hours (000)</b>	6,560	6,408	6,612	6,813	+ 1.3%

(a) Excludes capital labor

The largest single cost center which accounts for 50 percent of total operating costs, is operating labor and fringes. It increased at an average rate lower than the rate of inflation and as such would not be considered an extraordinary trend. This cost category, however, did jump 21 percent between 1980 and 1981 while the CPI rose only 7.5 percent. Thus although the four-year trend does not indicate a major problem, recent experience points to a need for closer examination. Over the same four-year period, extraordinary increases, that is anything higher than the average rate of 18.3 percent, occurred in several vehicle operating and overhead cost categories. These include:

	<u>Average Annual Percent Change</u>
Maintenance Labor and Fringes	+26.6
Services	+29.2
Fuel and Lubricants	+46.3
Other Materials and Supplies	+45.4
Utilities	+22.5
Casualty and Liability	+39.5
Leases and Rentals	+40.3

These items together accounted for 47 percent of total 1981 operating costs. The reasons for the unusual cost escalation in these vehicle operating and overhead costs should be explored and explained in the forthcoming Functional Performance Audit (Phase II, Task 1). The investigation could cover the following issues:

- Maintenance Labor and Fringes
  - The maintenance staff grew by 506 employees, or by 36 percent between 1979 and 1981. Was this increase necessary?
  - Is work being efficiently scheduled?
  - Is there a cost saving opportunity through outside contracting?
  
- Services
  - What types of services are being purchased; are they effective and efficient?
  - How are service contracts controlled?
  
- Fuel and Lubricants
  - Has fuel consumption changed and why?
  - Have steps been taken to control costs?
  
- Other Materials and Supplies
  - Have unit costs increased?
  - Has the number and distribution of supplies and parts needed changed?
  - Are warranties being obtained and effectively tracked?
  - Are inventory procedures adequate to maintain parts availability?
  - Are procurement practices efficient and effective?

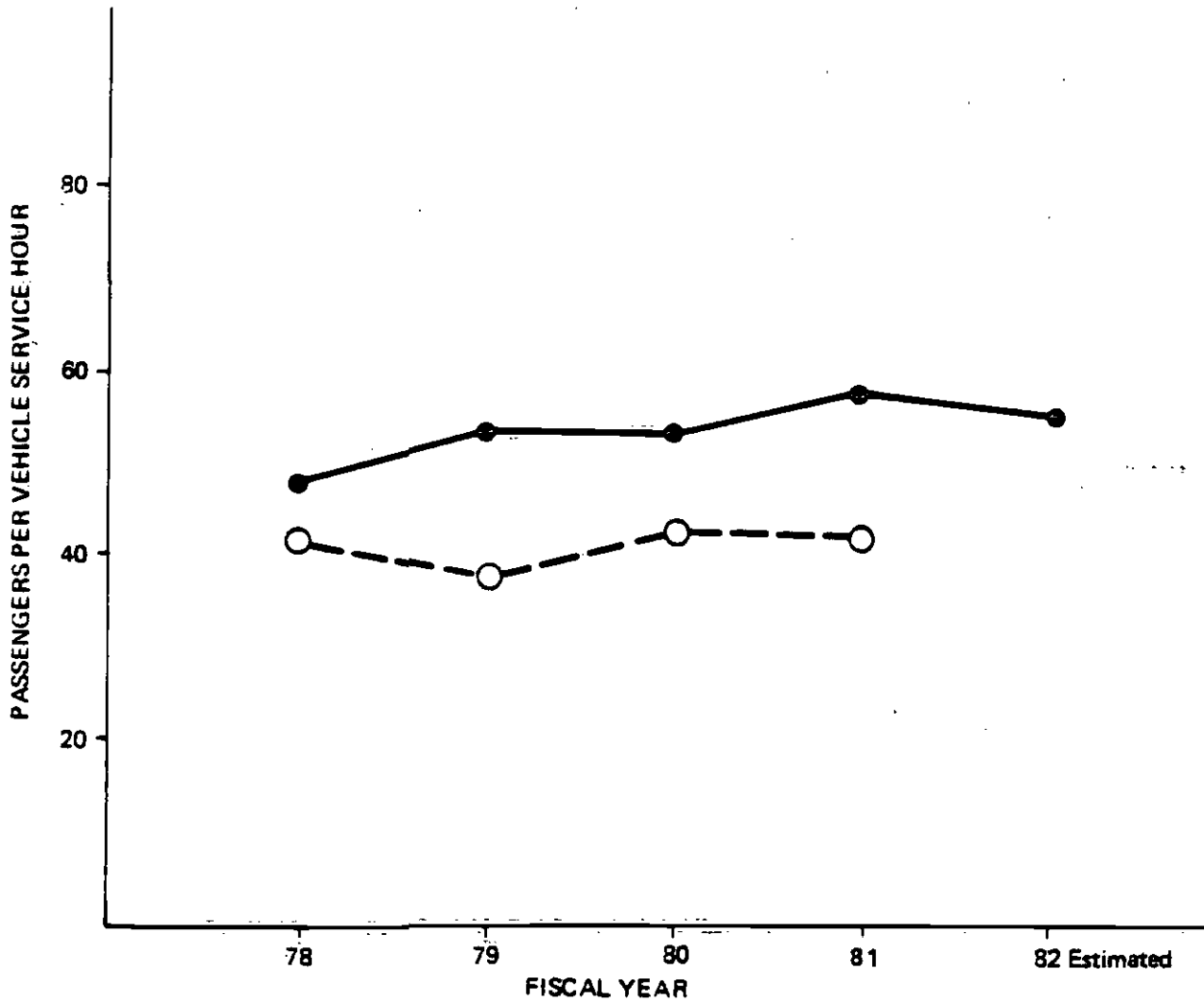
- Utilities
  - Is there an energy conservation program and how effectively is it implemented?
  
- Casualty and Liability
  - What is the distribution by size of claim?
  - What is being done to settle claims prior to litigation?
  - What is the level of self-insurance?
  - Is the safety program effective?
  
- Leases and Rentals
  - Are leases wisely negotiated?
  - Is leasing the most cost-effective approach?

### C. Passengers Per Vehicle Service Hour

While operating cost per vehicle service hour is a key indicator of overall system efficiency, passengers per vehicle service hour is a key indicator for identifying trends in system effectiveness. It relates transit utilization, measured as total passenger boardings, to a unit of service, measured as service hours. Values and trends for this indicator for fiscal years 1978-1981 are presented in Exhibits 1-22 and 1-23. The information has been plotted and is illustrated in Exhibit 1-26.

Comparison of current performance against that in previous years is one way to evaluate trends in ridership productivity. It assumes an agency's underlying goal of

EXHIBIT 1-26  
SCRTD TDA PERFORMANCE INDICATORS  
TRENDS IN PASSENGERS  
PER VEHICLE SERVICE HOUR



● Actual Performance

○ Average Performance of Fixed Route Services in Los Angeles County

maintaining and increasing ridership; when a system maintains or increases ridership per vehicle service hour it is effective in achieving this goal. Between 1978 and 1981 SCRTD's performance in this measure increased a total of ten passengers per hour, for an average annual growth rate of 7 percent. Only between 1979 and 1980 did ridership performance level out and slightly decline. Examining the elements of the performance indicator shows that during the same four year period, ridership increased at an average annual rate of 8 percent, whereas, service hours expanded at a rate just over 1 percent per year. This simple analysis indicates that neither a net increase or decrease in available service is responsible for driving performance upwards. Rather, either internal actions on the part of improved service planning, fares, marketing and operating speed; or external factors such as growth in regional employment, and the availability and price of gasoline, have resulted in SCRTD's attracting higher levels of ridership per unit of service.

Standards against which to compare performance are more difficult to establish for effectiveness measures than for efficiency ones. Inter-operator comparisons are hampered by unreliable and incomparable data and significant differences in service areas. To provide some benchmark of performance, unweighted average countywide values for the passengers per vehicle service hour indicator are plotted along with the trend line of actual SCRTD values. During fiscal years 1978 and 1979 some demand-responsive services were unavoidably included in the computation of the countywide values. As shown, SCRTD has consistently performed above the average of the county's nine fixed route operators (Hermosa Beach was excluded).

#### D. Passengers Per Vehicle Service Mile

This ratio is but another way of measuring service effectiveness. It replaces vehicle hours as the measure of service output with vehicle service miles. The impact of this alteration is that while passengers per vehicle hour is biased towards services with high operating speeds, passengers per vehicle mile is biased toward those with slower operating speeds.

Between 1978 and 1981 performance as measured by this indicator has improved at an average annual rate of 8 percent; the same rate at which passengers per vehicle service hour increased. On further examination of the statistics, the reason for this similarity is evident. Systemwide operating speed slowed less than two-tenths miles per hour between 1978 and 1981. Thus, one would expect similar trends in both indicators.

According to reported data, SCRTD is currently carrying almost two additional passengers each service mile than it did in 1978. Due to its operating characteristic of serving long passenger trips at high speeds with little turnover in seats, express service carries less than one-third the number of passengers per mile than local service. In terms of passengers per vehicle hour, the difference between express and local performance is smaller. Overall, the trend has been for more effective transit services; however, estimates for fiscal year 1982 indicate a turnaround in performance. Causes for reduced effectiveness should be explored.



### E. Vehicle Service Hours Per Employee

This ratio measures labor productivity by comparing service output, as measured by vehicle service hours to units of labor input, measured by the number of full time equivalent employees. Trends in this indicator may be useful for explaining movements in operating cost indicators because as employee productivity declines, costs per unit of output increase. To compensate for lower productivity, either more employees must be hired to maintain service levels, or the hours and miles of service must be reduced to match staffing levels.

As cited previously, the consistency and reliability of reported full time equivalent employees is a particularly weak area in SCRTD's data reporting. Vehicle service hours are more reliable. According to reported TDA statistics, labor productivity fell 13 percent in the 1978-1981 four year period, with the number of annual vehicle service hours per employee dropping 125 hours. Factors contributing to this downward trend could include increases in non-operating personnel; absenteeism; and/or inefficient labor utilization.

To verify the accuracy of the TDA statistics and inferred trends, additional employee information was collected from the agency's Section 15 Report, as presented in Exhibit 1-25. This data reveals that between 1979 and 1982 total employees increased by 882 employees, or almost 13 percent. During the same period, service hours increased only 6 percent. By function, staffing levels changed as follows:

- Transportation (87 percent of which are drivers)  
- - up by 200 employees, or 4 percent

## APPENDICES

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- Appendix 1-A: TPM Data Reporting  
Form: FY 1981
- Appendix 1-B: TDA Data Reporting  
Form: FY 1981
- Appendix 1-C: Staff Members Contacted  
and Documents Reviewed

**APPENDIX 1-A  
SCRTD DATA REVIEW**

**TPM DATA REPORTING FORM: FY 1981  
Weekdays and Saturdays**

W E E K D A Y	LOCAL SERVICE			EXPRESS SERVICE		OTHER
	Demand-Based Headways	Policy-Based Headways	Intra-Community Circulation	Multiple Local Stops	Few Local Stops	
Total Vehicle Miles (000)	39,561,411	20,497,218	1,558,951	14,646,396	4,313,325	
In-Service Vehicle Miles (000)	33,504,919	18,343,380	1,452,294	12,563,719	2,717,025	
Total Vehicle Hours (000)	3,227,076	1,448,497	128,891	845,261	190,794	
In-Service Vehicle Hours (000)	2,968,911	1,332,618	118,678	777,639	175,529	
Peak Vehicles	1,044	392	36	291	144	
Unlinked Passengers (000)	231,874,301	45,059,758	3,114,734	26,178,595	3,517,778	
Passenger Revenue (000)	66,702,994	16,354,819	1,046,239	11,432,714	2,927,112	
Auxiliary Revenue and Local Subsidies (000)						
<b>S A T U R D A Y</b>						
Total Vehicle Miles (000)	5,291,606	2,360,824	135,898	1,731,392	39,676	
In-Service Vehicle Miles (000)	4,914,820	2,148,464	124,327	1,612,052	39,624	
Total Vehicle Hours (000)	434,089	156,526	10,752	98,311	1,945	
In-Service Vehicle Hours (000)	416,725	150,265	10,322	94,385	1,867	
Peak Vehicles	551	200	21	118	3	
Unlinked Passengers (000)	26,956,243	4,254,988	220,373	2,866,240	96,668	
Passenger Revenue (000)	8,073,011	1,694,813	77,942	1,497,125	47,769	
Auxiliary Revenue and Local Subsidies (000)						

APPENDIX 1-A  
 SCRIPD DATA REVIEW

TPM DATA REPORTING FORM: FY 1981  
 Sundays/Holidays

W E E K D A Y	LOCAL SERVICE			EXPRESS SERVICE		OTHER
	Demand-Based Headways	Policy-Based Headways	Intra-Community Circulation	Multiple Local Stops	Few Local Stops	
Total Vehicle Miles (000)						
In-Service Vehicle Miles (000)						
Total Vehicle Hours (000)						
In-Service Vehicle Hours (000)						
Peak Vehicles						
Unlinked Passengers (000)						
Passenger Revenue (000)						
Auxiliary Revenue and Local Subsidies (000)						
<b>S U N D A Y / H O L I D A Y</b>						
Total Vehicle Miles (000)	4,500,176	1,808,300	74,608	1,628,234	44,254	
In-Service Vehicle Miles (000)	4,156,531	1,617,758	68,462	1,446,810	44,196	
Total Vehicle Hours (000)	345,824	120,675	7,531	93,763	2,169	
In-Service Vehicle Hours (000)	331,991	115,848	7,230	91,356	2,082	
Peak Vehicles	401	142	9	103	3	
Unlinked Passengers (000)	19,423,768	2,815,700	153,989	2,207,886	80,852	
Passenger Revenue (000)	6,565,674	1,112,377	61,978	1,340,446	19,653	
Auxiliary Revenue and Local Subsidies (000)						

APPENDIX 1-B  
SCR TD DATA REVIEW

TDA DATA REPORTING FORM: FY 1981

Table 2-Historical Financial Status Capital Outlay and Operating Expenses by Year of Expenditure (In Thousands of Dollars)  
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

<u>CAPITAL OUTLAY AND DEBT REDUCTION</u>	FY 1980 Audited	FY 1981 Audited	FY 1982 Estimate	
Rapid Transit Facilities Development	101	-	1,895	8,000
Revenue Vehicle Acquisition for Expansion	102			
Revenue Vehicle Acquisition for Replacement	103	31,537	147,738	4,750
Service Vehicles	104	155	1,107	1,540
Buildings and Structures	105	7,275	133	35,115*
Equipment	106	3,283	2,694	11,860
Office Equipment and Furnishings	107	102	304	
Land	108	1,068	1,005	
Debt Reduction	109	2,405	2,530	4,045
Other Capital Outlay <small>Work in progress</small>	110		5,184	
<b>SUBTOTAL CAPITAL OUTLAY:</b>	<b>111</b>	<b>45,825</b>	<b>162,590</b>	<b>65,310</b>

\*with land

OPERATING EXPENSE OBJECT CLASSES

Operations	112	154,782	185,896	201,340
Maintenance	113	62,660	84,145	97,080
Administration	114	47,629	57,394	61,130
<b>SUBTOTAL OPERATING EXPENSE</b>	<b>115</b>	<b>265,071</b>	<b>327,435</b>	<b>359,550</b>
<b>ANNUAL INFLATION RATE</b>	<b>116</b>		<b>24%</b>	<b>9.8%</b>
<b>RECONCILING ITEMS:</b>				
Interest Expense	117	615	501	1,865
Leases and Rentals	118	3,113	5,055	5,785
Depreciation and Amortization	119	12,828	18,119	35,000
<b>SUBTOTAL OPERATING EXPENSE AND RECONCILING ITEMS</b>	<b>120</b>	<b>282,627</b>	<b>351,110</b>	<b>402,200</b>
<b>DEDUCT: Depreciation and Amortization</b>	<b>121</b>	<b>(12,828)</b>	<b>(18,114)</b>	<b>(35,000)</b>
<b>NET TOTAL OPERATING EXPENSE</b>	<b>122</b>	<b>268,799</b>	<b>332,996</b>	<b>367,200</b>
<b>TOTAL CAPITAL AND OPERATING</b>	<b>123</b>	<b>314,624</b>	<b>495,586</b>	<b>432,510</b>

**APPENDIX 1-B  
SCRTD DATA REVIEW**

**TDA DATA REPORTING FORM: FY 1981  
(Continued)**

Table 8 Historical Operating Characteristics

<u>EXPRESS BUS</u>	FY 1980	FY 1981	FY 1982
<u>OPERATING CHARACTERISTICS:</u>			
Revenue Bus Miles of Operation (000's)	196 24,430	22,903	22,565
Total Bus Miles of Operation (000's)	197 27,145	26,055	25,968
Revenue Bus Hours of Operation (000's)	198 1,322	1,226	1,212
Total Bus Hours of Operation (000's)	199 1,469	1,323	1,315
Linked Passengers Carried (000's)	200 25,482	27,242	25,801
Unlinked Passengers Carried (000's)	201 34,907	37,318	35,344
Full Time Equivalent Employees	202 1,546	1,458	1,655
Base Fare	203 75¢	95¢	\$1.25

LOCAL FIXED ROUTE

<u>OPERATING CHARACTERISTICS:</u>			
Revenue Bus Miles of Operation (000's)	204 69,532	68,708	67,695
Total Bus Miles of Operation (000's)	205 72,258	78,165	77,904
Revenue Bus Hours of Operation (000's)	206 5,290	5,587	5,521
Total Bus Hours of Operation (000's)	207 5,877	6,029	5,990
Linked Passengers Carried (000's)	208 231,916	262,568	248,679
Unlinked Passengers Carried (000's)	209 317,693	359,682	340,656
Full Time Equivalent Employees	210 6,184	6,644	6,620
Base Fare	211 55¢	65¢	85¢

DEMAND RESPONSIVE

<u>OPERATING CHARACTERISTICS:</u>			
Revenue Bus Miles of Operation (000's)	212		
Total Bus Miles of Operation (000's)	213		
Revenue Bus Hours of Operation (000's)	214		
Total Bus Hours of Operation (000's)	215		
Linked Passengers Carried (000's)	216		
Unlinked Passengers Carried (000's)	217		
Full Time Equivalent Employees	218		
Base Fare	219		

**APPENDIX 1-B  
SCRTD DATA REVIEW**

**TDA DATA REPORTING FORM: FY 1981  
(Continued)**

Table 9 Historical Performance Characteristics

<u>EXPRESS BUS</u> PERFORMANCE MEASURES	FY 1980	FY 1981	FY 1982
Revenue per Unlinked Passenger	220 0.73	0.94	1.18
Operating Cost per Unlinked Passenger	221 2.00	2.23	2.59
Operating Cost per Vehicle Service Hour	222 52.85	65.85	75.74
Unlinked Passengers per Vehicle Service Hour	223 26.40	30.43	29.16
Unlinked Passengers per Vehicle Service Mile	224 1.43	1.63	1.57
Vehicle Service Hours Per Employee	225 855.39	841.10	732.33
<u>LOCAL FIXED ROUTE</u> PERFORMANCE MEASURES			
Revenue per Unlinked Passenger	226 0.23	0.29	0.37
Operating Cost per Unlinked Passenger	227 0.63	0.70	0.81
Operating Cost per Vehicle Service Hour	228 37.60	48.64	49.87
Unlinked Passengers per Vehicle Service Hour	229 60.06	64.38	61.69
Unlinked Passengers per Vehicle Service Mile	230 4.57	5.23	5.03
Vehicle Service Hours Per Employee	231 855.39	840.86	834.04
<u>DEMAND RESPONSIVE</u> PERFORMANCE MEASURES			
Revenue per Unlinked Passenger	232		
Operating Cost per Unlinked Passenger	233		
Operating Cost per Vehicle Service Hour	234		
Unlinked Passengers per Vehicle Service Hour	235		
Unlinked Passengers per Vehicle Service Mile	236		
Vehicle Service Hours Per Employee	237		

APPENDIX 1-C

SCRTD DATA REVIEW  
STAFF MEMBERS CONTACTED AND DOCUMENTS REVIEWED

STAFF MEMBERS CONTACTED

Planning Department

Teresa Aquerreberere  
Paulette Cunningham  
Haim Geffen  
Dan Miller

Stephen Parry  
Michael Siekert  
Gary Spivak

Scheduling and Service Analysis Department

Joseph Cooper  
Rex Gephart  
Anne Huck

Robert Price  
Dennis Shoemaker  
Joel Woodhull

Treasurer's Office

Joseph Scatchard

Personnel

Alvin Rice

DOCUMENTS REVIEWED

Five Year Short Range Transit Plan, Fiscal Years 1983 - 1987, February 1982.

"Methodology for Calculating Data for TPM Reporting,"  
Memorandum from Terry Aquerreberere.

"Patronage Estimation" and other memoranda from Ann Huck.

SCRTD Section 15 Report, Fiscal Year 1981.

"Scheduled Service Operating Cost Factors," Report  
No. 4-24, June 1980 - June 1981.

"Statistical Digest," Fiscal Year 1981.

"Mileage Section Functions and Procedures - Update with  
Corrections," Memorandum from J.A. Cooper, March 29, 1982.

Examples of the Following:

- Area Accounts Report
- Basic Operating Schedule
- Bus Line Accumulation of Time and Mileage
- Cost Factor Control Sheet
- Herman file
- TPM Line Data Reports