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ABSTRACT

The Education Cooperative (TEC) composed of nine contiguous Massachusetts towns (Dedham, Natick, Needham, Norwood, Walpole, Wayland, Wellesley, Weston, and Westwood) is exploring the possible development of a regional transportation system to serve the special education pupils within these communities. This report describes the planning required and evaluates the potential savings of such a system. The objective of the study was to develop a model for sharing the transportation of the special education children of the nine contiguous TEC towns. Some of the general subobjectives are: to demonstrate a savings in the operation of the transportation system, to improve service quality and consistency, and to centralize transportation administration to foster continued efficiency and control. Ancilliary objectives are to suggest legislation, to facilitate cooperative action among school districts, and to encourage other towns to join in undertaking cooperative enterprises. The report describes the development of a centralized office to coordinate transportation activities and to handle the data needs of those activities, presents costs analyses of the current transportation operation and of the projected regional transportation system, and presents some cost comparisons and recommendations for further action. (Author/DN)

CRTR-36

COST ANALYSIS
FOR
REGIONAL TRANSPORTATION SYSTEM

Prepared for

The Education Cooperative
15 West Street
Natick, Massachusetts 01760

Under a Grant From

The Governor's Commission
on
School District Organization and Collaboration

By

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1.0 INTRODUCTION

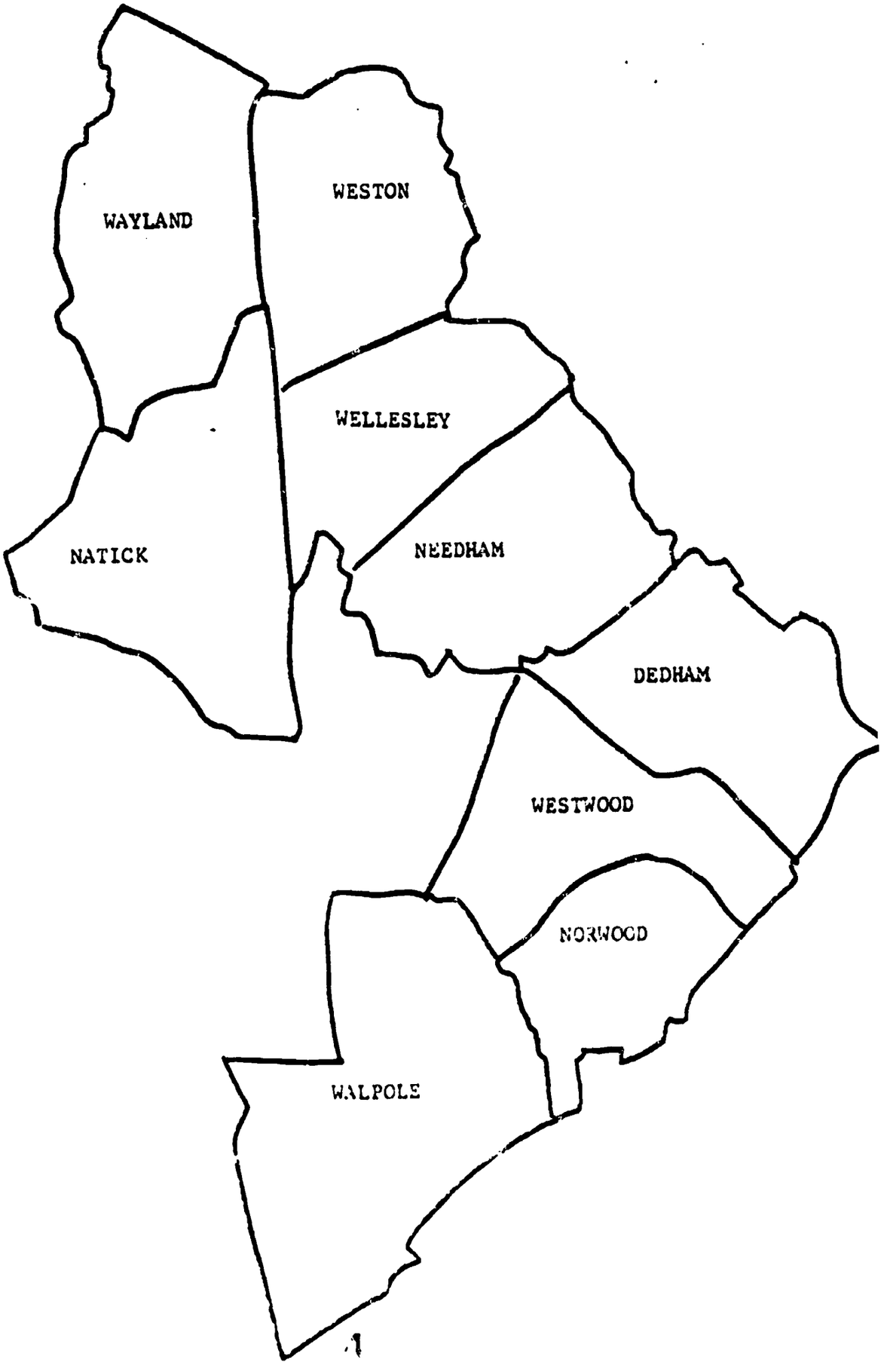
The Education Cooperative (TEC), under a grant from the Governor's Commission on School District Organization and Collaboration, through the Massachusetts Advisory Council on Education, is exploring the possible development of a regional transportation system to serve the special education pupils within the nine TEC communities. This report describes the planning required and evaluates the potential savings of implementing such a system. The objective of the study was to develop a model for the sharing of transportation for children of the nine contiguous TEC towns. Some of the general sub-objectives are: to demonstrate a cost saving in the operation of the transportation system, to improve service quality and consistency, and to centralize transportation administration to foster continued efficiency and control. Ancilliary objectives are to suggest legislation, to facilitate cooperative action among school districts, and to encourage other towns to join in undertaking cooperative enterprises.

TEC is a cooperative composed of 9 contiguous towns (Dedham, Natick, Needham, Norwood, Walpole, Wayland, Wellesley, Weston and Westwood - see Figure 1). The primary intent of TEC is to strengthen and enlarge the educational services available to its nine member communities. TEC is an example of the kind of cooperative activity which the Department of Education is encouraging. TEC is organized under Chapter 40, Section 4E of the General Laws. Each town pays a flat assessment fee for administrative staff and is assessed a per pupil charge for those students with whom the work study coordinators work.

Chapter 766 of the Acts of 1972, which goes into effect in September 1974, will place a much heavier burden of responsibility on the local school districts for providing both programs and transportation for children with special needs. With the many programs currently in effect, it is often easy to lose sight of the size of the pupil population involved. It has been estimated that as many as 10-12% of the total school age population falls into the category of children with special needs. While the intent of Chapter 766 is to integrate the children back into their local community, where possible, it is at the same time abundantly clear that many of the special needs of these children cannot be adequately met within their own community. The answer to this problem

THE EDUCATION COOPERATIVE

FIGURE 1



lies in the continued use of many private institutions and, to a greater degree, in the formation and expansion of regional cooperatives such as TEC. Particular attention has been given to the transportation needs of special education children in Chapter 9 of the Proposed Regulations for Implementation of Chapter 766 of the Acts of 1972. In the area of cooperative activity, Section 905.3 states,

> "A school committee or two or more school committees acting together may contract with persons or corporations to provide any or all of the required special transportation. Such contracts shall be awarded, after the receipt of sealed bids, to the lowest qualified bidder..."

Furthermore, Section 905.5 states,

> "Two or more school committees may jointly or collectively agree to provide special transportation....."

Thus, we see that there is every encouragement and no legal impediments for groups of towns banding together to provide cooperative transportation for their children with special needs. They may therefore share the costs on a per pupil basis for coordinating the transportation operation, designing of the routes, preparing the bid specifications, and awarding the transportation contracts.

The purpose of this report is to outline a plan whereby TEC can provide cooperative transportation for the children with special needs within the nine TEC towns. This study was limited to those children who were transported out of their town of residence to school. It will also demonstrate how this can be done with substantial cost and administrative savings. This report is divided into four major sections. First, there is the development of a centralized office to coordinate transportation activities and to handle data needs of those activities. The second section presents a cost analysis of the current transportation operation. The third section presents a cost analysis for projected regional transportation. The fourth section presents some cost comparisons and recommendations for further action. It is hoped that the information presented here will stimulate the TEC communities to take

further action in providing cooperative transportation for their pupils, and that the example of TEC will offer encouragement and a model for emulation to other communities considering cooperative transportation ventures.

2.0 DEVELOPMENT OF A CENTRALIZED OFFICE FOR TRANSPORTATION OPERATION

2.1 Designate a Transportation Coordinator

Initially, a person must be designated to serve as the Regional Transportation Coordinator for the cooperative. This was done in the case of TEC by the appointment of Robert K. Earls as the Project Coordinator. In the early phases of a project, this position can result in full time activity for a month or two. However, once the data is collected and the procedures set up, this position requires only part time activity.

2.2 Data Collection

A great deal of data must initially be collected on pupils, the schools they attend, and the transportation carriers and their contracts. Forms were designed for collecting pupil data and were distributed to each of the Special Education Administrators in the nine member towns. This data was received, checked by the Transportation Coordinator, and forwarded to Concord Research for keypunching and the creation of data processing files. Similarly, a form was prepared and sent to collect data on each of the receiving schools, i.e., schools to which the children were sent.

2.3 File Creation

The above data was received by Concord Research, checked and keypunched. Data processing files were created from the cards, and reports were prepared, listing the pupil information in a variety of ways. For example, pupils may be sorted and listed alphabetically, by their town of residence, by their receiving school, by their handicap, by their carrier, or by any other identifier that may be present in the pupil's record.

2.4 Ongoing Coordination Operation

The centralized transportation office is active in many more roles than the predominant role of collecting and checking data. It has an ongoing function to collect, maintain, and update records of pupils and schools. But its main function is to coordinate the requests for changes in transportation which it receives from the individual Special Education Administrators of the various towns. The Transportation Coordinator will review the requests and coordinate the required changes in routes with the proper transportation carrier. On an annual basis, he will thoroughly check over the data base and update it, based on projections of pupils for the coming year. He will arrange to have routes redesigned and bid specifications prepared, and will conduct the bidding for new transportation contracts. He will then administer the contracts, once awarded, and continue coordination for the ensuing year.

3.0 COST ANALYSIS FOR CURRENT TRANSPORTATION SYSTEM

3.1 Survey of Present Transportation.

In order to get an accurate picture of the current transportation system, a survey of routes was conducted with the cooperation of the carriers and their drivers. This survey provided data on the route schedules, driving time, loading time, number of children transported, and mileage between each stop on each route. Surveys were distributed, through the cooperation of the Business Managers in each town, to their respective transportation carriers. In most cases the carriers distributed the surveys to their drivers and asked them to collect the necessary data for their routes. As usual, there were some problems, as the drivers did not understand exactly what was required, and, therefore, a substantial number of returns were not useable in the form intended. Ordinarily, we would conduct a follow-up survey to fill in the gaps. However, time did not allow for this procedure. At the conclusion of the survey, we had obtained useable data on 69 of an estimated 130 routes.

The data from the acceptable route surveys were keypunched and entered into our route analysis program. This program computed a number

of statistics on each route and also assembled overall statistics for all 69 routes. The summary output of this program is shown in Figure 2. The quantities shown are the starting time and ending time of each route, the route run time, the dead head time where available (i.e., the time when the vehicle travels empty), the road times, the number of pupils on each route, average load time (i.e., the number of minutes it takes, on the average, to pick up a pupil), the route length in miles, the time per pupil (i.e., the average time a pupil is in the vehicle), and the distance per pupil (i.e., the average distance any pupil rides). Finally, the average speed of the vehicles is computed. At the bottom of the listings are averages for the total of 69 routes. The routes were numbered arbitrarily as they were received: Routes #1-15 are Weston, Routes #16-26 are Wellesley, Routes #27-35 are Wayland, Routes #40-58 are Walpole, Routes #59-61 are Westwood, Routes #62-71 are Norwood, Routes #72 79 are Dedham.

The overall averages at the bottom of the listing are of interest. They show that the average load time per pupil is nearly 3 minutes. They show that the average pupil rides for about 35 minutes and travels about 15 miles. The average route length and run time is 16 miles and 39 minutes. The vehicles are averaging about 2.9 children per vehicle. The average speed that the vehicles as a group are maintaining is almost 30 miles an hour, which is typical for this type of transportation. The average time the vehicles spend in motion is about 32 minutes.

The total number of routes, when summed for the nine towns, is approximately 131 routes. However, this figure may be slightly higher than the actual number of routes when one considers that approximately 12 routes serve more than one RSC town. Therefore, they have in all likelihood been counted twice. Where data were not available, we had to estimate a number of routes based on the different schools to which the children were transported. This figure may also be slightly higher than the actual number of routes. It is estimated that the total number of routes actually in operation now is closer to 110, when all the above factors are taken into consideration. This would give an overall average of 2.8 pupils per vehicle.

FIGURE 2: ROUTE ANALYSIS

ROUTE NO.	SCHOOL AND LOCATION		START TIME	STOP TIME	ROUTE RUN TIME	DHED,NDK TIMES		NUMBER PUPILS	AVG LOAD TIME	ROUTE LENGTH	TIME PER PUPIL	DIST / PUPIL	SPEED
1	NATICK JR HS	NATICK	725	755	30	0	25	1	5.0	11.7	30.00	11.70	28
2	CHARLES RIVER WORKSHO		815	900	45	0	21	5	4.8	13.7	30.60	8.98	39
3	MEMORIAL SCHOOL NATICK		820	855	35	0	19	3	5.3	14.1	26.00	10.73	44
4	ARMES SCHOOL		740	815	35	0	25	3	3.3	14.3	27.67	10.87	34
5	BEEBE VOC. HIGH		720	746	26	0	23	1	3.0	10.8	26.00	10.80	28
6	WAYLAND JR HIGH		735	750	15	0	11	1	4.0	5.1	15.00	5.10	27
7	ST HENRY REM CR NRDG		810	850	40	0	35	1	5.0	21.2	40.00	21.20	36
8	LINCOLN SCHOOL NATICK		730	812	42	0	32	3	3.3	14.3	28.00	9.43	26
9	FRAM SCHL FOR DEAF		830	854	24	0	20	1	4.0	11.3	24.00	11.30	33
10	GIFFORD SCHOOL		821	833	12	0	7	1	5.0	4.5	12.00	4.50	38
11	[illegible] SCH WELLESLEY		805	826	21	0	17	1	4.0	7.9	21.00	7.90	27
12	MCLEAN HOSP		825	900	35	0	22	3	4.3	13.6	27.33	10.40	37
13	NATICK SR HIGH		720	752	32	0	20	3	4.0	14.0	23.33	10.50	42
14	CARROLL SCH LINCOLN		745	834	49	0	31	7	2.6	15.8	30.14	9.74	30
15	MIN TEMPL WKSHP CONC		848	910	22	0	16	1	6.0	9.8	22.00	9.80	36
16	CHAS RIVER WORKSHOP		810	900	50	0	50	8	0.0	11.8	28.75	6.31	14
17	SO NORFOLK ASSOC		730	900	90	0	65	4	6.3	18.7	67.50	13.63	17
18	BEEBE VOC FRAM		700	800	60	0	60	5	0.0	18.9	43.00	14.02	18
19	SCH FOR SPEC LRNG		715	815	60	0	60	4	0.0	15.5	42.50	10.45	15
20	CARROLL SCH LINCOLN		813	854	41	0	35	4	1.5	19.6	34.25	18.35	33
21	FRAM BEACH HOUS		821	858	37	0	32	4	1.3	12.9	24.00	8.55	24
22	FRAM CTR L.D. CHILD		847	901	14	0	13	1	1.0	3.8	14.00	3.80	17
23	ARL SCH MCLEAN HOSP		816	853	37	0	34	2	1.5	13.6	34.50	13.05	24
24	PINDER SCH S NATICK		846	904	18	0	9	2	4.5	3.2	14.50	2.95	21
25	THE LEAGUE SCH BOST		925	958	33	0	31	1	2.0	18.2	33.00	18.20	35
26	JEFFORD SCH WESTON		825	851	26	0	24	1	2.0	9.3	26.00	9.30	23
27	LITTLE PEOPLES SCHOOL	NEWTON	805	828	23	0	18	1	5.0	10.2	23.00	10.20	33
28	FREEMAN JR. HI. SCH.	NEEDHAM	745	810	25	0	21	1	4.0	11.3	25.00	11.30	32
29	MAIN ST.	CONCORD	847	907	20	0	15	1	5.0	6.6	20.00	6.60	26
30	WINTER ST.	FRAMINGHAM	835	858	23	0	16	2	3.5	5.4	20.50	5.50	24
31	WESTON POST RD.	WESTON	820	842	22	0	16	2	3.0	6.9	19.00	5.55	25
32	BARRETT BRIDGE RD.	LINCOLN	815	853	38	0	30	4	2.0	13.2	25.00	8.53	26
33	CLINTON ST.	FRAMINGHAM	845	909	24	0	18	2	6.0	11.3	24.00	11.30	37
34	MILL ST.	NATICK	740	814	34	0	25	3	3.0	10.3	27.00	8.20	24
35	CARROLL SCH		750	850	60	0	57	1	3.0	30.0	60.00	30.00	31
41	HOOVER SCHOOL		836	845	9	0	5	5	2.0	1.6	7.80	1.52	19
42	SOUTHEASTN ACAD		750	855	65	0	62	2	1.5	43.5	63.50	43.40	42
43	SO MIDDLESEX		716	755	39	0	38	1	1.0	21.0	39.00	21.00	33
44	KENNEDY SCHOOL		745	845	60	0	56	1	4.0	18.5	60.00	18.50	19
45	INDUSTRIAL SCH		730	750	20	0	14	2	3.0	6.4	15.00	5.40	27
46	KENNEDY SCHOOL		845	900	15	0	12	1	3.0	8.7	15.00	8.70	43
47	NEEDHAM STATE HOSP		820	840	20	0	17	1	3.0	7.0	20.00	7.00	24
48	WESTWOOD CH CARE CTR		750	900	55	15	37	6	3.0	16.5	32.50	10.40	26
49	WESTWOOD SCHOOL		100	125	20	5	14	2	3.0	6.0	15.00	4.40	25
52	WALPOLE HIGH SCHOOL		730	737	7	0	4	1	3.0	3.0	7.00	3.00	45
53	HIGH SCHOOL	WALPOLE	905	915	10	0	7	1	3.0	2.9	10.00	2.90	24
55	OLD POST RD SCHOOL	WALPOLE	806	815	9	0	6	1	3.0	3.0	9.00	3.00	30
57	CHAS RIVER WKSHOP		805	930	85	0	73	6	2.0	41.1	54.50	28.73	33
58	CANTON HOSPITAL SCHOOL	CANTON	810	825	15	0	12	1	3.0	8.0	15.00	8.00	40
59	CHAS RIVER NURSERY		815	900	33	12	23	2	5.0	12.1	26.50	10.15	31
61	SIMMONS SCHOOL		645	832	77	30	69	4	2.0	33.6	42.25	18.00	29
62	ARL WORKSHOP		737	800	10	13	9	1	1.0	3.3	10.00	3.30	22
63	BEACON SCHOOL		720	849	69	20	58	4	2.8	18.7	49.75	13.35	19
64	CHAS RIVER WKSHOP		820	905	45	0	30	6	2.5	22.5	32.83	16.72	45
66	ST COLETTA SCH		620	910	144	26	123	8	2.6	73.8	87.38	43.71	36
67	CHAS RIVER WKSHP		810	859	34	15	28	3	2.0	13.3	25.33	10.67	28
[illegible]	CARROLL SCHOOL		745	[illegible]	[illegible]	0	[illegible]	7	1.7	32.3	53.71	26.63	30

68	KARL QUINN SCH	846	914	28	0	26	2	1.0	12.1	24.00	10.70	27
69	CEREBRAL PALSY SCH	755	848	53	0	49	6	0.7	22.1	33.17	13.72	27
70	KARL QUINN SCH	735	755	20	0	19	1	1.0	9.7	20.00	9.70	30
71	KENNEDY CTR	824	859	35	0	26	5	2.3	13.6	26.20	11.92	31
72	LANDMARK SCHOOL	700	855	99	16	96	4	0.8	66.8	75.75	56.60	41
73	KINGSLEY SCHOOL	745	855	70	0	63	8	1.2	28.7	38.25	15.97	27
75	CARL QUINN SCHOOL	825	912	37	10	36	1	1.0	20.7	37.00	20.70	34
76	WESTWOOD DAY CARE	815	905	40	10	24	5	3.2	11.3	22.40	7.82	28
77	ST COLETTAS	710	847	66	31	55	4	2.8	25.4	42.75	18.80	27
78	WESTWOOD CARE CTR	833	910	37	0	30	7	1.0	9.8	27.57	7.26	19
79	BERRY REHAB CTR	730	900	80	10	69	3	3.7	47.2	61.33	40.97	41

AVG LOAD TIME= 2.95
AVG TIME/PUP= 35.33
AVG DIST/PUP= 14.84
AVG RT. LENGTH= 16.01
AVG RT RUN TIME= 39.12
AVG NO. PUP= 2.91
AVG DEAD-HEAD TIME= 3.09
AVG SPEED=29
AVG ROAD TIME= 32.22

BASED ON 69 ROUTES
197 PUPILS

3.2 Analysis of Cost Data

In order to establish the basis for a cost analysis of future regional transportation systems, data were collected on the present system. This data consisted of transportation contracts and invoices. In most cases, transportation contracts were not available since it has not generally been the practice to issue contracts for specific special education routes. The actual routes are generally worked out by the carrier. In a few cases, the transportation of special education pupils was provided for under the regular school transportation contract. By and large, the cost information was obtained through actual invoices that had been submitted on a monthly or bi-weekly basis by contractors. The costs on the invoices were then extrapolated to obtain yearly costs and cost per pupil.

3.2.1 Transportation Invoices - The form of the cost data varied considerably from town to town, and from carrier to carrier. There appear to be two major methods of invoicing - by pupil and by route. Many of the towns received invoices listing the cost for each child carried, but not identifying the child by the route he rode on. In these cases, the bill was often rendered on the basis of the actual number of days the child was transported to school, irrespective of the number of days the route was run. In other towns, billing was on the basis of the route, either on a per trip or a per round trip basis. The billing in these cases was generally done on the basis of the number of times the route was run, irrespective of which children were picked up on a given day. When billing was on a per route basis, it was usually identified by the school where the route terminated.

In order to provide some consistency in the cost data, we attempted to correlate, in every case, the amount billed on the invoice with a particular child or children. At the same time, we tried to correlate the route survey information with the invoice. This provided a three-way check on most of the data available. For transportation billed on a per route basis, the cost of the route was divided equally among the children associated with that route. Through this process of correlating the data three ways, 28 additional pupils were identified who were not on the TEC records. This brought the total number of pupils involved within the nine TEC towns to 305. Of these, cost data was available on only 278 pupils.

3.2.2 Cost Analysis - A summary of the cost data obtained for TEC, and its breakdown by town, is shown in Table 1. The items are as follows:

1. # of Pupils w/ Cost Data - The number of TEC pupils on whom cost data were available. Does not include all TEC pupils.

2. Daily Cost Total - The total daily transportation cost for the number of pupils in Item 1.

3. Average Daily Cost/Pupil - Average cost per day/pupil, obtained by dividing Item 2 by Item 1.

The remaining items on the Cost Data Table are based on the entire pupil population considered in this study. The average per pupil cost of Item 3 was added for each pupil on whom no cost data were available. Thus, Items 4-9 are adjusted figures.

4. Total TEC Pupils (new) - Total number of TEC pupils, including those who lacked cost data, and those who were "found" (see Section 3.2.1).

5. Approximate Total of Rts - This number is considered approximate in some cases because 12 routes are in shared modes (see Section 3.1).

6. Adjusted Daily Cost Total - Total pupils in Item 4 times the Average Daily Cost in Item 3.

7. Adjusted Annual Cost Total - The Adjusted Daily Cost multiplied by a standard school year of 180 days. NOTE: May fluctuate, depending on variations in the billings of the 3 towns that have per route billings.

8. Adjusted Annual Average Per Pupil Cost - Adjusted per pupil cost for one year. Total Annual Cost divided by Item 4 total of TEC pupils.

SUMMARY OF COST DATA

	DESCRIPTION		DEDHAM	NATICK	NEEDHAM	NORWOOD	WALPOLE	WAYLAND	WELLESLEY	WESTON	WESTWOOD	TEC TOTAL
1.	# of Pupils w/ Cost Data	#	44	37	28	25	21	37	33	35	18	278
2.	Daily Cost Total	$	204.74	240.25	161.43	155.49	182.99	258.49	207.40	212.94	192.00	1815.73
3.	Average Daily Cost/Pupil	$	4.65	6.49	5.77	6.22	8.79	6.99	6.28	6.08	10.67	6.53
4.	Total TEC Kids (new)	#	47	37	28	34	21	45	37	38	18	305**
5.	Approximate Total of Rts.	#	14	15	15	15	11	23	11	15	12	131*
6.	Adjusted Daily Cost Total	$	218.79	240.25	161.43	211.48	182.99	314.55	232.36	258.40	192.00	1992.08
7.	Adjusted Annual Cost Total (180 days)	$	39366.	43245.	29057.	38066.	32938.	56619.	41824.	46512.	34560.	358574.00
8.	Adjusted Annual Average Per Pupil Cost	$	837.57	1168.78	1037.76	1119.60	1568.49	1258.20	1130.40	1224.00	1920.00	1175.65
9.	Adjusted Annual Average Cost Per Route	$	2811.86	2883.00	1937.16	2537.76	2994.38	2461.70	3802.25	3100.80	2880.00	2737.21
10.	# of Carriers	#	1	1	2	3*	3	3	1	1*	3	13*

**Actual Figures

* Estimated Figures

TABLE 1

9.	Adjusted Annual Average Cost Per Route	- Adjusted Annual Cost divided by the approximate total of routes.
10.	# of Carriers	- A total of 13 different carriers were identified as operating in the nine town area.

4.0 COST ANALYSIS FOR PROJECTED REGIONAL TRANSPORTATION SYSTEM

Before a regional transportation system can be undertaken, a plan must be prepared. This section presents a detailed plan and cost analysis for use in projecting possible savings resulting from a regional transportation system. It is based on detailed data from the present transportation system, and the pupils that it serves. Ideally, the plan would include projections for the coming year's pupil population. However, the time scale and scope of this project do no permit including projected new pupil enrollments.

4.1 Development of Transportation Guidelines

In any cooperative venture one may find different standards of service from town to town, different understandings of cost requirements, and different determinations of the transportation needs of children. It is therefore important to come together at the start to reach a common agreement on a set of guidelines that can be uniformly applied in transporting pupils from all of the member towns of a regional transportation system. Ideally, it would be well to have a meeting of the Special Education Administrators for each town, together with transportation representatives, to draft a comprehensive set of guidelines that could be applied throughout the regional transportation system.

The following is a list of some examples of areas that should be considered in setting up guidelines. In most cases there is a great deal of subjectivity that must be applied by the Special Education Administrators and the Transportation Coordinator in defining any set of guidelines to apply to individual children.

4.1.1 Compatability - As an example, it is possible that certain types of children with emotional problems could be adversely affected by being transported with children who are mentally retarded or physically handicapped. It may be desirable to provide separate transportation for children with these types of handicaps. Furthermore, it is possible that more than 5 children with behavioral problems would be over the limit a driver could safely handle in the process of transporting them. It is therefore possible that the permissible vehicle limit would be lowered for certain types of children.

4.1.2 Load Limit - As illustrated above, there may be practical limitations to the load a vehicle can carry, aside from the limit of the number of children that can be safely controlled. A practical limit usually results from the imposition of time or mileage limits. In addition, the type of vehicle generally used for this type of transportation (usually a nine-passenger wagon) places an upper limit on the number of pupils that can be transported together. With an average load time of approximately 3 minutes per child, it is not hard to see that the number of children per vehicle will be kept low if a time limit is imposed.

4.1.3 Travel Time Limit - Should a travel time restriction be imposed? The Division of Special Education has established a one hour maximum riding time. There are exceptions to this, where route length is substantially longer due to distant school assignment. These types of considerations make the choice of a school closer to the pupils' homes desirable. These considerations have a direct economic impact. Shortening the routes unduly will lessen the load factor, thereby increasing the overall cost. A goal of 45 minutes average travel time, with an upper limit of 60 minutes, seems to be a reasonable compromise between service and economy.

4.1.4 School Opening Time - It is often possible to combine children destined for more than one school on the same route, providing those schools are relatively close to one another. In these situations it is very desirable to have school opening times adjusted so that they are close but not exactly the same. This makes multi-community and

multi-school transportation much more attractive and easier to accomplish. Such a change would require the cooperation of the receiving schools, if adjustments in their opening times were to be required. This, of course, is not to suggest that the transportation requirement should dictate programmatic requirements for special education programs. However, it is well to keep in mind that any improvement on transportation which results in dollar savings, can often result in increased dollars being available for programs.

4.1.5 Transportation Needs - It is necessary to classify the children as to their transportation needs. The classification of children by their transportation needs is not quite the same as classifying them by their type of special handicap. For example, the term physically handicapped is a clear definition of a type of handicap. However, this is not clear enough for transportation purposes. A child may have braces and walk with crutches. Or, a child may be confined to a wheelchair. The need is not to know whether he has Cerebral Palsy, Muscular Dystrophy, or a neurological disorder, but to know what type of transportation requirement his particular condition requires (e.g., a taxi could easily transport 5 children with crutches, but could not safely transport 5 children with wheelchairs).

For transportation purposes, it is sufficient to classify children in general groups with regard to their handicaps. The following seven categories should suffice for general transportation classification;

Hearing Impairment - deaf, hard of hearing, etc.

Visual Handicap - blind, low vision, etc.

Emotional Handicap - emotionally disturbed, autistic, other behavioral problems

Mental Retardation

Language Handicap - speech impairment, bi-linguality, etc.

Physical Handicap - Cerebral Palsy, Muscular Dystrophy, neurological disorder, other motor disorders

Learning Disability - aphasia, dyslexia, other perceptual disorders

These classifications will suffice to describe the general handicap area. What is more important is how the handicap affects the transportation requirements of each individual child. In the majority of cases there will be no restrictions imposed by the handicap. The following sampling will illustrate the type of sub-classification that is desired in order to determine transportation requirements:

Lift into and out of vehicle.
Transport in a wheelchair.
Wheelchair transported with child.
Requires special attention due to young age.
Requires special attention due to medication.
Liable to have seizures and must be closely watched.
Becomes ill, upset, or unruly if ride is too long.
Requires attendance of an adult during transportation.
Behavior problem and should be transported alone or with an attendant.

In summary, there are a multitude of details which must be attended to in order to design satisfactory transportation guidelines for children with special needs. In a cooperative situation it is even more critical to define these standards and have them accepted by the member school systems, so that no child will receive improper transportation because the information on his needs was misunderstood or ill-defined. When these guidelines are defined and adopted by the TEC communities, both the Regional Transportation Coordinator and the Special Education Administrators of the communities will be in a much better position to apply the guidelines consistently to the the transportation requirements of each child.

4.2 Projected Route Requirements

One of the key areas that will enable us to project the cost for a regional transportation system is to project the route requirements in some detail. In order to do this, certain key assumptions have to be made. Specifically, we assume that 9-passenger vehicles will be available for transportation. Secondly, we assume that reasonable groupings of pupils in TEC towns will keep the maximum transportation

time below 60 minutes, except in special cases. These assumptions can, of course, be varied with the implementation of the transportation system. In our preliminary analysis[1] of routing possibilities for the TEC communities, we divided the schools into three groups. Type I schools are those where there is only one receiving school in any given town. Type II schools are grouped. Type IIA are those cases where there is more than one receiving school in a TEC community. Type IIB are those cases where there is more than one receiving school in a community, but that community is not one of the TEC communities. In the preliminary report, the three cases considered differed only in the way in which the schools were grouped for servicing by single routes. For purposes of this detailed projection of route requirements, we will focus on Breakdown III of the preliminary report, which consisted of grouping all TEC children by their destination schools, then grouping the schools (both within the TEC communities and outside of the TEC communities) by the town in which they are located. The following is a list of assumptions that were made in preparing these route projections.

1. All TEC community students were grouped by the school they attend, rather than by the town they live in. This presupposes cooperative transportation.

2. Receiving schools were grouped, i.e., where two or more schools occurred in the same town, they were considered as one school for the purpose of mutual transportation.

3. Rough mileage estimates were made by the zip centroid method which was described more completely in the preliminary report[1].

4. An average vehicle speed of 35 mph was applied to the mileage estimates in order to obtain route travel time.

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[1] A Preliminary Analysis of Routing Possibilities for TEC Communities, by Lee Zarick, March 21, 1974, Concord Research Corporation

5. A one hour travel time limit was used where physically possible. This limit was also used by the State Department of Education in a routing system developed for them.

It is felt that the mileages, and thus the times, of the routes generated were on the long side. Consequently, most of the routes, once implemented, should be shorter than indicated in the accompanying table.

A summary of the routes projected for the TEC regional transportation system appears in Table 2. These projected routes were prepared using data on the 277 pupils who currently receive special education transportation. This will allow direct comparison of cost projections with the current cost of the routes being driven. Naturally, in implementing the plan, the routes would have to be redesigned using the new pupil data available at the end of the school year. The Table shows the routes numbered from 1 to 58, grouped by destination town. Shown for each route are the number of receiving schools, the number of origin towns (i.e., the number of towns in TEC where pupils are picked up), the number of pupils picked up, the estimated mileage from first pickup to last school, and the estimated time in minutes for the route. Finally, an estimated cost is shown, and this will be discussed in Section 4.3. The routes are divided into three groups, the first being routes destined for schools grouped within TEC communities. These schools are located in 6 of the 9 TEC communities. The second grouping, starting with Route #20, is for schools grouped outside of the TEC communities. Here only 5 communities have more than one school. The remainder, from Route #31 to #58, are routes destined for a single school. The school name is shown in the second column. Conceptually, there is not much difference between picking up children at more than one residence within a town and in picking up children at more than one residence in two or more towns. Likewise, there is not too much difference between dropping children at one school in a given town, and dropping children at two or more schools in a given town. The only difference lies in the necessity of getting the data together and designing route bid specifications which will accomplish it. Care should be taken to point out that the routes

TABLE 2

SUMMARY OF PROJECTED ROUTES FOR TEC REGIONAL TRANSPORTATION SYSTEM

ROUTE #	DESTINATION TOWNS	NUMBER OF SCHOOLS	NUMBER OF ORIGIN TOWNS	NUMBER OF PUPILS	ESTIMATED MILES	ESTIMATED TIME, MIN	ESTIMA COST
TYPE IIA SCHOOLS GROUPED IN TEC							
1	NATICK	1	1	1	6.9	15	1
2	NATICK	2	4	9	37.4	60	2
3	NATICK	3	1	8	34.0	60	2
4	NATICK	3	1	8	34.6	60	2
5	NATICK	2	2	7	28.6	45	2
6	NEEDHAM	1	3	8	31.0	55	2
7	NEEDHAM	1	1	6	20.8	40	21
8	NEEDHAM	3	1	9	34.2	60	2
9	NEEDHAM	2	2	6	28.8	50	24
10	NEEDHAM	1	1	5	20.4	30	21
11	NORWOOD	2	1	3	15.0	30	2
12	WAYLAND	3	2	8	28.3	40	24
13	WAYLAND	3	4	9	39.4	60	27
14	WELLESLEY	2	2	3	17.1	25	20
15	WESTWOOD	1	3	8	30.6	50	25
16	WESTWOOD	1	1	8	24.0	45	22
17	WESTWOOD	1	2	8	24.0	45	22
18	WESTWOOD	1	2	8	27.1	50	23
19	WESTWOOD	1	1	2	7.5	15	17
TYPE IIB SCHOOLS GROUPED OUTSIDE TEC							
20	BOSTON	2	3	4	39.6	60	27
21	BOSTON	2	1	7	30.1	55	24
22	BOSTON	2	2	3	16.4	30	20
23	CONCORD	2	3	3	25.0	45	23
24	FRAMINGHAM	3	2	8	36.9	60	27
25	FRAMINGHAM	4	2	7	41.3	75	28
26	FRAMINGHAM	2	2	4	34.9	60	26
27	FRAMINGHAM	1	2	5	31.0	55	25
28	NEWTON	2	2	7	32.9	55	25
29	NEWTON	2	2	5	39.2	65	27
30	WATERTOWN	2	2	3	29.0	40	24

TABLE 2 (Cont.)

SUMMARY OF PROJECTED ROUTES FOR TEC REGIONAL TRANSPORTATION SYSTEM
(CONTINUED)

RT #	DESTINATION TOWNS	SCHOOLS	NUMBER OF ORIGIN TOWNS	NUMBER OF PUPILS	ESTIMATED MILES	ESTIMATED TIME, MIN	ESTIMA COST
TYPE I SCHOOLS OUTSIDE TEC							
31	LEXINGTON	KREBBS	2	4	31.0	55	25.2
32	LEXINGTON	KREBBS	3	6	29.0	50	24.5
33	LINCOLN	CARROL	4	7	42.9	75	29.0
34	LINCOLN	CARROL	2	7	39.3	60	27.8
35	LINCOLN	CARROL	1	7	24.5	45	23.1
36	LINCOLN	CARROL	1	4	17.4	25	20.8
37	MARLBOROUGH	COM. CLIN. NURSERY	2	4	29.8	50	24.8
38	MEDFIELD	STATE HOSPITAL	1	1	5.6	15	17.0
39	MILTON	CURRY COLLEGE	1	1	10.8	20	18.7
40	N. READING	BERRY REHAB.	5	5	52.6	90	32.1
41	SOUTHBOROUGH	FAY	1	1	13.6	20	19.6
42	STOUGHTON	STOUGHTON DAY	1	1	10.7	20	18.7
43	WALTHAM	FERNALD	1	1	10.5	20	18.6
44	WEYMOUTH	MULTIPLY H.C.	1	1	17.2	20	20.8
45	WRENTHAM	STATE	3	6	31.9	55	25.5
46	KINGSTON	SOUTHWESTERN	1	2	45.7	90	29.9
47	FOXBOROUGH	KENNEDY CTR	2	5	21.9	40	22.3
48	ASHLAND	COM. CLIN. NURSERY	1	1	12.0	20	19.4
49	BELMONT	ARLINGTON	3	7	32.7	55	25.7
50	BEVERLY	LANDMARK	2	3	53.1	90	32.2
51	BRAINTREE	ST. COLLETTA'S	2	3	32.7	55	25.7
52	BRIGHTON	KENNEDY HOSP.	4	4	34.3	60	26.2
53	BROOKLINE	BEACON NURSERY	1	1	11.9	20	19.1
54	CAMBRIDGE	CARROL HALL	1	1	17.9	35	21.0
55	CANTON	MASS. HOSP.	2	3	17.7	35	20.9
56	CHESTNUT HILL	B.C.	2	3	17.0	35	20.7
57	WESTON	GIFFORD	3	4	17.3	35	20.8
58	DEDHAM	RICHARDS	1	4	15.8	30	20.3
		TOTAL		277	1542.8	2655	$1381.5
		MEAN (AVE.)		4.78	26.6	45.8	$ 23.8
		(AVERAGE SPEED 35 MPH)				PER PUPIL	$ 4.9
						PER PUPIL	$ 898.2

shown in Table 2 are projected routes only. They are meant to demonstrate the feasibility and evaluate the cost effectiveness of a proposed regional transportation system. When detailed routes are designed, far more consideration will have to go into their design than was included here.

Several general comments can be made with regard to grouping children and thus obtaining cost savings for the regional transportation system that are not available to the individual school system. Grouping children allowed us to pickup children from two or more towns in most cases. Approximately 75% of the routes have children grouped either by towns or by their schools. The average number of pupils per vehicle works out to be 4.78 pupils, which is 2 more children per route than is currently the case. As was pointed out earlier, mileage estimates are based on a very general method used for esimtating mileages between the centroids of towns based on their zip codes. Into each estimate is added approximately 2.5 miles for each pickup or drop off, so there is a generous allottment in mileage utilizing this estimating technique. It would not be surprising if the actual mileage for these routes worked out to be 10 or 20% less than indicated. Correspondingly, the estimates of time are based on a 35 mph average speed. This is not much greater than the route surveys indication of roughly 30 mph average speed. This latter figure would tend to go up as routes become slightly longer. The average length of the route works out to be 26.6 miles, and the average time is 45.8 minutes. These are almost the same as the values obtained in designing the routes for the Division of Special Education.

4.3 Estimated Bid Rates

Estimates of probable bid rates are based on CRC's experience in preparing bid specifications for the Division of Special Education. It must be understood that these estimates serve only as an approximation, due to changing economic conditions and the resultant unpredictable effect on bid rates. In order to shed some light on the effects of route redesign and competitive bidding, it would be well to review

the results of the project to improve the Special Education Transportation System for the Massachusetts Department of Education[2] (Table 3). The results show that an overall cost reduction of 32% was achieved by redesigning the routes and preparing comprehensive data packages which specified each route in detail. This detailed bid specification, together with stimulated competitive bidding, achieved the results shown. What is even more remarkable is that the redesigned routes showed a decreased load factor and route length, indicating an improved service factor was simultaneously achieved. These results are included to show that not only can cost savings be made, but substantial improvement in effective transportation service can be achieved at the same time, though a comprehensive program to centralize transportation, redesign routes, and stimulate competitive bidding.

Cost estimating relationships were generated based on the Commonwealth's experience in 1972-1973, and again in 1973-1974, in special education contract costs. Figure 3 shows a comparison of the special education transportation costs for the two years. The actual 1973-74 bid rates are shown plotted as dots, representing both the mileage cost and the route length for each of approximately 456 routes. These bids were received in September of 1973. Both the average cost and the average route length are indicated by arrows. The lower curve is the cost estimating relationship which was derived by fitting a curve to represent the average value of the points displayed. This curve represents the cost estimating relationship that was used in estimating the route costs for the projected regional transportation system for TEC. For comparison, the upper curve is the cost estimating relationship that was fit to the points (not shown) representing 1972-73 route costs, before route redesign was undertaken. An alternate way of stating the cost estimating relationship in terms of total route cost would be

$$\text{Total Route Cost} = \$15.30 + 0.32 \times \text{miles}$$

This was the relation used in generating the cost shown in Table 2.

[2] A Management Information System for Efficient Transportation of Pupils with Special Needs, April 30, 1974, Concord Research Corporation

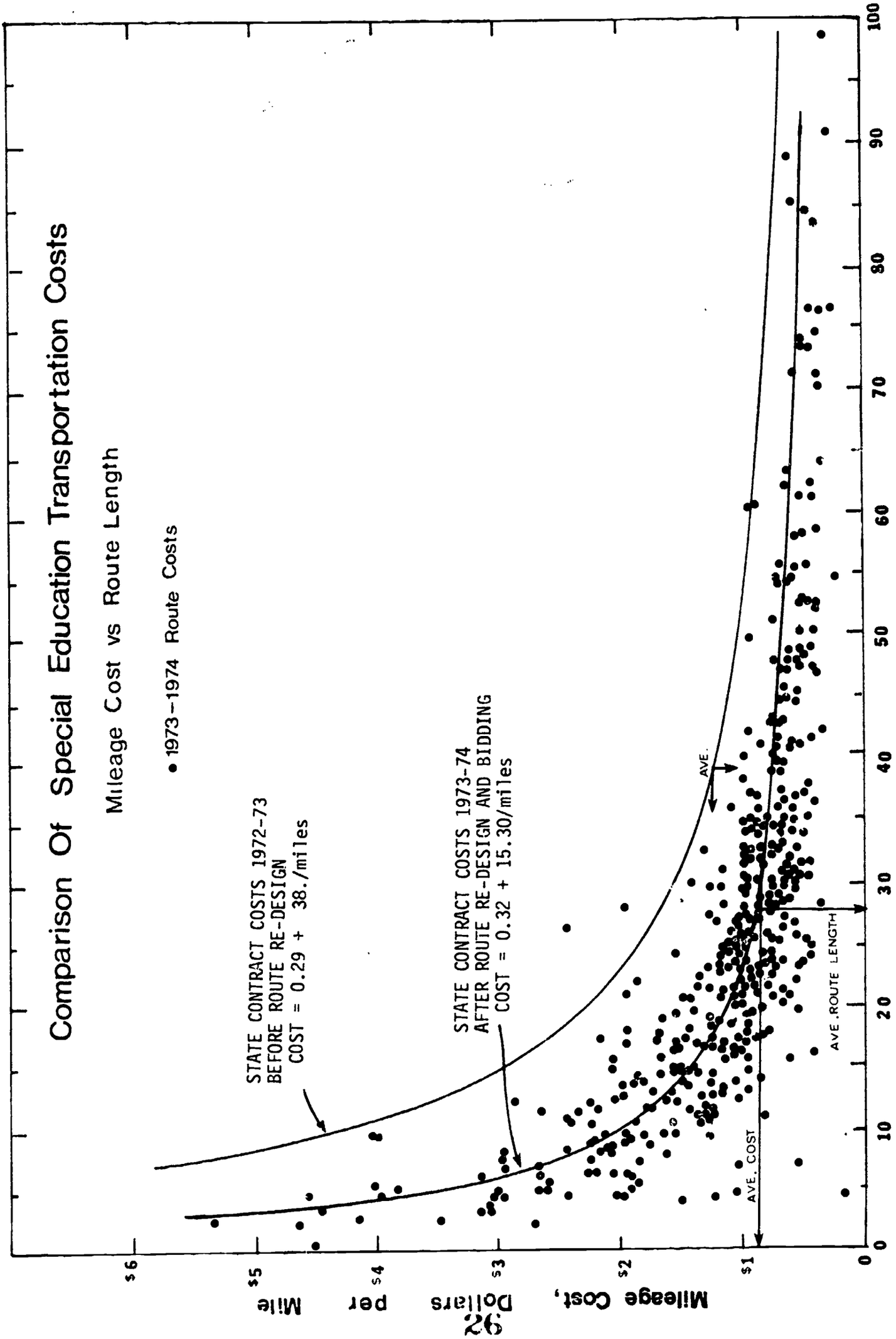
TABLE 3

SUMMARY OF RESULTS

A PROJECT TO IMPROVE THE SPECIAL EDUCATION TRANSPORTATION SYSTEM FOR THE MASSACHUSETTS DEPARTMENT OF EDUCATION

	1972-73 STATISTICS BEFORE ROUTE REDESIGN	1973-74 STATISTICS AFTER ROUTE REDESIGN AND COMPETITIVE BIDDING	CHANGE
COST RESULTS			
TOTAL PROJECTED CONTRACT TRANSPORTATION COST	$3,076,890	$1,838,229	-40%
TOTAL NUMBER OF ROUTES	385	467	+21%
COST PER ROUTE	$7,992	$3,936	-51%
TOTAL PUPILS TRANSPORTED	1,870	1,651	-11%
AVERAGE YEARLY TRANSPORTATION COST PER PUPIL	$1,645	$1,113	-32%
SERVICE RESULTS			
AVERAGE PUPIL LOAD PER VEHICLE	5.5	3.5	-34%
AVERAGE ROUTE RUN TIME - MINUTES	77	55	-29%
AVERAGE ROUTE LENGTH - MILES	39	27	-31%

FIGURE 3


Comparison Of Special Education Transportation Costs
Mileage Cost vs Route Length
• 1973-1974 Route Costs
STATE CONTRACT COSTS 1972-73
BEFORE ROUTE RE-DESIGN
COST = 0.29 + 38./miles
STATE CONTRACT COSTS 1973-74
AFTER ROUTE RE-DESIGN AND BIDDING
COST = 0.32 + 15.30/miles
AVE.
AVE. COST
AVE. ROUTE LENGTH
Mileage Cost, Dollars per Mile
$1
$2
$3
$4
$5
$6
0
10
20
30
40
50
60
70
80
90
100

The estimated route cost shown in Figure 2 range from a low of $17.00 to a high of $32.00. The total of $1381.54 per day is approximately 24% less than the current cost of $1815 per day. The average cost per route is $23.82, higher than the present figure, but the number of routes is much less. The per pupil cost of $4.99 a day is much lower than the current average. The projected annual figure of $898 per pupil is substantially below the Commonwealth's annual cost of $1113 per pupil.

5.0 COMPARISON OF COSTS AND RECOMMENDATIONS FOR FURTHER ACTION

5.1 Cost Comparisons

When current operating costs are compared with the projected cost of a regional system (Figure 4) we find that an annual savings of approximately $86,000 can be obtained. On an annual per pupil basis, this represents a reduction from $1175 to $892 (almost $300) per pupil. This yields an overall cost savings of 24%, which is a conservative figure considering the estimating procedure used. Further economies in the per pupil cost would be obtained if the total number transported were to increase in the coming year, as loading and utilization efficiency would increase. It is to be noted that the overall per pupil annual cost of $892 is more than $200 less than the equivalent Division of Special Education average. This is because, in the TEC communities, the pupils are concentrated in a much smaller area than in the case of statewide transportation. The projected regional costs have been based on the current pupil population of 305 students. This is a sizeable population, and is roughly equivalent to 1/5th of the students transported directly by the Division of Special Education. It is interesting to note that, under the proposed regional system, the effective cost per mile would also yield an overall reduction of 24%, from the current $1.19 per mile to 90¢ per mile. The 90¢ figure is close to the Commonwealth's rate, which is to be expected since it is based on a cost estimating relationship derived from the statewide experience.

FIGURE 4

COST COMPARISON FOR PROPOSED
REGIONAL TRANSPORTATION SYSTEM

	PRESENT SYSTEM	PROJECTED REGIONAL SYSTEM	CHANGE	STATE TRANSPORTATION SYSTEM
Total Projected Contract Transportation Cost	$358,574	$273,219	-$85,354	
Average Yearly Transportation Cost Per Pupil	$1175.65	$ 895.80	- 24%	$1113.00
Average Daily Cost Per Pupil	$6.53	$4.98		$6.18
Total Pupils Transported	305	305	--	1,651
Total Number of Routes	131	58	- 56%	467
Average Annual Cost Per Route	$2737.21	$4694.90	+ 71%	$3936.25
Average Cost Per Mile	1.19*	0.90	- 24%	0.89

*Based on routes surveyed.

The cost savings are a result of three major steps. Efficient route optimization and redesign allows for improvement in overall cost effectiveness. Stimulation of open competitive bidding results in more competitive prices. The centralized control through the Regional Transportation Coordinator enables the efficiencies obtained in the first two cases to be maintained throughout the school year.

There are additional benefits to the school districts, over and above the aforementioned cost savings. Local administrators are relieved of most of the burden of arranging and continually revising transportation for these children. The service the children receive is improved, and is more uniform. And, by reducing the cost of transportation, budget appropriations are proportionately reduced.

5.2 Recommendations for TEC Action

5.2.1 Member communities should agree to cooperate in a regional transportation system, with TEC assuming centralized responsibility for planning, coordinating, and contracting for the system. This agreement should include hiring or designating a Regional Transportation Coordinator, and a method of sharing transportation costs.

5.2.2 The Regional Transportation Coordinator should initially spend at least half his time coordinating the transportation requirements for the cooperative.

5.2.3 A meeting should be held of all local Special Education Administrators and Transportation Supervisors who handle such transportation in their respective communities. This meeting should draft guidelines to be used by both the Regional Transportation Coordinator and the local personnel in planning transportation needs for the coming year.

5.2.4 One person should be designated in each town to determine the transportation requirements of each pupil and communicate these requirements to the Regional Transportation Coordinator, using the guidelines previously agreed upon. This should be someone thoroughly familiar with the needs of each pupil (i.e., Special Education Administrator).

5.2.5 TEC should secure a planning consultant to assist the Regional Coordinator in preparing routes which meet the agreed upon guidelines, and prepare bid specifications.

5.2.6 Bid specifications should be widely advertised by the Regional Transportation Coordinator to stimulate competitive bidding among responsible carriers.

5.2.7 Bids should be reviewed and awarded to the lowest responsible bidders.

5.2.8 The Regional Transportation Coordinator should continue to handle transportation matters throughout the school year, though it is estimated that such activities will diminish roughly to ¼ time during the school year. Any changes in the transportation system will be made by him, and any such changes communicated to the proper carrier.

5.2.9 It is recommended that the cost for regional transportation services be split among the towns on a per pupil served basis. These costs would include the actual transportation costs, the cost of the part time Regional Transportation Coordinator, and any consulting services that are required during the year. If we estimate, for planning purposes, that the cost of the Regional Coordinator and consulting services totals $10,000 per year, the per pupil cost would increase approximately 3½%, or $32 per pupil. Thus, the overall net savings to the towns will be approximately 21% (see 5.1) or $75,000.

5.2 Recommendations for Other Cooperatives

5.2.1 A fundamental recommendation to all considering transportation cooperative systems is to organize early in the school year and get planning assistance early in the school year. Delay will mean diminished effectiveness and higher cost.

5.2.2 Define an administrative structure that will provide continuity and centralization for the transportation operation. This may take the form of designating a Transportation Coordinator.

5.2.3 Define the population to be served, i.e., which pupil categories are to be serviced by the regional transportation system.

5.2.4 Define a uniform recording and reporting system to maintiin information about the pupils. This reporting system should include information about transportation needs, schools they attend, and the transportation carriers responsible for the transportation.

5.2.5 Transportation guidelines should be drafted and adopted by the cooperative, and one person should be designated as responsible for defining transportation requirements for each school system.

5.2.6 Routes should be designed and bid specifications prepared which optimize the efficiency of the transportation system throughout the cooperative region and maintain the flexibility of the system to respond to changing requirements during the school year.