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ABSTRACT

This report presents the results of a study conducted by Lambda Corporation to assess the demographic problems in achieving school desegregation in 44 urban areas of the United States. The present volume is intended to present in brief form the results for each of the 44 areas and to review the general conclusions that can be drawn from the survey as a whole. The purpose of this study is primarily to discern the range of possibilities for school desegregation in each of 44 districts when account is taken of the districts' particular demographic situation; it is decidedly not the purpose to identify a single plan that is recommended for that district. The primary contribution of this study has been the development of a method that not only calculates the extent of achievable desegregation and the associated burden in terms of student busing, but also takes into explicit account the characteristics that are unique to specific school districts. Since there is so much diversity within the 44 cities studied, the specific results of the study must be displayed either in graphical or tabular form for each area, or in summary tables that display a limited set of results for all areas. For such specific results the reader is referred to the "Synopsis of Survey Results" in Part 1 and the detailed "Area Reports" in Part 2. (Author/JM)

Report 117

A Survey of Urban School Desegregation

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SUMMARY REPORT

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CONTENTS

CONTENTS (continued)

PREFACE

This study was carried out by Lambda Corporation with assistance by Concord Research Corporation in data organization. George E. Pugh was overall project leader. The project members were:

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The study would not have been possible without the cooperation of many local transportation planning agencies whose staff provided the data on road networks in each of the areas examined. We reiterate our thanks to them.

The project wishes to acknowledge the very effective guidance and leadership provided by Constantine Menges, Project Officer for the Department of Health, Education, and Welfare, and the support and assistance of many others in the Department. This report is, however, the responsibility of Lambda Corporation.

The principal authors of this report are George E. Pugh and J. Neil Killalea.

INTRODUCTION

This report presents the results of a study conducted by Lambda Corporation to assess the demographic problems in achieving school desegregation in 44 urban areas of the United States. The work was supported by contracts HEW-OS-71-140 and HEW-OS-71-185 for the U. S. Department of Health, Education, and Welfare.

The total output of this survey analysis is varied and voluminous. The present volume is intended to present in brief form the results for each of the 44 areas and to review the general conclusions that can be drawn from the survey as a whole. In order to make this volume as self-contained as possible it repeats some of the methodological material from the Lambda report School Desegregation with Minimum Busing, which should be referred to for a full discussion of the method of analysis, the data sources employed, the sensitivity of results to assumptions, and the conclusions that had been reached at that time.

We wish to caution the reader here, as we will in later sections of the report, that the results of this study must be interpreted in the light of its purposes, constraints, and available data. The purpose is primarily to discern the range of possibilities for school desegregation in each of 44 districts when account is taken of the districts' particular demographic situation; it is decidedly not the purpose to identify a single plan that is recommended for that district. Constraints of funds and time made it impracticable -- and the study's purpose make it unnecessary -- to obtain information at a level of accuracy that would obviously be required in

order to be able to recommend a plan. In most districts examined, the data employed in the study is clearly accurate enough to lend credibility to the results; for each study area we have indicated the source and extent of error.

This report is presented in two parts. Part One reviews briefly the methodology, the sources and quality of data, and the terms that are central to an understanding of this work, and presents the general conclusions of the study. Part Two contains reports on the 44 areas.

The 44 school districts examined in the study are listed below.

Atlanta, Georgia
Birmingham, Alabama
Boston, Massachusetts
Broward County, Florida
Charleston, West Virginia
Chicago, Illinois
Cleveland, Ohio
Colorado Springs, Colorado
Columbia, South Carolina
Dade County, Florida
Dallas, Texas
Dayton, Ohio
Denver, Colorado
Detroit, Michigan
Duval County, Florida
East Chicago, Indiana
East St. Louis, Missouri
El Paso, Texas
Ferndale, Michigan
Fort Wayne, Indiana
Fort Worth, Texas
Gary, Indiana
Hartford, Connecticut
Indianapolis, Indiana
Kansas City, Missouri
Mobile, Alabama
Newport News, Virginia
Northern Virginia
Oakland, California
Oklahoma City, Oklahoma
Omaha, Nebraska
Pasadena, California
Philadelphia, Pennsylvania
Pomona, California
Pontiac, Michigan
Prince George's County, Maryland
Richmond, Virginia
San Antonio, Texas
San Francisco, California
Seattle, Washington
St. Louis, Missouri
Toledo, Ohio
Tucson, Arizona
Wichita, Kansas

SUMMARY

Public discussion and official consideration of the problems of racial isolation in schools in urban America have been hindered by the lack of objective information on the phenomenon of desegregation itself. This study is an attempt to bring into focus in a quantitative way some of the factors that determine the extent of desegregation that is achievable in specific urban areas.

It is necessary, of course, to be able to measure and evaluate desegregation for a number of purposes, including allocation of funds by federal and state agencies and determination of constitutional questions by the courts. This implies a standard or yardstick of desegregation. For all districts to comply with a single fixed standard, however, would be to disregard the very real differences among areas. The primary contribution of this study has been the development of a method that not only calculates the extent of achievable desegregation and the associated burden in terms of student busing, but also takes into explicit account the characteristics that are unique to specific school districts. The method has been applied to 44 urban areas to depict the range of possibilities.

There is so much diversity within the 44 cities studied that it is almost impossible to make any generalizations that are universally true. Thus, the specific results of the study must be displayed either in graphical or tabular form for each area, or in summary tables that display a limited set of results for all areas. For such specific results the reader is referred to the "Synopsis of Survey Results" in Part One and the detailed "Area Reports" in Part Two. In this

introductory Summary it is only possible to discuss general trends, recognizing that exceptions to the general trends will always exist.

There is a range of possible student assignments, with each of which can be associated an expected level of desegregation and an amount of travel burden.

Biased neighborhood school assignments. The racial composition of schools in most urban areas seems to approximately reflect the racial demography of existing housing patterns. Generally, however, in areas in which no systematic effort has been made to desegregate the schools, there is a tendency for the school attendance patterns to exaggerate the racial isolation that exists in the housing patterns. It is probable that the travel burden associated with such a situation is higher than is actually necessary.

Unbiased neighborhood school assignments. Thus, in many areas, the part of the racial isolation in the schools that can be traced to biased attendance patterns can be eliminated simply by adopting school assignments that accurately reflect the composition of the neighborhoods. The travel burden associated with such unbiased assignments can be no higher than the burden for a biased assignment.

Minimum-transportation desegregation assignments. If a systematic effort were made to reduce racial isolation in the schools, a great deal could be done even without increasing the busing of students. The effect is achieved by simply sending the same buses to different schools. The analysis indicates that on the average

about half of the existing racial isolation in the schools could be removed without any increase in the number of students bused. Indeed, about half of this improvement can usually be achieved without any noticeable increase in the total travel time of the students who are transported. The amount of desegregation that can be accomplished in this way with little or no increase in the travel burden tends to be highest for small cities with small minority populations. The increase in desegregation tends to be least in large cities with large concentrated minority areas. For almost all areas racial isolation in the high schools tends to be less severe than for the elementary schools, and the further reduction of existing isolation seems to be easier for the high schools -- both because they draw from racially heterogeneous neighborhoods and because a larger percentage of high school students must already be transported to school.

Desegregation assignments using moderate transportation. In many areas -- very large cities with large concentrations of minorities are exceptions -- a moderate increase in transportation above the minimum will remove a substantial amount of the racial isolation in schools, often to levels that would more than satisfy constitutional guidelines as set forth by the courts. For areas in which moderate increases in transportation provide less than these levels of desegregation, further improvements are subject to a law of diminishing returns: the transportation burden per unit of improvement tends to increase as greater racial uniformity is sought.

Desegregation in large cities. Limited desegregation steps, effective in many areas, will usually not have a very great effect on racial isolation in the large concentrated minority areas of most large cities. Reduction of racial isolation in these areas almost always requires some increase in travel burden, the amount of increase depending strongly on the extent to which the isolation is to be reduced. Again, reductions in racial isolation are subject to the law of diminishing returns. Assignments using only moderate amounts of increased transportation would leave in the concentrated minority areas a higher percentage of minority students than are assigned to neighboring suburban schools. Not only would such assignments fail to meet constitutional guidelines, they might also, in the opinion of some, lead to "white flight" on the part of majority students who would be assigned to the still largely minority schools, thus nullifying much of the benefit of the plan. To reverse this situation would require resort either to increased transportation within the city or to a metropolitan-area plan.

Metropolitan desegregation. A desegregation plan that encompasses the metropolitan area surrounding a large city containing predominantly minority students can moderate the problems of center-city desegregation. In such large areas, very high levels of desegregation can be attained. Although the study analyzed only a few areas in sufficient detail to estimate the required levels of transportation, the results in these areas are not unlike those produced for cities and counties whose size and racial composition are similar to those of metropolitan areas. It appears that reasonable levels of desegregation in elementary schools in such metropolitan-area plans could be achieved only at substantial transportation burden.

Like most analysis, the present study answers some questions but raises others. It is possible to desegregate any area to levels that meet constitutional guidelines, but the cost of doing so varies from area to area. For those areas in which complete or nearly complete desegregation would entail very high levels of student transportation, plans could be developed that require less busing but that also produce less desegregation. Whether or not such plans should be considered as alternatives to complete desegregation -- particularly in light of the slow pace in desegregating the nation's schools -- touches on social, educational, and constitutional issues beyond the scope of this study. The methods developed here can, however, provide one approach for addressing these questions.

PART ONE: METHODS AND CONCLUSIONS

I. A REVIEW OF THE METHODOLOGY

The primary methodological development used in this survey is a computer system that systematically assigns students to schools as efficiently as possible in terms of whatever objectives and constraints are specified. The system then calculates the resulting level of desegregation and other important factors, such as the fraction of students bused and the length of the average bus ride. This discussion briefly reviews the data employed, the school assignment procedure, and the method of calculating the level of desegregation.

Data

The Lambda assignment system can operate with data at various levels of detail, and of course the degree of realism of the results depends heavily on the level employed. The basic aim of this survey has been to obtain an overview of the range of possibilities for school desegregation, rather than to develop realistic plans. Thus, the data was limited to publicly available information that already existed in, or was readily convertible to, computer-readable form. Three types of data were used for each area under study: information on the location and racial compositions of the school-age population, information on the location and capacity of schools, and information on the available roads.

The school population data was obtained from data files from the 1970 Census. These files provide information on the age and racial composition of the population in each "block group," the area used by the Census Bureau in its First-Count data tabulations. A block group, consisting of about 4 to 10 city

blocks, typically has about 160 children of school age. Based on information from the Office of Education and the National Catholic Educational Association, a correction was made to remove from the files the children attending private and parochial schools. Information from the Office of Civil Defense was used to locate the population center of each block by latitude and longitude as required for the analysis.

School capacity was determined from enrollment figures provided for each school by the Office of Education. Schools were associated with specific census block groups by reference to their actual addresses. The latitude and longitude of the census block were used to provide an approximate location for each school. Enrollment rather than nominal capacity data was used because of inconsistencies in the definition of "capacity." The census data on school-age population can and does disagree with enrollment figures -- among other reasons because the census files do not reflect drop-out information, which would of course be reflected in enrollment data. The census files were adjusted to match the actual reported enrollments at each grade level for each area studied, an adjustment that was usually largest for the high school population. In actually making assignments, the study used present enrollment as an indicator of capacity but permitted an assignment of up to 5 percent more students to individual schools if this would help to reduce busing requirements. A sensitivity analysis of the procedure indicates that the results are not markedly changed by the different methods of estimating capacity.

Transportation networks were obtained through the cooperation of the regional transportation planning councils in each area. They provided relatively detailed and authoritative road networks, including both distances and travel speeds on all major roads. In some cases the network was accompanied by the coordinate information (latitude and longitude of intersections) needed in the analysis; in others, it was necessary to derive the coordinates from maps to define intersections in the network.

The Assignment Procedure

In application to a typical situation, the system assigns thousands of students at various grade levels to many different schools along the shortest route in the road network as it is represented in computer form. The procedure can be understood by reference to a very small part of an urban data base, as represented in Figure 1. The shaded area corresponds to a "block group," which is the unit by which population is reflected in data from the Bureau of the Census. There are three schools -- let us assume they are elementary schools -- to which students from this area might be assigned. If we have specified that this assignment is to be made so that students walk to school whenever it is possible, and if School 2 is within the permissible distance, students will be assigned to School 2 (if it has the necessary capacity).

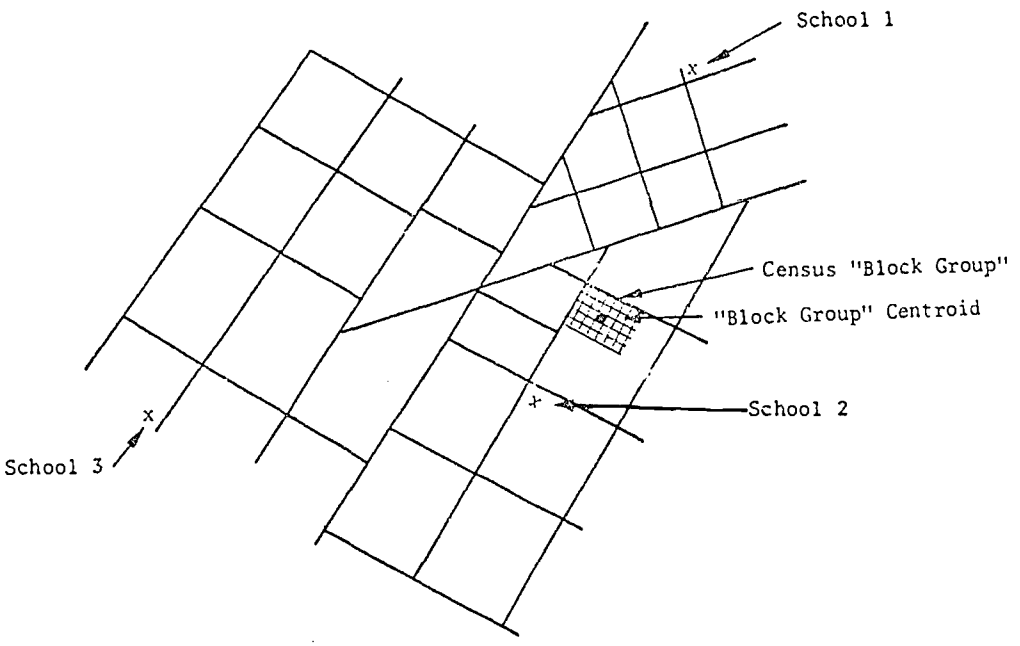


Figure 1. The School Assignment Problem

If, however, we have specified that the assignment is to reduce racial isolation, students from this block group could be assigned to a more distant school, either School 1 or School 3. Some of the considerations that could enter into such decisions are:

- If both School 2 and the residential area in question are predominantly minority, and if Schools 1 and 3 are predominantly majority, assigning these students to one of these other schools will help to reduce racial isolation.

- If Schools 1 and 3 have approximately the same percentage of majority, students will be assigned to the nearer of the two schools, School 1.

- If School 1 is within the maximum permissible walking distance but School 3 is not, preference can be given to assigning students to School 1, even if, judged by racial composition alone, assignment to School 3 would decrease racial isolation.

- If School 3 has a significantly higher percentage of majority students than does either of the other schools, the assignment of students from this block group will depend on the relative emphasis we have specified on the conflicting goals of reducing segregation and minimizing busing time.

We have referred in this discussion to "preference" and "emphasis". The method of reflecting preferences and relative emphasis is discussed in the next section.

Travel time to the more distant schools is estimated in the computer system by calculating the shortest travel time over the road network to the school in question. Since the road network may not include the minor residential roads necessary to reach the center of the block group, an additional increment of travel time, typically at a speed of 15 miles per hour, is calculated from the center of the block group to a nearby intersection in the network of major roads. Another increment of travel time also at 15 miles per hour is added to get from the intersection to the destination school.

Returning to the full-scale problem, the assignment process is carried out on each of the hundreds or thousands of block groups in a district, one at a time. Each grade level in the block group is considered separately. Considering each such subgroup, the system determines whether the overall "value" of the assignment can be improved by reassigning these students to a different school. (The "value" is determined by calculating the Desegregation Measure, discussed immediately below, and then subtracting a penalty which depends on the amount of travel required.) If a different assignment would increase the "value" when both the travel penalty and the desegregation objectives are considered, then the students are reassigned. The process continues cycling several times (typically

5 to 15) through all block groups until it is not possible to improve significantly the "value" of the assignment. At this point the program concludes by printing all significant factors that have been calculated.

The Desegregation Measure

The overall effectiveness of an assignment produced by the system must take into account two factors primarily: the amount of transportation, or inconvenience to children, and the desegregation value. The way in which the transportation burden is quantified is discussed in Section II. We discuss here the method for measuring the degree of desegregation.

Consider the school assignment problem in relation to a single minority child. If the child is in a school in which almost all his schoolmates are also minority children, the assignment has placed him in a segregated environment. If he can be assigned to a school that has a larger percentage of non-minority schoolmates, the environment will be more desegregated. We therefore define the "contribution" that each minority student makes to desegregation as proportional to the percentage of non-minority students he finds in the school to which he is assigned. To obtain the desegregation level of an assignment of senior high school students, we average the individual contributions of all minority students in this grade level, and we term this the Desegregation Measure for senior high schools in this assignment. In effect the Desegregation Measure reflects the racial composition of the school system as seen by the minority students. If the minority students are isolated in their own schools the school

system can appear to them to be almost entirely minority even though a predominance of non-minority students attend other schools. As the minority students are intermixed with other students the racial composition of the school system from their point of view appears to have a higher percentage of majority students.

We can calculate the Desegregation Measure not only for the grade levels separately but also for the entire school system. This report concentrates on figures for the separate grade levels.

It follows from this definition that the highest possible value of the Desegregation Measure, or DM, is equal to the racial composition of the particular area in question (or, when a grade level is separately considered, the racial composition of the students in that grade level). If District A contains 60 percent majority students, the highest value the DM can have is 60. District B, having 80 percent majority students, achieves its highest DM at 80. Thus, one cannot readily compare the Desegregation Measures of two districts that differ in racial composition.

To facilitate such comparisons, the Office for Civil Rights has used a measure called the Desegregation Index, or DI, which ranges from zero to 100 percent regardless of the racial composition of the district. The DI is based, however, on the DM and can be easily calculated from the DM. An assignment that produces a DM for District A (above) of 45 would produce a DI of 75 percent since 45 is 75 percent of the highest possible DM (.75 = 45/60). For District B, a DM of 45 is only 56 percent of the best possible DM and thus would produce a DI of 56 percent (.56 = 45/80).

II. ELEMENTS OF THE ANALYSIS

The basic unit of analysis is a "case": an assignment of students to schools that is optimum for a specific set of conditions and objectives -- such as the level of desegregation desired, the extent to which the numbers of students transported should be minimized, how long the bus ride can be, and so on. This section defines and discusses the terms and concepts employed, which serve as a foundation for understanding the study's outputs and the differences between the cases displayed in Part Two.

Busing: How Many, How Long

The objectives originally specified by HEW for this study required that the assignments be made (1) to meet whatever desegregation objectives were specified and (2) to minimize the number of students who ride the bus, with the restriction that busing transit time from the center of the population block group to the assigned school was not to exceed 35 minutes. Thus in the original specifications for the study there was no requirement to minimize travel time, so long as it did not exceed 35 minutes per student. (It should be noted that some students may require a few minutes -- longer, possibly, in rural areas -- to get to the pickup point, and a few minutes may be required for loading, so that the actual "time to get to school" may be longer than the times indicated here. Typically, however, these additional times are independent of where the bus goes after it is loaded; and since this study is concerned with the differences in travel time resulting from different assignments, the approximation is acceptable.)

In the process of examining school districts in the early phase of the work, other matters relating to busing time were analyzed. For instance, when considering only the 35-minute limit, the computer program could produce assignments in which the number of students bused was a minimum but in which the travel time for some of those students was unnecessarily long and in some cases would approach 35 minutes. Additional calculations were therefore made to determine the effect on the results of modifying this procedure. In these calculations it was required not only that no student ride the bus longer than 35 minutes but also that the travel time averaged over all students be kept as low as possible. In terms of desegregation achieved and number of students bused, the results for the two kinds of travel constraints were very similar. This implies that cases that employed the simpler definition of travel constraint are valid for the original purposes of this study. However, the more realistic travel objective did result in very much reduced average travel times.

For purposes of realism, therefore, it was decided to adopt, for assignments made in the latter phases of the project, a definition of the travel burden that, although more complex in expression, was felt to be more in accord with practice. Indeed, it is more in accord with practice and judgment to recognize that a "transportation penalty" is actually a complex function involving the number of students bused, the length of their ride, and even the length of the walk for those students who live within legally permissible walking distance of an appropriate school. It is desirable to avoid having a student bused if he can walk, to

avoid having students ride long distances, and also to avoid very long walks. A penalty factor was therefore designed and added into the analysis system that could reflect a penalty point system for these undesirable assignments.

Figure 2 shows in graphic form how a typical transportation penalty is defined. The busing penalties are shown on the right, the walking penalties on the left. If a child must ride the bus at all, an arbitrary penalty of 10 points is imposed, even if his travel time is (theoretically, of course) zero. The curve stops at 35 minutes, since this is an absolute limit on travel time. As travel time on the bus increases, the number of penalty points increases accordingly. On the left is shown the penalty curve for long walking distances. The walking penalty is zero for zero distance and increases more rapidly with the walking distance; the curve stops at one mile reflecting the maximum walking distance usually allowed in this survey.

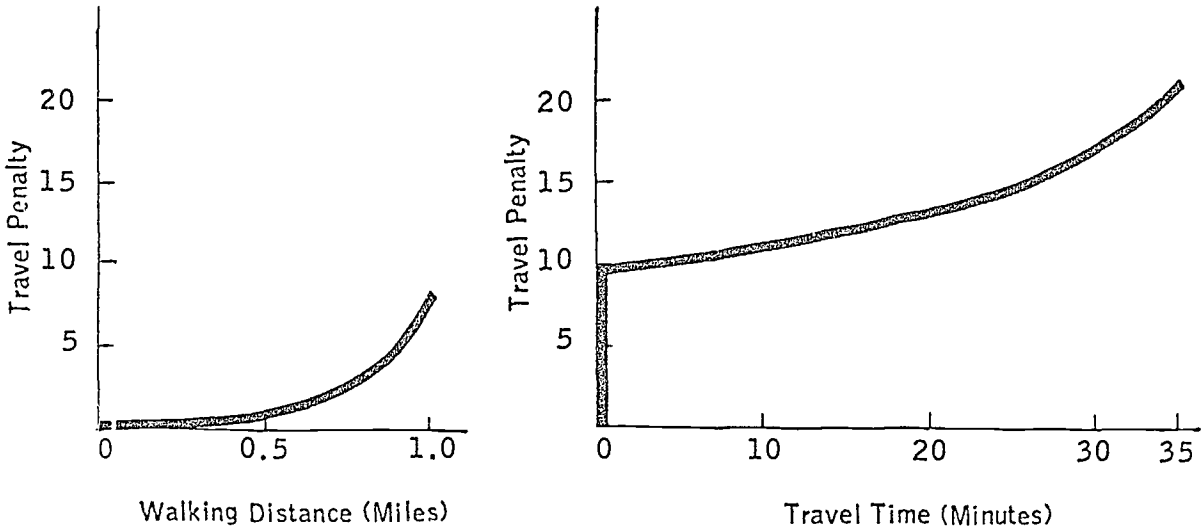


Figure 2. A Typical Transportation Penalty

The transportation penalty can be defined differently for various grade levels, so that, for instance, long rides and long walks could be penalized more heavily for younger children than for senior high school children. Similarly, the maximum permissible walking distance can be varied for each set of grades. The school planner can reflect his preferences and the geography of his area by adjusting the number of penalty points for each "inconvenience," and the student assignment system will produce an assignment that minimizes the total number of penalty points in accordance with his stipulation. In the example, the walking penalty could, for example, be set to zero, except that no student's walk could exceed one mile. This would cause students to go to a neighborhood school if it has capacity and is within one mile from home, but it would not provide any motivation to assign them to the nearer of two schools if both were within walking distance.

The text describing each of the school districts specifies whether the simple or the more complex travel penalty was employed.

The preceding discussion relates to determining the numbers bused, the travel time, and the travel distance. One additional factor was analyzed that pertains both to busing and to walking. In the standard method of assignment used in the survey the program assigns students to school individually. This means that minority and majority students from the same neighborhood can be assigned to different schools, if this will help increase school desegregation. Parallel test assignments were produced for some areas in which the program was constrained to assign all children in a block group, regardless of race, to the same school,

thus precluding the possibility that separate buses might be required in the same neighborhood to bus white students toward the central city and black students toward the suburbs. The fact that results in the standard and in the test assignments are very similar assures us that results -- in terms of desegregation level and busing level -- obtained when this constraint is not used are valid. Of course, for a more detailed analysis it would be desirable to replace the standard method for assigning students by the more realistic method.

Walking Distance

In general, a maximum of .75 mile walking radius -- or straight-line distance -- is applied. On the average, this is equivalent to 1.0 mile in actual distance walked.

For simplicity the .75-mile walking radius was used for all grade levels, whereas many districts permit secondary school students to walk somewhat longer distances. The effect of this simplification on the study results of course depends on how local practices differ from the assumed walking distance.

The percentage of students bused is quite sensitive to the circumstances under which students are permitted to walk to school. Since various walking rules, involving different distances and different safety criteria, are used throughout the United States, the results of this study are applicable to a district only to the extent that its rules are similar to those used here. In districts that permit longer walking distances than assumed, the busing levels reported here may well be overestimates.

The December 10 report pointed to the difficulty of comparing results of calculations using a .75-mile walking radius with figures reported in districts using different walking rules. In studies conducted by Lambda outside the scope of this survey, assignments were made in which the standard .75-mile radius was replaced by distances actually used by the school districts, including in some cases the different distances applied to different age groups. This and other modifications to the standard procedure can make it possible to compare more realistically the desegregation levels and busing levels in effect in the district with those calculated by this approach.

Grade Organization

We have attempted to use in this study a grade organization that reflects the predominant practice of each district. In almost all cases this is feasible. In some districts, however, the actual practice is a combination of organizations--for instance, a district may be in a three-year process of changing from the 1-8/9-12 system to what we refer to as the junior high school system, or 1-6/7-9/10-12. Since the purpose of this study is to discern trends of achievable desegregation, rather than to define a desegregation plan that could in fact be implemented, we have elected to report on each such "mixed grade organization" as totally one organization method or another, usually as a junior high school system. For districts operating a mixed grade level system, the text preceding its results specifies the organization selected.

All standard cases assume that a school identified as, say, a junior high school can be used only as a junior high school, and so on for other grades. To estimate the extent to which the present functions of schools limit the level of desegregation achievable in the district, calculations were made in a few cases in which the program would automatically "reorganize" the schools by first determining where the student population was located, assessing the potential of modifying the grade of each school (even to using a single school for all grade levels simultaneously), and then developing an optimum assignment of students to those newly organized schools. In practice it was found that essentially complete desegregation could be achieved without grade reorganization, so that these calculations were carried out for only a few cities that were examined early in the study. It should be noted that this analysis was aimed only at establishing a theoretical upper limit on achievable levels of desegregation; the fact that this extreme kind of reorganization shed little useful light on desegregation should of course not be taken to mean that school districts should discard educationally sound concepts on reorganization that might make it possible to achieve desegregation with less busing attributable to desegregation than might otherwise be required.

Definition of "Minority"

The term "minority" in this analysis is used to refer to population groups that are minority groups nationally, even though in specific school districts they may constitute the majority of the student population. The minority groups include all non-white races reported in the census data, plus Spanish-surnamed Americans.

The Spanish-surnamed populations were estimated from data from the Office for Civil Rights concerning the racial compositions of schools in each area.

The "Center City" and the "Metropolitan Area"

The original intent of this survey was to analyze two distinct areas for each city: a center-city area corresponding to the central school district, and a metropolitan area which could include the full urban area without regard to artificial district boundaries. In many, but not all cities, it has proved possible to adhere very closely to this original concept. The areas covered by the analysis are defined in a brief text that precedes the results for each city.

In the central city analysis, school district boundaries do not always coincide with the boundaries of the central city. One would of course like to analyze only the actual central school district. The census data used for the school populations are not based, however, on the geographic boundaries of the school district, and thus it is sometimes impossible to select a school population that exactly matches the school district. It is usually possible, on the other hand, to select both the schools and the school population located within any specified set of political boundaries. For this reason the geographic area included in central city analyses is often defined by political boundaries rather than by the exact boundaries of the school district. Of course, in many cities the two sets of boundaries are identical and there is no problem. In extreme cases, however, there is no such thing as an identifiable central school district; for example, some cities in Texas have as many as ten to twenty "school districts" within the central city,

no one of which can be selected as the "central" district. Moreover, since the school district boundaries often extend beyond the boundaries of the central city, it is difficult to determine what areas should be included in the analysis. The rule followed here is that where there are one or two clearly identified central school districts, the area included in the analysis is that which coincides as closely as possible with those districts; where there is no clearly identified central school district, the simple political boundaries of the central city have been used.

The geographic area to be included in a "Metropolitan Area" analysis poses additional problems. The relevant metropolitan areas often encompass many school districts and may cross city and county boundaries. For analysis of school desegregation at the level of the metropolitan area, one should clearly include the urbanized area contiguous to the central city, but there is no standard definition of this area. Typically, the Standard Metropolitan Statistical Area (SMSA) used by the Bureau of the Census is far too large, and often includes towns that are obviously separate from, and irrelevant to the desegregation of, the main metropolitan area.

Lacking an accepted definition, we have defined each metropolitan area individually to attempt to include the relevant contiguous urbanized area. Areas were typically included or excluded along city or county lines, for ease in identifying the areas involved. The specific criterion is noted in the text accompanying the results for each of the districts examined.

In some school districts, the concept of an associated metropolitan area is rather meaningless. For example, where the school district itself is a suburb of a larger metropolitan area -- as in Pasadena, California or Oakland, California -- it seems inappropriate to extend the analysis to include the entire area. Thus no metropolitan cases have been analyzed for such districts. In other cases the central school district itself already encompasses the full metropolitan area, so that a further enlargement of the area is irrelevant.

It should be noted here that, at the initiation of the project, a basic question to be answered was, Is it possible to desegregate a metropolitan area if a reasonable limit -- 35 minutes -- is placed on travel time? To answer this question a single case was run, in which complete desegregation was sought and virtually unlimited busing was permitted, the only constraint being a 35-minute limit on travel time. The results were that all metropolitan areas could be completely desegregated, but since this case makes no effort to limit even the number of students transported in these calculations, the assignments result, as could be expected, in very high levels of transportation. The calculations are of technical interest only.

It is clear in retrospect that a range of analyses might have been conducted analogous to the several cases studied for center-city districts. For a few metropolitan areas examined in the latter part of the survey, one or two additional cases were run in which the goal was to desegregate but simultaneously to minimize the percentage of students bused. The results of these analyses are more interesting and more applicable to the real-world situation.

Definition of Cases

The preceding sections discuss assumptions and conditions that were common to all or most of the cases analyzed. The two factors that vary from case to case are the amount of busing permitted (or required) and the level of desegregation that results (or is stipulated to be met). The full set of cases is defined below. Cases 2, 5, and 6 were analyzed for the cities examined in the early months of the survey. In most of these analyses travel time was not minimized and the estimated travel time is not meaningful. Cases 1, 2, and 5 are a better selection for analysis purposes and were used in the latter stages. In most of these later calculations travel time was minimized to provide more meaningful information on the transportation burden.

> Case 1. Pure Minimum Transportation Assignment. In this case, all students attend the nearest appropriate school that has capacity. Students are transported if they live more than .75 miles (straight line) from school, and transportation is to the nearest school that has capacity. This case is frequently called the colorblind neighborhood assignment, because no distinction between minority and majority is recognized in the assignment.
>
> Case 2. Minimum Transportation Assignment with Desegregation Goal. In this case, as in Case 1, no student is transported who could otherwise walk to school, so that the number bused in the two cases is identical. After the program has determined which students must be transported simply to get them to school, it takes into account -- as it does not in Case 1 -- the race of the students and assigns them to schools with the objective of increasing as much as possible the level of desegregation.
>
> Case 3. Desegregation with Minimal Extra Busing. In this case, all conditions are the same as those in Case 2, except that a small amount of busing, in addition to the minimum, is permitted if it serves to increase desegregation levels. "Small" is defined more precisely

as follows: no child who could walk to a school of appropriate grade level would be bused unless the transfer would create an increase in the Desegregation Measure equivalent to that brought about by moving him to a school 70 percent more favorable in terms of racial composition (as from a completely black school to one that is 30 percent black).

Case 4. Desegregation with Moderate Extra Busing. This case is the same as Case 3, except that the criterion is that a move involving busing would have to yield an improvement in desegregation equivalent to moving the student to a school 25 percent more favorable.

Case 5. Desegregation with Extensive Extra Busing. The same as Case 3, except that a move need create an improvement equivalent to only a 5 percent more favorable environment.

Case 6. Maximum Feasible Desegregation. This case represents placing no limit at all on the number of students bused, to obtain the maximum feasible level of desegregation, subject only to the constraint that no child's travel time is more than 35 minutes. As noted elsewhere, the case is of academic interest only, since the calculations shed no light on the levels of busing that would be required in an efficient assignment.

Summary of Data, Cases, and Areas Covered

Table I lists, for each area surveyed, the cases examined and the quality of the data. The listing can be understood by reference to the first entry, Atlanta, which should be read as follows:

Cases 1, 2, 5, and 6 were run for the center city. Only in case 1 were all transportation parameters minimized.

Cases 5 and 6 were run for the metropolitan area, and transportation parameters were minimized in case 5.

The population data is considered by Lambda to be only fair, and the data for the transportation network is quite good. The third column shows that the definition of the area is in good agreement

with the Local Educational Area (LEA). These qualitative judgments are not a reflection on the source data, but only on the applicability of the data to the use made in this study.

An analysis of the techniques for validating data is to be found in Report on Validation, one of a series of Lambda publications stemming from this survey.

Table 1. Cases Studies and Data Quality

	Areas and Cases (* = transportation minimized)	Data Quality (1 is best)		
		Pop.	Trans.	Area Def.
Atlanta, Georgia	City 1*, 2, 5, 6--Metro 5*, 6	3	1	1
Birmingham, Alabama	City 1*, 2, 5, 6--Metro 5*, 6	2	2	2
Boston, Massachusetts		1	1	1
Broward County, Florida	County 1*, 2*, 5*	1	2	1
Charleston, West Virginia	County 1*, 2, 5, 6	1	2	1
Chicago, Illinois	City 1*, 2*, 5*	1	2	1
Cleveland, Ohio	City 2, 5, 6--Metro 6	3	1	1
Colorado Springs, Colorado	City 1*, 2, 5, 6	1	2	2
Columbia, South Carolina	County 1*, 2, 5, 6	1	1	1
Dade County, Florida	County 1*, 2*, 5*	3	2	1
Dallas, Texas	City 1*, 2*, 5*--Metro 1*	2	2	2
Dayton, Ohio	City 2, 5, 6--Metro 6	1	1	2
Denver, Colorado	City 2, 5, 6--Metro 6	2	1	1
Detroit, Michigan	City 2, 5, 6--Metro 6	2	1	1
Duval County, Florida	County 1*, 2*, 5*	1	1	1
East Chicago, Indiana	City 1*, 2*, 5*--Metro 1*, 5*	3	2	2
East St. Louis, Illinois	City 1*, 2*, 5*--Metro 1*, 5*	3	2	2
El Paso, Texas	City 2, 5, 6	2	1	2
Ferndale, Michigan	City 2, 5, 6	2	1	3
Fort Wayne, Indiana	City 2, 5, 6	1	1	2
Fort Worth, Texas	City 1*, 2*, 5*--Metro 1*, 5*	1	2	2
Gary, Indiana		1	2	2
Hartford, Connecticut	City 1*, 2, 5, 6--Metro 1*, 5*, 6	3	1	1
Indianapolis, Indiana	City 1*, 2, 5, 6--Metro 1*, 5*, 6	1	1	2
Kansas City, Missouri	City 2, 5, 6	1	1	2
Mobile Alabama	City 2, 5, 6--Metro 6	2	1	1
Newport News, Virginia	City 2, 5, 6--Metro 6	1	2	1
Northern Virginia	Metro 1*, 2*, 5*	1	1	1
Oakland, California	City 2, 5, 6	2	2	1
Oklahoma City, Oklahoma	City 2, 5, 6--Metro 6	2	2	2
Omaha, Nebraska	City 2, 5, 6--Metro 6	1	1	2
Pasadena, California	City 2, 5, 6	2	1	2
Philadelphia, Pennsylvania		3	3	1
Pomona, California	City 2, 5, 6	1	1	2
Pontiac, Michigan	City 2, 5, 6	1	1	2
Prince George's County, Maryland	County 1*, 2*, 3*, 4*, 5*, 6*	See separate report		
Richmond, Virginia	City 2, 5, 6--Metro 6	3	2	1
St. Louis, Missouri	City 2, 5, 6--Metro 6	1	2	1
San Antonio, Texas	City 2, 5, 6--Metro 6	2	1	3
San Francisco, California	City 2, 5, 6	3	2	1
Seattle, Washington	City 1*, 2*, 5*--Metro 1*, 5*	?	1	1
Toledo, Ohio		3	1	1
Tucson, Arizona	City 2, 5, 6--Metro 6	?	2	2
Wichita, Kansas	City 2, 5, 6--Metro 6	2	2	2

III. AN ILLUSTRATIVE ANALYSIS

To limit computation costs the analysis of most urban areas is based on only three cases for center cities and counties and one case for the metropolitan area. This section reviews the actual calculations for one area of about one million population*, for which a much more complete analysis was carried out. The review serves both to illustrate the full range of analysis that can be made and to explain some of the analyses carried out to test the validity of assumptions.

For any specific assignment of pupils to the schools that is developed, it is possible to calculate both the level of desegregation achieved and the amount of busing required. These two quantities are central to an understanding of the urban desegregation problem. To provide an easy way to visualize the relationship between the achievable desegregation and the required student transportation we have found it helpful to display the results in a graphical form.

For any specific assignment we plot the level of desegregation achieved as measured by the DM (or DI) against a vertical scale. We plot the required percentage of students transported against a horizontal scale. Thus any specific assignment can be plotted as a single point on such a graph. If we have produced a number of alternative student assignments for a single school district each such assignment can be plotted on the same graph. The resulting set of points provides a simple visual display which summarizes these desegregation alternatives in terms of desegregation achieved and student transportation required.

*Prince George's County, Maryland, the tenth largest school district in the country.

Using the standard survey assumptions, specific assignments were produced for the elementary school students corresponding to cases 1 through 6 as previously described. In Figure 3 the results of these assignments are plotted for each of the six cases. To help in visualizing the results, the points are joined by straight lines.

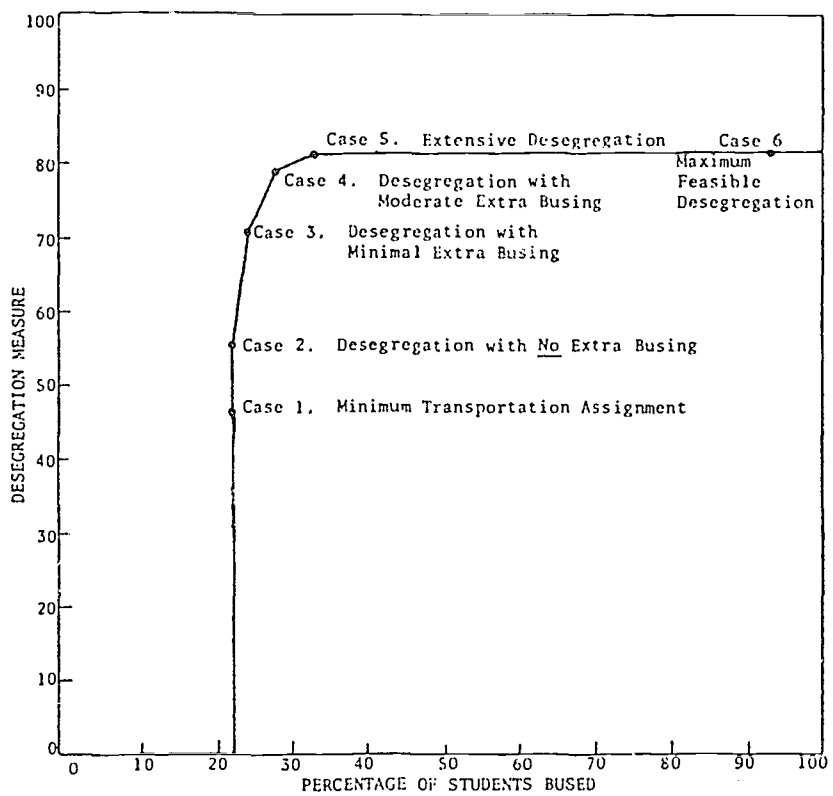


Figure 3. Typical Results for Elementary Grades

As would be expected case 1, the colorblind neighborhood assignment, requires the least transportation of students. Reading the bottom or horizontal scale corresponding to case 1, we see that it requires the transportation of 22

percent of the students. Based on the assumption of a .75 mile walking radius (or about a 1.0 mile walking distance) this amount of busing is essential, just to get all students to school. Case 1 produces a Desegregation Measure of 46 and a Desegregation Index of 57 percent (.57 = 46/81). Also as should be expected, case 2 requires no increase in the number of students transported, but because this assignment was designed to contribute to desegregation it produces a higher desegregation level DM = 56 (or DI = .69).

The highest possible level of the DM is achieved at about 81, representing an almost completely homogeneous school system in the assignments created by cases 5 and 6. Cases 3, 4, and 5 correspond to progressively higher levels of desegregation, compared with case 2, with limited additional busing.

As the chart shows, the percentage of students bused increases gradually from case 2 through cases 3 and 4, and then increases at a greater rate for case 5. At case 5 the percentage of students bused is 33 percent, compared with 22 percent in the minimum-transportation assignments. The desegregation level increases rapidly from cases 1 and 2 through 3 and 4, but the rate of increase is lower from case 4 to case 5. As a matter of academic interest case 6 represents placing no limit at all on the number of students bused; it produces very slightly more desegregation than case 5 at an extremely large increase in the number of students bused.

In Figure 4 we add the results for the same cases for the other grade levels. The most striking thing about this comparison is that, as we move from elementary through junior high to senior high schools, there is considerable increase in the percentage of students who must be bused because they live more than .75 miles (in a straight line) from an appropriate school. This reflects the fact that the secondary schools are relatively large and draw students from a relatively large neighborhood; as a consequence many more of these students live too far away from school to walk. This factor is responsible for the differences in the shape of the three curves; simply directing the buses to different junior and

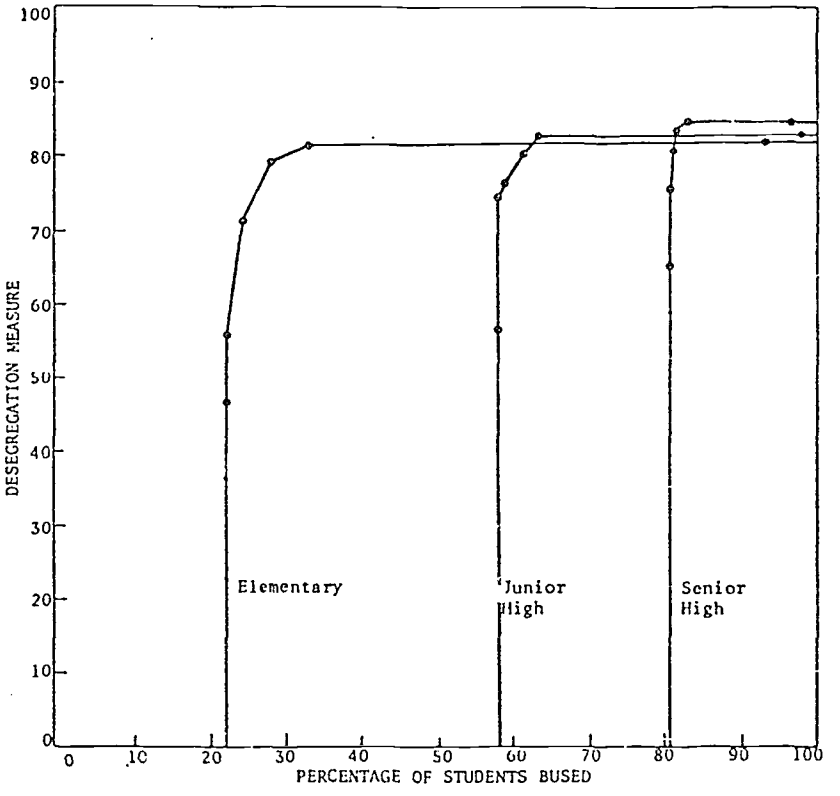


Figure 4. Typical Results, All Grade Levels

senior high schools makes it possible to reach very high levels of desegregation without busing any students who could otherwise walk. Note also that the maximum achievable DMs for the secondary grade levels are higher than that for the elementary schools; this occurs here, and in other survey areas, because the percentage of minority students in the secondary schools is lower than in the elementary schools, primarily as a result of drop-outs.

An Analysis of More Realistic Assignments

The basic calculations in the survey deal primarily with the simple question, How much desegregation can be achieved for a given percentage of students transported to school, assuming that busing transit time is limited to a maximum of 35 minutes and the walking radius is limited to 1.75 miles? In terms of these assumptions, the student assignments in the survey are optimum. Resources available for the survey did not permit analyzing the sensitivity of each area's results to the specific assumptions, but a detailed analysis was carried out for the area discussed in this section and we review it here.

To explore the changes in the results when reasonable restrictions (in addition to the 35-minute and the .75-mile limits) are imposed, we calculated "constrained" assignments which differ from the standard assignments in two important respects.

First, whereas the standard assignment permits majority and minority students to be independently assigned to different schools, if this would improve desegregation, the constrained assignment requires that both minority and

majority students from the same block group be given identical school assignments. This allows all children from the same neighborhood to attend the same school and precludes the possibility that separate buses might be required in the same neighborhood, to bus white students toward the central city and black students toward the suburbs.

Second, whereas in the standard assignment the travel time was limited only by a 35-minute travel limitation, in the constrained assignment it was required that the travel time for all students be kept as low as possible without seriously degrading the amount of desegregation. As has been noted in preceding sections, unless this constraint is imposed the average travel times calculated by the program are overestimates of what can be achieved. Figure 5 shows the results for cases 1 through 6 when these constraints are imposed; the constrained assignments are connected by dotted lines. For comparison the results from the standard assignment are shown. The very small difference between the two sets of curves shows clearly that the analysis results in the survey -- the standard assignment -- are not seriously distorted by the simplifying assumptions.

The numbers to the right of each data point on the constrained assignment curves in Figure 5 represent the average travel time in minutes from the center of the block group to the school, for those students bused under the assignment shown. For elementary students the average travel time increases gradually, from 12 minutes when no effort is made to achieve desegregation, up to an average travel time of 20 minutes when the point of diminishing returns is reached.

In the case of high schools the change in average travel time is much less. The total change over all students is from an average of 10 minutes to an average of 12 minutes travel time. Presumably because of the large percentage of high school students already riding a bus, any increase in travel time required to achieve desegregation objectives has a much smaller effect on the averages for all students.

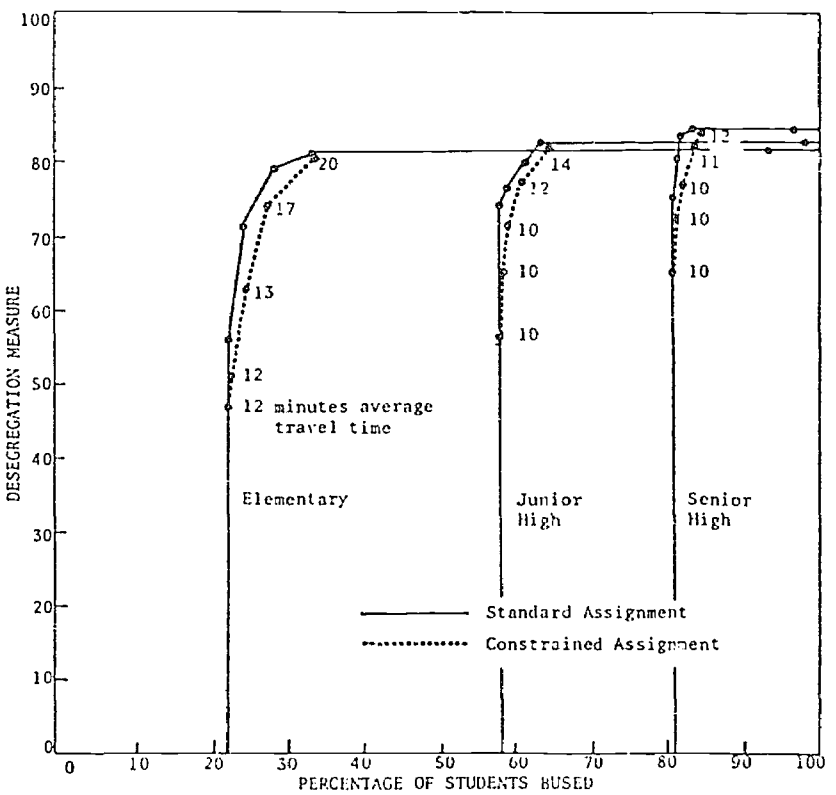


Figure 5. Results for "Realistic" Assignment

In order to provide an intuitive meaning to the levels of desegregation implied by the various (constrained) cases in Figure 5, Table II shows the racial composition of a small group of elementary schools (names are obviously fictitious) as assigned by the program. The actual current racial composition of

Table II. ILLUSTRATIVE SCHOOL COMPOSITION DATA, ELEMENTARY SCHOOLS

	PERCENT MINORITY ENROLLMENT						
SCHOOL NAME	ACTUAL	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
ALPHA EL SCH	6	17	13	11	12	17	19
BETA EL SCH	0	2	2	4	10	16	19
GAMMA EL SCH	2	1	0	4	10	17	19
DELTA EL SCH	0	3	3	4	9	14	18
EPSILON EL SCH	15	0	0	0	0	21	19
ZETA EL SCH	2	20	15	16	20	20	18
ETA EL SCH	0	0	0	0	6	15	18
THETA EL SCH	2	0	0	0	2	15	19
IOTA EL SCH	0	0	0	5	10	16	19
KAPPA EL SCH	63	4	15	16	20	21	19
LAMBDA EL SCH	16	29	30	33	25	20	18
MU EL SCH	1	1	1	3	12	23	19
NU EL SCH	1	18	12	23	21	21	19
XI EL SCH	7	5	11	23	22	19	19
OMICRON EL SCH	2	93	48	35	27	21	18
PI EL SCH	10	4	5	8	14	19	19
RHO EL SCH	0	1	1	0	14	17	18
SIGMA EL SCH	1	1	1	7	13	7	20
TAU EL SCH	97	98	96	65	38	23	19
UPSILON	84	99	90	76	44	23	19
PHI EL SCH	1	4	4	5	12	22	18
CHI EL SCH	3	4	4	4	11	15	21
PSI EL SCH	13	6	6	6	10	15	19
OMEGA EL SCH	17	9	12	20	20	17	18

each school as reported is listed in the first column. A comparison of that column with the case 1 figures is quite interesting. Case 1 is a minimum-transportation assignment in which children are assigned to the nearest school to home, as much as is possible. Thus, the results for case 1 very closely mirror the racial composition of the area near the school. In a number of cases the current racial composition of the schools, shown in the column labeled "Actual," is different from that of the neighborhoods in which they are located; for some schools the difference is very great.

The table also serves to remind us of the meaning of the Desegregation Measure. As used in this study, it is derived from averaging (over all minority students) the percentage of non-minority students as seen by a minority student in his school. A specific value of the DM does not imply that each school is uniformly at that racial composition. As the table shows, the racial composition, by school, is quite uneven until case 5 is reached, and is uniform only in case 6.

Majority-Minority Busing

Another way of viewing the meaning behind the various assignment cases is to examine separately the busing required of the minority and of the majority students. Figure 6 shows this breakdown for the elementary grades; these are the same assignments shown in Figure 5 in cases 1 through 5 except that the majority and minority students bused are plotted separately rather than in combination. In the minimum-transportation assignments (the bottom of the curves) the percentage of minority students riding the bus is less than for the majority

students -- 18 versus 22 percent. This is because the minority students typically live in more crowded urban areas where the distance to schools is less than in the suburban areas. As we impose a requirement for more school desegregation -- moving from case 2 through case 5 -- the percentage of the minority students who must ride the bus increases faster than it does for the majority students. Indeed, almost the entire increase in desegregation can be achieved without any appreciable increase in the number of majority students riding the bus, while there is a steady increase in the percentage of minority students bused as the curve moves from case 2 through 3 and 4 to 5. On the other hand, travel time for both groups of students increases at about the same rate as we move through the curve.

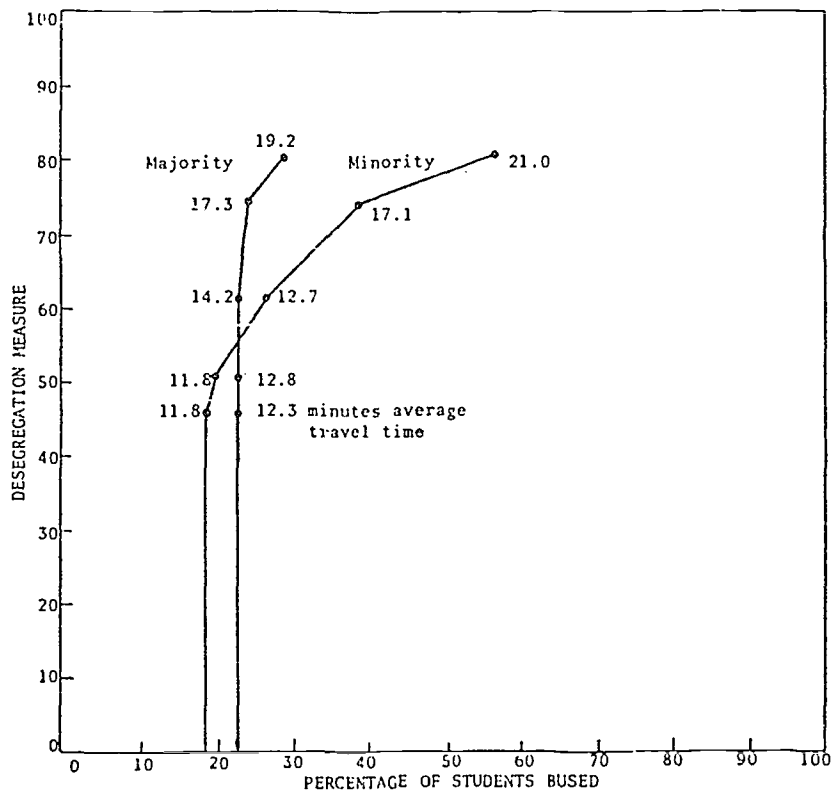


Figure 6. Transportation of Majority and Minority Students, Elementary Grades

Sensitivity to Walking Distance

In all the analyses reported in this study (except for Chicago) the maximum allowable walking distance was a standard .75 miles, which equates with almost one mile as the child walks. This standard was applied at all grade levels. Although a walking distance limit of about one mile is quite common in much of the Northeast part of the country much of the rest of the country uses longer distances, particularly for secondary schools. Obviously, for such areas the survey calculations will greatly overestimate the amount of transportation required. Because of this, the curves should strictly speaking be interpreted as reflecting the relation between the level of desegregation achieved and the percentage of students who would have to be transported if a one-mile rule were in effect.

An additional problem is to relate the calculated transportation requirements to the reported student transportation. In some areas the school system has developed its own transportation -- buses, routes, and so on. In others, however, students may be required to use public transit systems, sometimes at their own expense and sometimes subsidized. And of course some students do not actually use school or public transportation at all, but travel in privately owned automobiles. Again, the results of this study should be interpreted as indicating the percentage of students for whom some form of transportation would have to be provided if a one-mile walking limit were in effect.

IV. SYNOPSIS OF SURVEY RESULTS

In this section we present some of the most important results from the survey analysis in order to obtain an overview of the study as a whole.

Summary Tabulation of Results

Table III summarizes the results of the center-city analyses. The columns under "Study Results" reflect calculations performed in this survey. Cases 2 and 5, which were analyzed for every area studied, are reported in terms of level of desegregation achieved and percentage of children who would have to be bused. Desegregation levels are reported on the basis of the DI rather than the DM, to facilitate comparisons between districts of differing racial compositions. The fifth column under Study Results is the number of percentage points by which busing increased from case 2 to case 5.

Under the heading "DI as Reported" are listed the actual DIs for the school years 1970-71, 1971-72, and 1972-73, based on data submitted to the Office for Civil Rights by each school district.*

For nine areas -- asterisked on Table III -- "constrained" assignments were developed (see Section II for details). Because these assignments reflect a constraint in which time on the bus as well as the number of students bused was minimized, the analysis for these school districts provides more meaningful insight into the relation between achievable desegregation and travel burden. Much of the ensuing discussion is therefore based on the results for these districts.

* Figures for 1972-73 are preliminary and unofficial.

City or County	Study Results					D.I. as Reported		
* = travel times minimized	Case 2 D.I.	Case 2 % Bused	Case 5 D.I.	Case 5 % Bused	Busing Increase	1970-71	1971-72	1972-73
Atlanta	83	31	99	47	16	29	33	38
Birmingham	81	24	99	39	15	35	36	35
Boston*	61	13.	98	32	19	40	39	42
Broward County*	76	23	99	33	10	60	85	86
Charleston (Kanawha Cty)	93	52	99	54	2	82	82	83
Chicago*	59	5	93	17	12	30	32	31
Cleveland	57	26	99	46	20	20	20	20
Colorado Springs	95	38	99	40	2	75	80	80
Columbia (Richland S.D. #1&2)	90	53	99	61	8	59. . . #1 . . .	87	87
						93. . . #2 . . .	92	94
Dade County*	72	46	99	58	12	59	61	65
Dallas*	50	13	99	39	26	24	39	42
Dayton	52	24	99	51	27	25	27	32
Denver	86	41	99	52	11	66	69	69
Detroit	68	23	99	42	19	36	37	40
Duval County	60	38	99	53	15	36	51	82
East Chicago - Hammond	86	37	99	44	7	79	77	79
East St. Louis*	58	24	99	46	22	42	48	47
El Paso	98	38	99	42	4	55	58	60
Ferndale	92	28	99	28	0	59	69	59
Fort Wayne	79	47	99	53	6	47	62	63
Fort Worth*	77	18	99	29	11	36	47	49
Gary	79	34	99	46	12	32	31	31
Hartford	73	15	97	34	19	50	51	55
Indianapolis	63	37	99	50	13	37	42	44
Kansas City	64	36	99	51	15	22	20	21
Mobile	76	48	99	62	4	44	63	61
Newport News	55	39	88	59	20	25	91	92
Northern Virginia	85	49	98	52	3	61. . Alex. . .	68	72
						75. . Arl. . . .	93	93
						- F'fax Cnty.	-	94
Oakland	88	25	99	33	8	63	63	64
Oklahoma City	76	46	99	55	9	40	42	91
Omaha	77	39	99	48	9	41	45	49
Pasadena	81	40	99	51	11	98	98	98
Philadelphia*	69	27	99	44	17	34	32	32
Pomona	93	31	99	37	6	72	72	73
Pontiac	83	32	100	43	11	55	97	97
Prince George's County						56	56	56
Richmond	75	35	99	51	16	58	90	90
St. Louis	59	17	99	41	24	20	18	17
San Antonio	87	41	99	51	10	68	70	73
San Francisco	94	21	99	26	5	79	91	93
Seattle*	73	14	99	24	10	65	67	68
Toledo	74	30	99	39	9	45	45	48
Tucson	99	59	99	60	1	49 . . Elem. . .	52	53
						58 . . H.S. . .	57	59
Wichita	80	48	99	54	6	70	96	96

EXPLANATORY NOTES

"City or County": The center city or the county as defined for this study. Metropolitan area analyses are not shown.

"Study Results": Calculated desegregation and busing levels for cases 2 and 5. Results shown for total student population rather than individual grade levels. Desegregation Index used rather than Desegregation Measure.

"Busing Increase": Difference between busing levels in cases 2 and 5.

"D.I. as Reported": Desegregation Index reported to the Office for Civil Rights for the years shown.

Caution: Definitions of some areas in this study differ from definitions used in reports to the Office for Civil Rights.

Relation between School and Neighborhood

For the nine areas defined above, a comparison was made between the level of desegregation in these districts, based on enrollment by race as reported to OCR for the school years 1970-71, 1971-72, and 1972-73 and the level of desegregation that would exist if the students were assigned without racial bias to neighborhood schools. For this analysis we employ the results from case 1, which can be termed a colorblind neighborhood assignment, because students are assigned to the nearest appropriate school without taking into account race. Case 1 is therefore an indication of the degree of residential segregation. Table IV lists the results for case 1 and, for comparison, the levels of desegregation reported to the Office for Civil Rights. (Again, the DI is used rather than the DM.)

Table IV. School and Neighborhood Racial Compositions

	Case 1	DI As Reported		
	DI	1970-71	1971-72	1972-73
Boston	47	40	39	42
Broward County	63	60	85	86
Chicago	42	30	32	31
Dade County	63	59	61	65
Dallas	38	24	39	42
East St. Louis	49	42	48	47
Fort Worth	58	36	47	49
Philadelphia	52	34	32	32
Seattle	66	65	67	68

Although caution should be used in drawing conclusions from the table -- principally because of uncertainties in the data -- it seems reasonable to suggest that

- A large part of the existing level of racial isolation in schools can be attributed to existing residential patterns. In most cases the DIs as reported are in the same range as the DIs calculated for case 1.

- With a few exceptions, there seems to be a tendency for the actual school assignments to exaggerate the residential isolation. Note particularly Boston, Chicago, Fort Worth, and Philadelphia.

- In a number of areas -- notably Broward County, Dallas, and Fort Worth -- desegregation actions reduced the gap somewhat between the years 1970-1971 and 1971-1972, but there was no appreciable progress in such areas a year later.

Improvements with Minimum Busing

Clearly, school assignments should at least not exaggerate the racial isolation inherent in housing patterns. In many cases the courts have imposed much stronger requirements, stipulating that the school assignments be selected so that they eliminate a large part of the racial isolation that results from segregated housing patterns. It is therefore of interest to know how the costs of such assignments will depend on the amount of desegregation that is to be achieved. How much additional desegregation can be achieved at little or no additional cost?

Table V shows, for the nine school districts listed above, the DIs for cases 1 and 2, and, for comparison, repeats the DIs based on actual assignments as reported to OCR for three recent years.

Table V. Potential Improvement with Minimum Transportation

	Study Results				
	Case 1 DI	Case 2 DI	DI as Reported 1970-71	1971-72	1972-73
Boston	47	61	40	39	42
Broward County	63	76	60	85	86
Chicago	42	59	30	32	31
Dade County	63	72	59	61	65
Dallas	38	50	24	39	42
East St. Louis	49	58	42	48	47
Fort Worth	58	77	36	47	49
Philadelphia	52	69	34	32	32
Seattle	66	73	65	67	68

The difference between the desegregation index for case 2 and that for the assignments (as reported to OCR) provides a measure of the improvement in desegregation that can be achieved with little or no additional cost. The overall conclusion from these results seems clear. Substantial reductions in racial isolation can typically be achieved with little or no increase in pupil transportation.

A word of caution about this result is needed. The levels of desegregation achieved in this type of plan will probably not appreciably reduce racial isolation in large urban ghetto areas. It is probable that these areas will remain with predominantly minority schools under any plan that does not increase the level of pupil transportation. Thus, the significant reductions in racial isolation which can be accomplished without increases in transportation tend to occur around the edges of the central minority area or in more isolated small pockets of

minority population. The level of desegregation defined by case 2 represents the maximum desegregation that can be achieved without significant increases in student transportation.

Transportation Burden for Additional Improvements

Increases in the level of desegregation beyond the levels indicated in Table V are subject to a law of diminishing returns. That is, initial improvements beyond the case 2 level (for example to case 3 or even case 4) can be accomplished at relatively little cost, but as greater uniformity in the racial composition of the schools is sought, the transportation burden per unit improvement in desegregation tends to increase.

Using the cases 2 and 5 that were studied for almost all areas in the analysis, however, we can calculate the added transportation burden per unit of desegregation benefit achieved in the transition from case 2 to case 5. For this discussion we will define an arbitrary unit of desegregation benefit to be an improvement in the desegregation index equivalent to what would be produced by moving a single minority student to a school with a 25 percent larger fraction of majority students (for example from a school with 30 percent majority to a school with 55 percent majority). The average transportation cost for this much improvement can then be measured both in average number of additional students transported and in average increase in the total student transportation time. Table VI shows the average cost for this amount of desegregregation benefit in moving from case 2 to 5.

Table VI. Increase from Case 2 to Case 5 in Transportation Burden per Unit* of Desegregation Benefit

	Increase In Number Transported	Increase in Total Minutes of Transportation Time
Boston	.50	8 minutes
Broward County	.52	13 "
Chicago	.33	12 "
Dade County	.47	17 "
Dallas	.65	16 "
East St. Louis	.58	10 "
Fort Worth	.60	10 "
Philadelphia	.67	19 "
Seattle	.53	15 "

* Unit is defined as an increase in the Desegregation Index (or Desegregation Measure) equal to that produced by moving a single minority student to a school with a 25 percent larger proportion of majority students.

The similarity of these transportation costs per unit desegregation benefit among the wide variety of areas studied may at first seem hard to believe. Intuitively one would expect that the costs per unit benefit would be much higher in a large city like Chicago, which should be hard to desegregate, than in a smaller area like Seattle which should be comparatively easy to desegregate.

The apparent paradox has logical explanation, which becomes apparent when we recall the diminishing returns characteristic of the desegregation process. The fact that Chicago is harder to desegregate than Seattle is already reflected in the Desegregation Indexes for case 2 and case 5, both of which are substantially

lower in Chicago than Seattle. Thus, the move from case 2 to case 5 in Seattle includes the final stages of the desegregation process (DI = 93 to 99) when the racial composition of the schools is comparatively uniform and the transportation burden per unit benefit tends to be high. The move from case 2 to case 5 for Chicago does not include this final phase of desegregation (DI = 93 to 99), but includes instead an earlier part of the desegregation process (DI = 59 to 77) when the racial composition of the schools is less uniform and the desegregation benefit per unit transportation burden can be relatively high.

Differences between Areas in Ease of Desegregation

In the foregoing discussion we have focused our attention on the travel burden per unit of desegregation benefit and have demonstrated that this burden per unit of benefit is surprisingly constant between case 2 and case 5 over a wide range of urban areas. This, of course, does not mean that the total travel burden associated with going from case 2 to case 5 will be similar for all areas. It means only that the ratio between added travel burden and added desegregation benefit will be similar.

Obviously in a large city both the number of people benefited and the number of people burdened by additional transportation requirements will tend to be much higher than in a small city. Moreover, even when we look at the travel burden on a per student basis (to remove the effects of area size on the results), rather large differences in the travel burden will be observed depending on the racial composition of the area.

For example, consider the extreme case of an area with only 1 percent minority enrollment. It would be possible to change such an area from a totally segregated system to a totally desegregated system (DI = 100) without reassigning more than 2 percent of the student population. In such a school district, the additional travel burden should not affect more than 2 percent of the student population. The total additional travel burden is low, but the number of minority students who can benefit from the desegregation is also low. Even if we look at the desegregation benefits from the point of view of the majority students the maximum average percentage of minority students that can be encountered by the majority students in their classes cannot exceed 1 percent, so from this point of view also the magnitude of the total benefits is small.

Conversely, if we consider an area in which the minority and majority populations are about equal, we will find that the total travel burden could be quite high. To change such an area from total segregation to total desegregation (DI = 100) could require the reassignment of as much as half the student population -- i.e., half the minority students would have to be moved out of minority schools and would be replaced by half of the majority students transferred from other schools. This could result in an added transportation burden affecting 50 percent of the student body. Thus, in such a district the total transportation costs may be quite high, but the magnitude of the desegregation effect in terms of number of students affected is also large.

Despite the large differences between these two types of districts, the transportation burden per unit of desegregation benefit could be very similar in both districts.

The foregoing analysis shows that the transportation burden per unit of desegregation benefit is quite similar for a wide range of different city types. The differences in ease of desegregation of different areas (which one intuitively expects because of differences in size and population patterns) show up in this study primarily in the differences in the level of desegregation achieved in the case 2 assignment.

Unfortunately the case 2 assignment was not carried out in the same way in all of the areas studied. For those areas that were analyzed toward the end of the study, the assignments were carried out with travel distance minimized. The results for these areas provide an indication of the amount of desegregation that can be achieved without significant increases in either the number of students transported or the total travel time. For the majority of the areas, however, the case 2 assignment was carried out without any minimization of travel time. While these assignments did not require any increase in the number of students transported, we have no way of knowing how much increase might be required in the total travel time. In some cases the required increase in travel time could be significant. Typically, therefore, the desegregation level achieved in the case 2 assignment is somewhat higher when the assignment was done in the standard way without minimization of travel distances. This observation is

borne out, both by calculations for a few specific areas where the case 2 assignment was done both ways, and by a statistical analysis of the survey results in which the case 2 DIs were compared between areas where the assignment was done in different ways. These comparisons suggest that the increase in the DI (going from a neighborhood assignment to case 2) will usually be between 30 percent and 50 percent greater when the case 2 transportation time is not minimized. Thus, the values of DI in case 2 for areas in which travel was not minimized will typically represent a somewhat optimistic estimate of the desegregation achievable without any significant increase in travel time. It does of course correctly represent the level of desegregation achievable without any increase in the number of students transported.

Cities with Large Concentrations of Minority Students

In many areas, therefore, efficient desegregation plans can be developed that would incur either no increase or moderate increase in transportation burden and that would remove a significant portion of racial isolation in the schools. Such limited steps will, however, usually not have a very great effect on racial isolation in the large concentrated minorities areas of most large cities. Reduction of racial isolation in these areas almost always requires an increase in travel burden, an increase that depends strongly on how much of the racial isolation is to be eliminated. Such "compromise" assignments are feasible; whether or not they are desirable requires further examination.

The most efficient compromise assignments tend to assign to schools in the concentrated minority areas a higher percentage of minority students than are assigned to neighboring schools. The objection can be raised that majority students transported to these still largely minority schools might be taken out of the public school system, thus nullifying much of the benefit of the plan. It can be argued that in order to minimize these effects it is necessary to assure that all schools to which majority students would be transported would be assigned at least a certain critical percentage of majority students. Indeed, it is sometimes held that the previously minority schools should be planned to have an even lower percentage of minority students than the neighboring schools to which minority students are transported, in order to eliminate in the public mind the vestiges of a segregated school. To the extent that such steps are taken, they of course represent an increase in the transportation burden -- a lessening of efficiency in favor of assumed effectiveness. In many cases the transportation burden would be severe. Another recourse would be a plan that would include not only the central city but also the surrounding metropolitan area; this subject is discussed below.

These types of arguments raise questions about the desirability, as distinguished from the feasibility, of seeking racial uniformity in school systems in which the enrollment is predominantly minority. For example, it may be preferable to bring as many schools as practical within a range of racial composition that is considered suitable for integrated schools*, and leave other schools

*Studies by Riverside Research Institute for the New York State Commissioner of Education suggest that, when the percentage of blacks in a school falls below about 15 percent, there is evidence of social isolation, particularly for black males.

with a racial composition approximating the composition of the neighborhoods in which they are located. This concept in turn raises questions: Would such limited desegregation be socially or educationally desirable? Would it be likely to be stable? How could statutes be framed that would encourage such desegregation with limited transportation, without at the same time permitting regression to completely segregated school systems? What would be the effect on progress in desegregation if statutes were adopted that placed specified limits on travel distance? Many of these kinds of questions could be addressed by further use and extension of the analysis method developed in this study.

Desegregation Potential versus Progress

The last three columns in Table III suggest several comments. The most general observation is that the DIs for these areas in the 1970-71 school year are, with seven exceptions, below 75. There was some progress by the next year, 1971-72: some thirteen areas had DIs at 75 or more, and the DI overall increased an average of 8 percentage points. After another year only fourteen areas had DIs at 75 or more, and the DI overall had increased by an average of only 2 percentage points.

In seven areas a sharp improvement took place in 1971-72 and was maintained in the following year:

	1970-71	1971-72	1972-73
Broward County	60	85	86
Columbia (Richland S.D. #1)	59	87	87
Newport News	29	91	92
Pontiac	55	97	97
Richmond	58	90	90
San Francisco	79	91	93
Wichita	70	96	96

In all these areas except Newport News the study (Table III) shows that relatively high levels of desegregation were achievable without an increase in the number of students transported, although in several areas the reported DI is higher than the level calculated in our case 2. In Newport News the reported DI of 91 is all the more remarkable in view of the relative difficulty of desegregating this city, as indicated by the study results.

In six areas some improvement took place between the first two years listed, but the result was still relatively little desegregation:

	1970-71	1971-72	1972-73
Dallas	49	39	42
Duval County	35	51	82
Ferndale	59	69	59
Fort Wayne	47	62	63
Fort Worth	36	47	49
Mobile	44	63	61

Moreover, with the exception of Duval County there was little or no progress among these school districts from 1971-72 to 1972-73. Referring to

the Study Results columns of Table III, we see that only for Dallas and Duval County can the low levels of desegregation actually in effect be even partially explained by the difficulty these areas would have in further reducing racial isolation.

In the remaining areas there was little or no change in desegregation from 1970-71 to 1972-73. In a few, such as Pasadena, the desegregation index is high, following earlier implementation of a desegregation plan. But in fully half of the areas in which no change took place, the DIs reported for 1972-73 are 50 or less. The study results indicate that for most of these areas an assignment that would require no increase in the number of students bused could result in much higher levels of desegregation than those in effect in the 1972-73 school year.

Extension to Include Metropolitan Area

In some cities the student population is made up mostly of what is nationally a minority. In cities of this racial makeup it would be possible to achieve complete "desegregation" as defined here and yet not affect the reality of severe racial isolation. Moreover, effecting a desegregation plan in such areas can lead to flight of the remaining white student population from the public schools through transfers to private schools and changes in residence. Thus, such a plan can be counterproductive. A desegregation plan that encompasses the surrounding metropolitan area may in some cases moderate this kind of movement and still reduce the racial isolation in the center city. The study shows that in such large

areas very high levels of desegregation can be achieved without exceeding the 35-minute limit on student travel time; only in a few areas, however, was the analysis extensive enough to estimate the levels of transportation that would be required. In these areas, the results are not unlike those developed in cities and counties whose size and racial composition are similar to that of the metropolitan area as a whole. In general, however, reasonable levels of desegregation in the elementary schools under such a metropolitan area plan could be achieved only at a cost in busing and travel time that many would consider substantial.

PART TWO: THE AREA REPORTS

INTRODUCTION TO THE AREA REPORTS

Each report on an urban area examined in this study consists of a brief commentary and one or more graphs summarizing the results calculated for each case studied. This section describes the material that is reviewed in the commentary and explains the graphing method and manner of interpreting results.

Contents of the Commentary

The commentary describes the quality of the data and the effect the data quality has on the reliability of the results. The discussion includes a definition of the area(s) studied, the cases run, and the grade structure used. Finally, there is a brief review of the conclusions that can be drawn from the graph and, where appropriate, from elements in the computer outputs that are not included in this volume.

In analyses of this kind, in which the data is collected from sources other than school districts, it is obvious that the data describing some areas will be subject to larger errors than the data for others. The element in the analysis that is most often found to be in error is the file used to represent the population of school age. The basic gauge for evaluating the quality of the census-based population file is the Directory for 1970-71 school year issued by the Office for Civil Rights, which lists the majority-minority proportions as reported to OCR by each district. Typically, the text compares the percent majority as employed in the study's files with the percent majority as reported in the Directory, and then comments on the degree of agreement or disagreement.

Some of the disagreement derives, of course, from differences in the areas covered by the two sources. To prepare data for use in the Lambda system, a set of mutually consistent files must be constructed that reflect the student population, the road network, and the location and capacity of schools. The population file is taken from census information, and the area to be analyzed is necessarily one of the many possible areas that can be defined with census data. Judgments therefore were made as to which of the census definitions best suited the area being examined, and these judgments are explicitly reflected in the commentary.

An additional source of disagreement is the inherent difference between census files and school files. First-Count census files report on the age and race of children, not on whether they attend public schools or not. Thus, corrections had to be made to census files used in this survey to reflect enrollment of children of school age in private or parochial schools. These corrections were quite large for some areas. Usually, the numbers of dropouts can be fairly well predicted, particularly since this phenomenon occurs primarily in the senior high schools. Large discrepancies therefore tend to indicate that the private and parochial school enrollment is considerably greater than could be expected. In subsequent studies using the basic Lambda assignment system it has been possible to employ the more recently released Fourth-Count census data, which makes it possible to prepare population files that take into account private school attendance and dropouts.

In certain areas where Negroes are only one of several minorities of significant proportions, a different kind of problem arises. Even though the study's population file might agree with information in the OCR Directory as to the proportion of all minorities grouped together, it is clear that failure to distinguish among the minority groups is a weakness in the analysis. It is possible--and even probable, considering residential patterns--for an assignment to desegregate schools in accordance with the definitions and yet to have many schools identifiable as white and black and others as, for example, white and Spanish-surnamed. This may or may not be considered satisfactory, but the present system does not indicate where such differences occur. Again, the Fourth-Count census files now make it possible to create population files that provide a better picture of the real distribution of various minorities in an area.

The transportation files used for the study were derived from information provided by regional transportation planning councils in the areas concerned. Although this data came from many sources, and although the councils revise their files at different times, a relatively high degree of reliance can be placed on their validity. The commentary text indicates the date of last revision, the method used for estimating rush-hour speeds, and the "density" of the network. (The density of a network is the number of intersections per mile as represented in the file.) In general the higher the density the more reliable and useful is the file for the kind of transportation planning involved in this survey, but this general rule has exceptions; for example, in some applications a density of 10

may be sufficient, and the fact that the density happens to be 30 intersections per mile is largely irrelevant.

The reader who is interested in more detail about the data employed in analyzing specific areas is referred to another volume in this series, Report on Validation.

Graph of Achievable Desegregation

This graph, which follows immediately after the commentary, is constructed from the computer outputs for the cases studied. There is at least one graph for each area; for areas for which both a center-city and a metropolitan area were defined, the metropolitan area graph is displayed only if the cases run provided meaningful information.

The shape of the graphed curves, and the interpretation that can be given to them, will of course depend on the cases analyzed. We begin here with a graph constructed from a typical set of cases and progress to others based on unusual combinations.

For each grade level--usually three, but sometimes two--we plot the relationship between the level of desegregation and the level of busing. For any specific assignment of students to schools we can plot a point on this chart showing the number of students bused and the level of desegregation achieved. Typically, a single "case" will be displayed with three points, one for each grade level--elementary, junior high and senior high. If several cases are run, corresponding to different levels of desegregation, then a series of points can be

generated for each grade level from which it is possible to draw a curve of desegregation achieved versus amount of busing used. Thus, the curve for each grade level is based on several data points obtained from the computer outputs for different cases. (A full description of the printouts is contained in the introductory section of volumes entitled Supporting Material.) After we have plotted the data points for all cases produced for the area the graph would usually appear as follows:

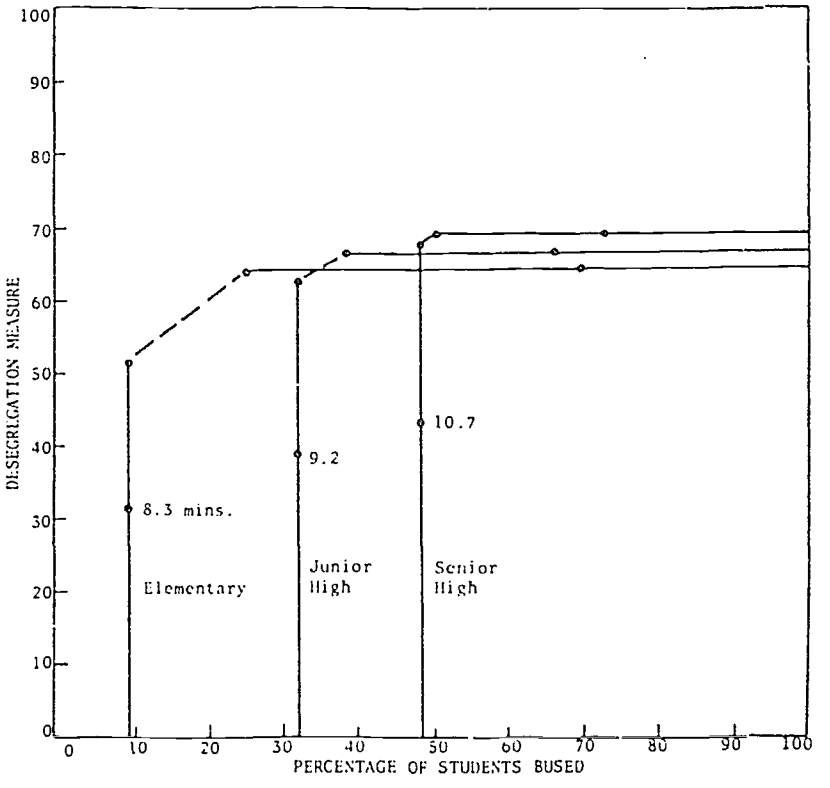


Figure 7.

For this hypothetical area we examined cases 1, 2, 5, and 6. Cases are numbered beginning from the lower left-hand portion of the curves. This graph depicts most of the features that should be understood to be able to interpret graphs in the actual reports, and it is of some value to describe them in detail.

Note first that a solid line is drawn vertically from case 2 down through case 1 to the bottom of the graph. The solid line is used here and elsewhere on graphs to indicate the "sureness" of a result. The case 1 data point for elementary schools should be read as "if we assign elementary school children so that no one rides a bus who lives within one mile of an appropriate school (if it has space) and so that anyone who must ride a bus is assigned to the nearest appropriate school that has capacity, the Desegregation Measure attained is 32 percent, 9 percent of the children have to be bused because of distance from school, and the average bus ride is 8.3 minutes."

The case 2 data point for elementary schools must, by the definition of case 2, be somewhere on the vertical line established by case 1, but the Desegregation Measure is usually higher, and frequently much higher than that of case 1. The reason is that, once it is determined how many students must be bused because they live too far away from school, the computer program seeks to assign them to schools so as to reduce racial isolation. In case 2, as in case 1, no students are placed on buses who could walk; but in case 2 the buses may be redirected to different schools.

Next to each of the case 1 data points there is a number, representing the average travel time. In almost all applications of case 1 the computer program was directed to minimize average travel distances and times. For most areas, the travel times were not explicitly minimized for other than case 1 and are not presented on the graph. For a number of the areas analyzed in later stages of the survey all cases included explicit minimization of travel distance (as well as minimization of walking distance), and on the graphs for those areas the times will appear for all cases. The data points for a case 2 in which travel distances are minimized will be lower -- will provide less desegregation -- than a case 2 in which the computer program can bus children longer distances with no constraint other than the standard 35-minute maximum always employed in the survey.

Turning to the horizontal lines connecting cases 5 and 6 for each grade level, we note that they are also solid. This is because both of these cases provide complete desegregation, a fact which is not evident from information on the graph and that requires verification from the computer outputs. This graph is drawn on a hypothetical analysis but it is typical of actual results in that case 6 provides no more desegregation than case 5, even though case 5 is not permitted to bus indiscriminately simply for the sake of reducing racial isolation. This is to say that, for almost all areas studied, the horizontal line could have been determined through a case 5 analysis without case 6. (Indeed, in analyses conducted in the latter stages of the survey, case 6 was not run for this reason.)

This occurs not because of any characteristics of the method or the mathematics, but arises empirically. In metropolitan area analyses case 5 more than occasionally does not provide complete desegregation.

The curves for each of the three grade levels reach their maximum at different levels of the Desegregation Measure. This reflects the different racial compositions of these age groups. In most areas, the dropout rate for minority students increases in the upper grade levels; the higher resulting fraction of majority students implies that full desegregation would result in a higher Desegregation Measure for the high schools than for the lower grades in which minority enrollment is less affected by dropouts.

In this example, and in actual analyses as well, the level of busing in case 6 is very much in excess of that in case 5. This does not at all mean that this level of busing is needed for complete desegregation; case 5 meets that goal with much less busing. These high levels of busing are simply the result of instructing the computer to desegregate and to do so without constraining itself by limiting the number of students bused. The data point for case 6 is plotted in graphs for center-city analyses merely to confirm graphically that the horizontal line represents complete desegregation, but the reader is cautioned that the specific busing level in this case is meaningless.

The critical portion of the curve is the range between cases 2 and 5. In the sample graph, and in the graphs for most areas examined, we simply draw a dashed line between the two data points. The dashed line represents a lower

bound for the results of any cases intermediate between cases 2 and 5; if such cases were actually run their results would fall either on that line or, more probably, above it. An upper bound for results in this range can also be calculated, so that it is possible to depict the entire area of possible results, which we will refer to as the area of uncertainty. For the hypothetical district we repeat in Figure 8 the preceding graph except that, for elementary schools, the area defined by these upper and lower bounds is shown. Obviously this area presentation offers an impression which can be quite different from that given with the lower bound alone. In the area reports in Part Two, when the range between cases 2 and 5 is quite large, and thus when the lower bound alone might be misleading, we have shown on the graph the area of uncertainty rather than merely the lower bound.

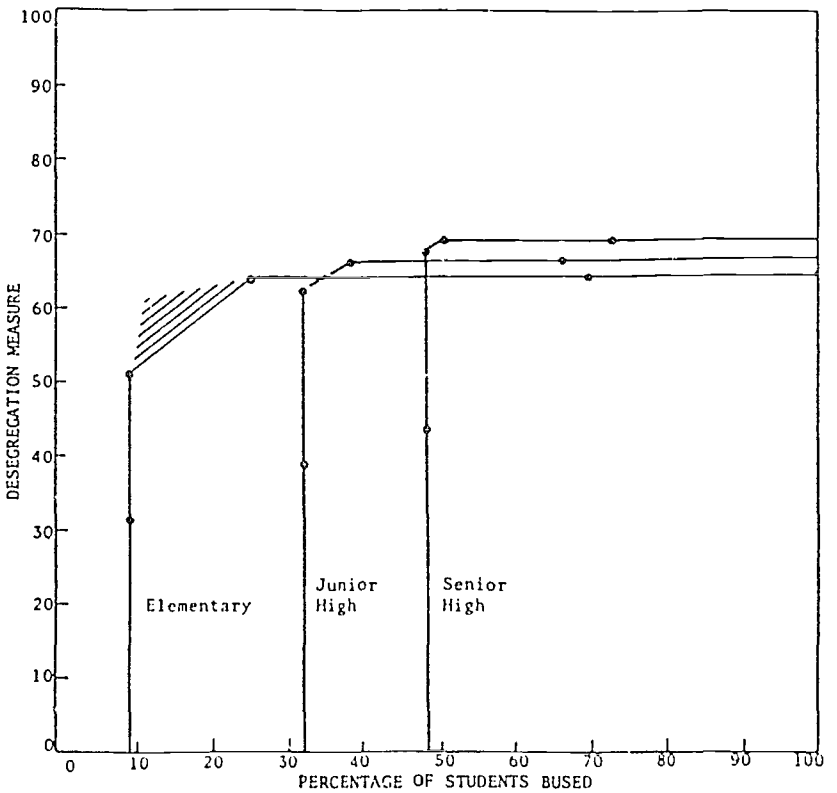


Figure 8

To obtain a sense of where the results for intermediate cases might fall, if they were actually produced, the graph for Toledo is reproduced here in Figure 9. A sufficiently full range of cases was produced for Toledo for us to feel justified in connecting their data points with solid lines. For reference, we show the area of uncertainty that would be calculated if only cases 2 and 5 were available. Of course, it cannot be ascertained without actually running the intermediate cases whether or not the results for other areas would be as far above the lower bound line as they are in Toledo.

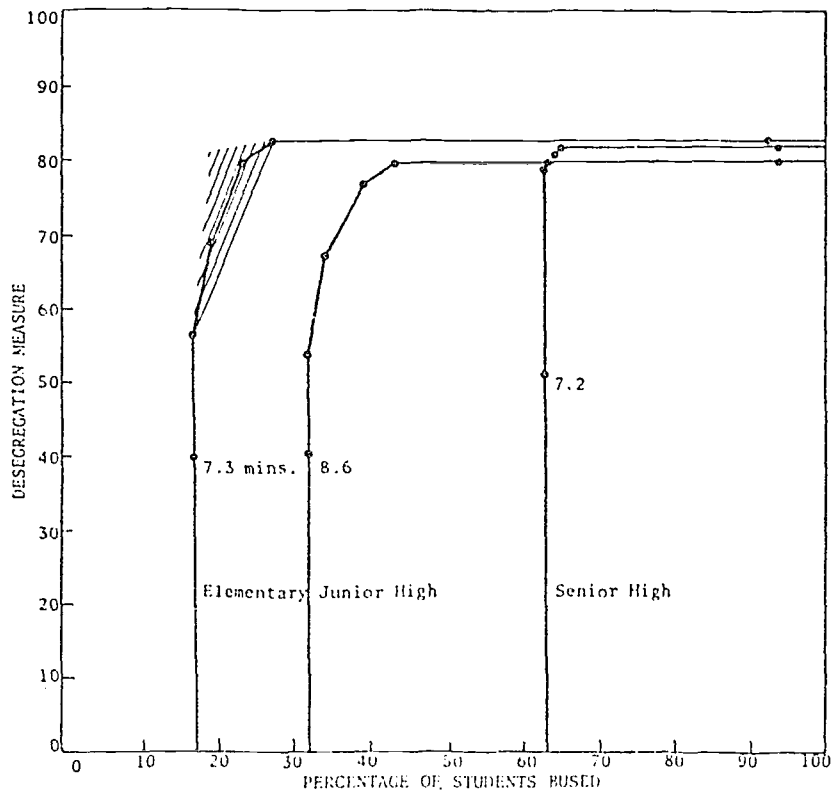


Figure 9. Toledo, Ohio

For metropolitan areas for which only case 6 was run, no graph is presented, not only because it is a single point but also because the levels of busing calculated are always much higher than necessary to desegregate the area. A more helpful set of cases for metropolitan areas is cases 1 and 5. When case 5 produces complete desegregation -- it does not always do so for metropolitan areas -- the graph appears as in Figure 10.

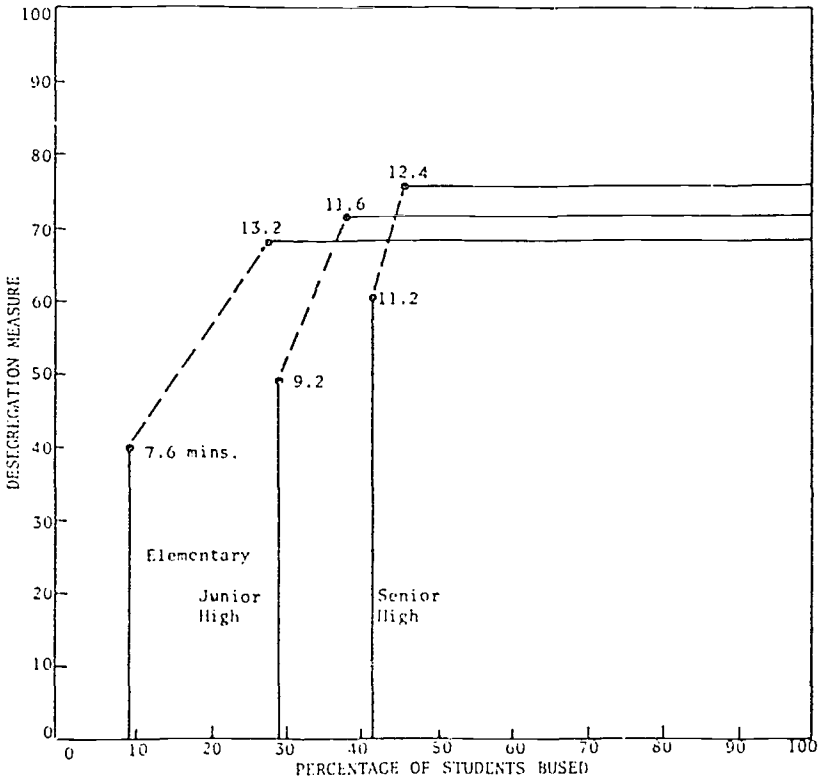


Figure 10.

In this figure case 1 defines, as usual, the minimum level of transportation and case 5 defines full desegregation. The area of uncertainty is shown for the elementary school level. It is obvious that, although there are only two data points for each grade level, the curves do present meaningful and useful information.

For metropolitan areas in which case 5 does not produce complete desegregation there is every reason to believe that case 6 would not do so either. Thus even where case 6 was not run (for example, Chicago) it is probably justified to assume that no significant additional desegregation is possible without violating the 35-minute travel limit.

Finally, a word of caution in interpreting results from the graphs (or from the computer outputs separately published). The computer calculations are expressed in fine detail--for example, desegregation measures as .416 and students bused as 14.963 percent. Given the uncertainties described above in the data, it is of course ridiculous to retain this fineness of detail, or to consider interpreting the graphs as though the data points have a meaning that can be expressed with such precision. The reader should regard the shape of curves more important than the numerical values; indeed, although improved data could and probably would change the numbers, it would probably not change significantly the shape of the curve. In essence the shape sheds light on the relative balance, or tradeoff, between busing and desegregation objectives, and it is with this function that the reader should be most concerned.

Atlanta, Georgia

Atlanta City is served by the Atlanta City School District, which is co-terminous with the city. Atlanta itself consists of Atlanta Division of DeKalb County and Atlanta Division of Fulton County. The central city cases in this study dealt with the 153 schools in that area. The urbanized area extends through parts of Clayton, DeKalb, Fulton, Garnett, and Cobb Counties; the definition used for the metropolitan cases included the entire urbanized area, except for a small portion in Cobb County. These areas are served by county school systems, in addition to independent city systems in Atlanta and Decatur. A total of 173 schools, in addition to the 153 in Atlanta, were included in the metropolitan area. The table lists the composition of this area by county and county division.

Areas included in the Atlanta Metropolitan Area

County	Division
Clayton	College Park
Clayton	Forest Park
Clayton	Jonesboro
Clayton	Morrow
Clayton	Riverdale
De Kalb	Atlanta
De Kalb	Avondale Estates-Belvedere
De Kalb	Candler-Glenwood
De Kalb	Chamblee-Doraville
De Kalb	Clarkston
De Kalb	Decatur
De Kalb	Druid Hills-North Decatur
De Kalb	North Druid Hills
De Kalb	Scottsdale
De Kalb	Stone Mountain
De Kalb	Tucker
Fulton	Atlanta
Fulton	Campbellton
Fulton	College Park
Fulton	East Point
Fulton	Fairburn-Union
Fulton	Hopeville
Fulton	Sandy Springs
Gwinett	Norcross

The overall majority population ratios for center city and metropolitan areas in the files used in this study were 37.0 percent and 67.4 percent respectively. The OCR register of schools for 1970-71 lists majority enrollment in Atlanta City as 31.3 percent, so that the majority is somewhat over-represented in the school population data used in the study. This is probably due to an underestimate of the number of white students who attend private and parochial schools. The minority population consists almost entirely of black people; the OCR register lists only 29 students of other minorities.

The transportation network was last revised in 1970 and lists peak travel times, so that the times listed in the tabular reports are possibly overestimated. (The average speed on the routes selected is about 20 mph.) The average intersection density over the whole area of about 174 square miles is about 21 per square mile, so that these intersections are, on the average, about .2 to .25 miles apart, and much closer in the city itself. The transportation data must be considered as very good in quality.

The Atlanta City School System is unusual in that schools are predominantly of only two grade ranges. Elementary schools extend through the seventh grade, while high schools serve grades 8 through 12. Thus instead of the usual three curves depicting desegregation by grade group, there are only two, representing elementary and secondary groups as they exist in the system.

Cases 1, 2, 5, and 6 were run for Atlanta City, and cases 5 and 6 were run for the metropolitan area. Only in case 1 for the center-city analysis and

case 5 for the metropolitan area analysis were travel distances minimized, and thus the travel times and distances for other cases are exaggerations of what might actually be achieved.

In relation to cities of similar size and racial composition, Atlanta elementary schools require a relatively greater increase in busing to increase desegregation to a point close to the maximum achievable: Extensive desegregation (case 5) requires transporting 38 percent elementary students, compared with 16 percent in case 2, in which students walk to school if this is possible. It is quite possible that an assignment could be defined between cases 2 and 5 which, although producing somewhat less desegregation than that in case 5, would require only slightly more busing than the minimum produced in case 2. The area in which the results of any such intermediate cases would lie is indicated by the shaded area on the graph.

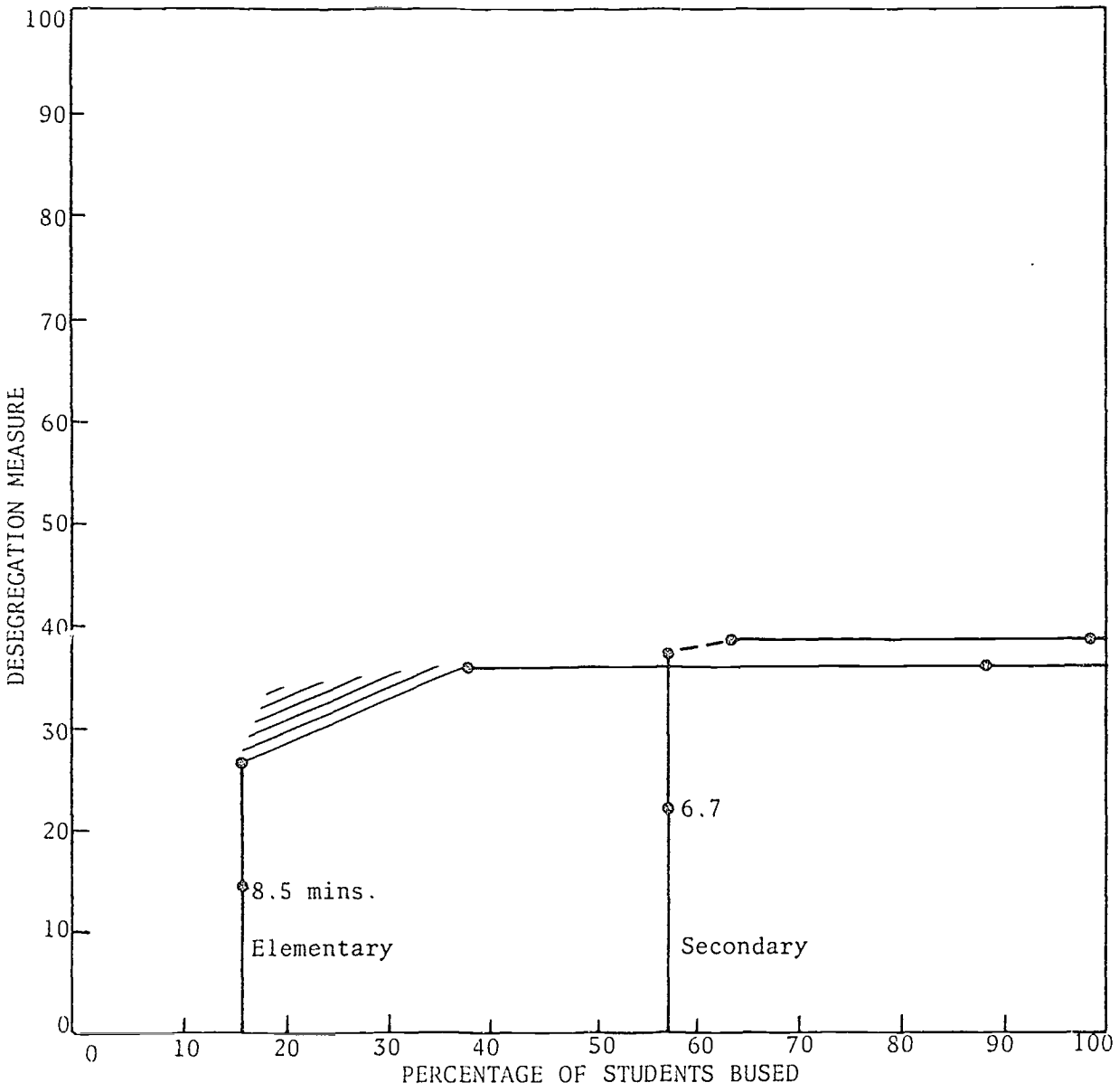
As for most other cities examined, the effect is not so strong for secondary schools: Some 63 percent would have to be bused to obtain complete desegregation, compared with the minimum of 57 percent calculated for case 2. Indeed, the desegregation achieved in case 2 is 98 percent of the maximum possible.

The metropolitan area analysis indicates that complete desegregation is achievable in the urbanized area. Since no attempt was made in the case 6 analysis to minimize the number of students bused, the results are of technical interest only. In a case 5 metropolitan area analysis, nearly complete desegregation is achieved at levels of busing that are more reasonable than those produced

in case 6. The average travel times in metropolitan case 5 are high enough, however, to suggest that substantial increases in average travel time would probably be required to achieve effective desegregation for either the center city or the metropolitan area. Additional analyses would be required to determine the range of practical alternatives for desegregation of the metropolitan area.

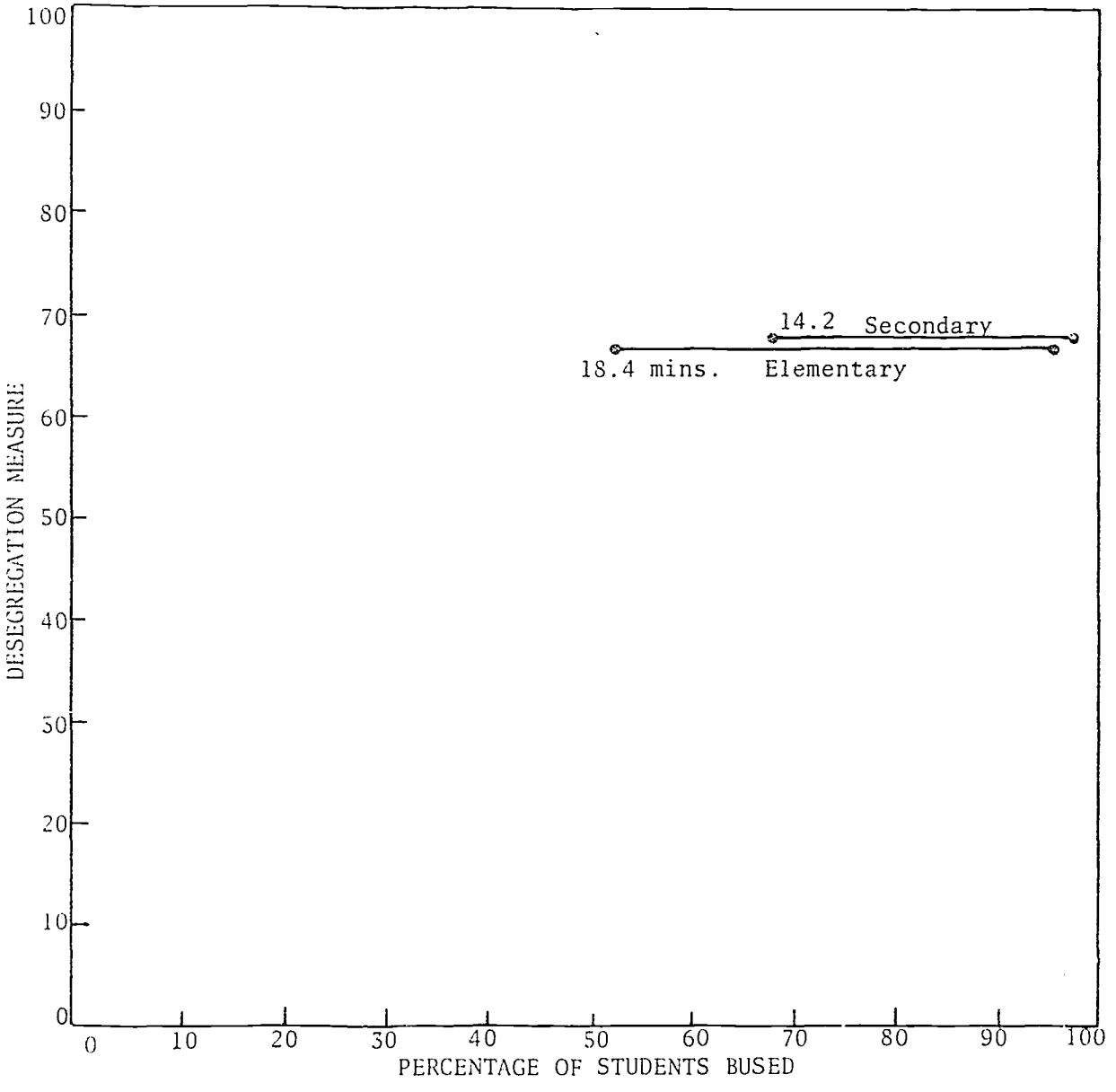
It should be noted that in many school districts the burden of busing falls on the minority students. In Atlanta, by contrast, the percentage of majority children requiring transportation in the cases studied here is greater than the percentage of minority children bused. This obviously results from the racial composition of the city; since what we refer to as "majority" students are actually a minority here, desegregation can be effected only by transferring more than the proportionate number of "majority" students. The situation in the metropolitan area is more like the typical result in this regard.

For the cases analyzed for Atlanta, travel times and distances as reported in the computer outputs are not shown on the graph, except for case 1. The travel times for case 1, the "colorblind neighborhood" assignment, are meaningful. In order to see the degree of increase, if any, in travel time as desegregation goals are set higher, additional cases would have to be analyzed in which the travel time is specifically minimized.



Graph of Achievable Desegregation

Atlanta, Georgia
Center-City Analysis



Graph of Achievable Desegregation

Atlanta, Georgia
Metropolitan Area Analysis

Birmingham, Alabama

The city is served principally by the Birmingham City School District, although the Jefferson County System also maintains a few schools in the city. The central city cases in the study deal with Birmingham City, and thus approximately with the Birmingham City School District. The metropolitan area was defined as Jefferson County; its schools are organized into a large county system, a system in Bessemer City, several small systems, and, of course, the Birmingham City System, constituting altogether a total of 240 schools. The table below indicates a breakdown of schools by district number and county division.

Jefferson County Schools by MCD and District Number

		District Number						
MCD		1920	330	390	1440	1140	2490	3270
10	Bessemer Division	6	15					
15	Birmingham Division	8		96				
35	Dolomite Division	2	1					
40	Fairfield Division				8	1		
80	Lipscomb Division	4		1				
90	Mountain Brook Division						5	
125	Tarrant City Division	5		1				3
	Others	82						
		107	16	98	8	1	5	3

The population data used in the study states majority students in Birmingham as 48.9 percent of the total student population, compared to data from the Office for Civil Rights reflecting a 45.4 percent majority enrollment in 1970-71 in the

school district. The match is actually better than it at first seems because about 6,000 of the population of Birmingham, presumably strongly majority, attend the County school system, and are included in the study's definition of the center city. The minority population is nearly all Negro.

The transportation files were last revised in 1965. The intersection density is about 21 per square mile, sufficiently dense for quite good accuracy. The speeds are ADT (Average Daily Travel) times, as modified by computer runs which adjust the speeds for the effect of capacity constraints on the transportation links. The quality of the data is to be considered good.

Birmingham City Schools are in two grade groups -- 1 - 8 and 9 - 12 -- while the County has a mixed system. The assignment runs produced in this analysis recognized three groups: 1 - 6, 7 - 9, and 10 - 12.

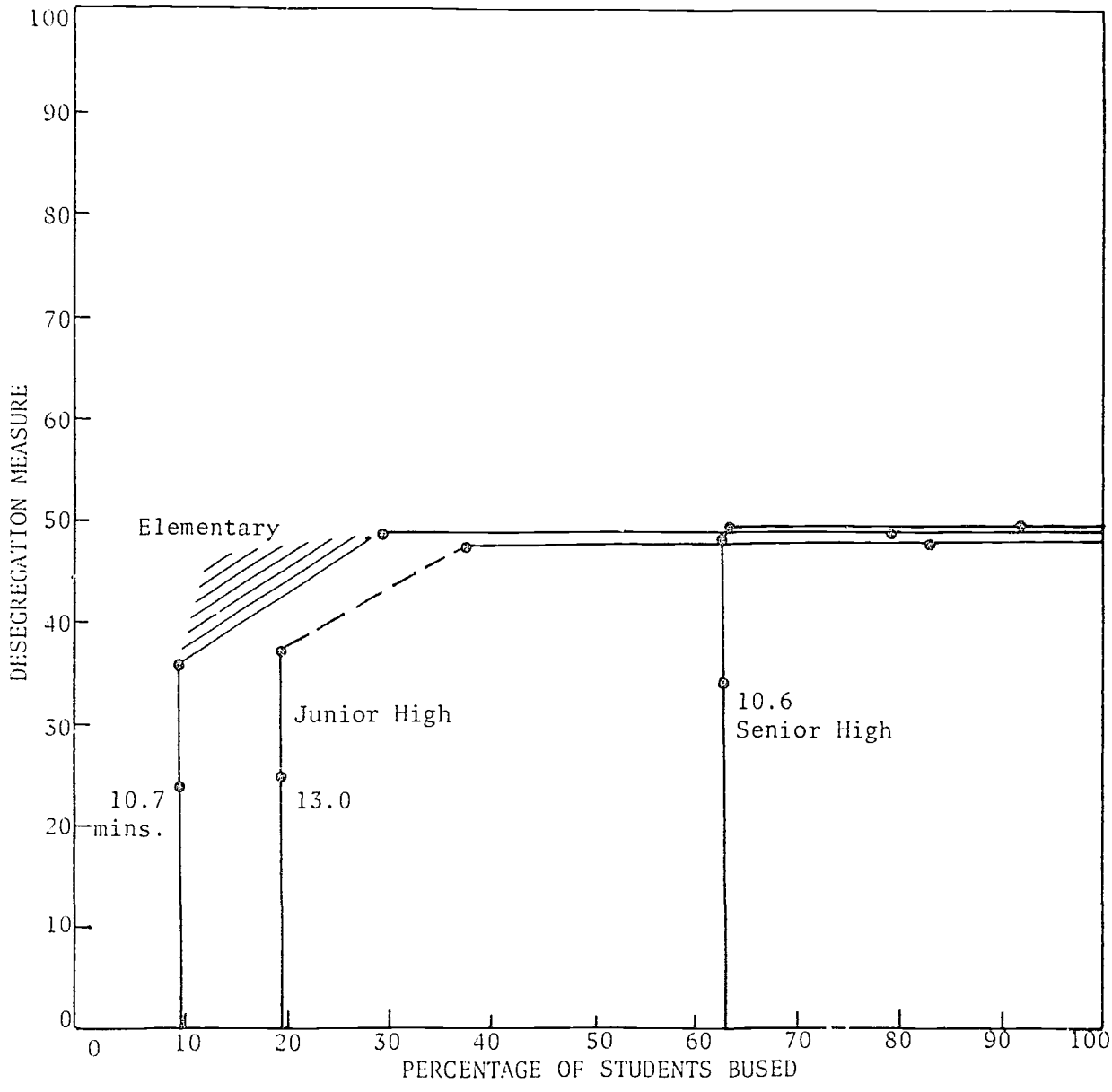
Cases 1, 2, 5, and 6 were analyzed for Birmingham City, and cases 5 and 6 were analyzed for the metropolitan area. Only in case 1 for the city and case 5 for the metropolitan area is any meaning to be attached to travel times and distances. In the other cases, only the 35-minute limit on travel time was applied.

In the City of Birmingham, complete desegregation of the elementary and junior high schools would require considerably more busing than is required in the minimum-transportation analysis (case 2). In elementary schools, complete desegregation would require busing some 30 percent of the students, compared with the minimum 9 percent, required to transport those children who are not within walking distance of an appropriate school. In the junior high schools,

37 percent must be bused, compared with 19 percent in the minimum-transportation case. These are large differences (although some increase is to be expected in elemenuary grades). For this reason, it would be desirable to run additional analyses between cases 2 and 5 to determine a better balance between desegregation goals and busing requirements for these schools. To indicate where such a balance might occur, we have indicated on the graph the "area of uncertainty" for elementary schools, that is, the area in which the results of such assignments must lie.

In the city's senior high schools, no such area of uncertainty need be drawn. The results of case 2, a minimum-transportation case, and of case 5, a desegregation case, are almost identical, indicating that complete desegregation of these schools could be obtained with virtually no busing other than that required simply to get all children to school. At the time this analysis was performed, however, the senior high schools were reported to have been far from racial balance: Parker High, for example, with no blacks in an enrollment of 1783 students, Huffman High with only 13 whites in an enrollment of 1469.

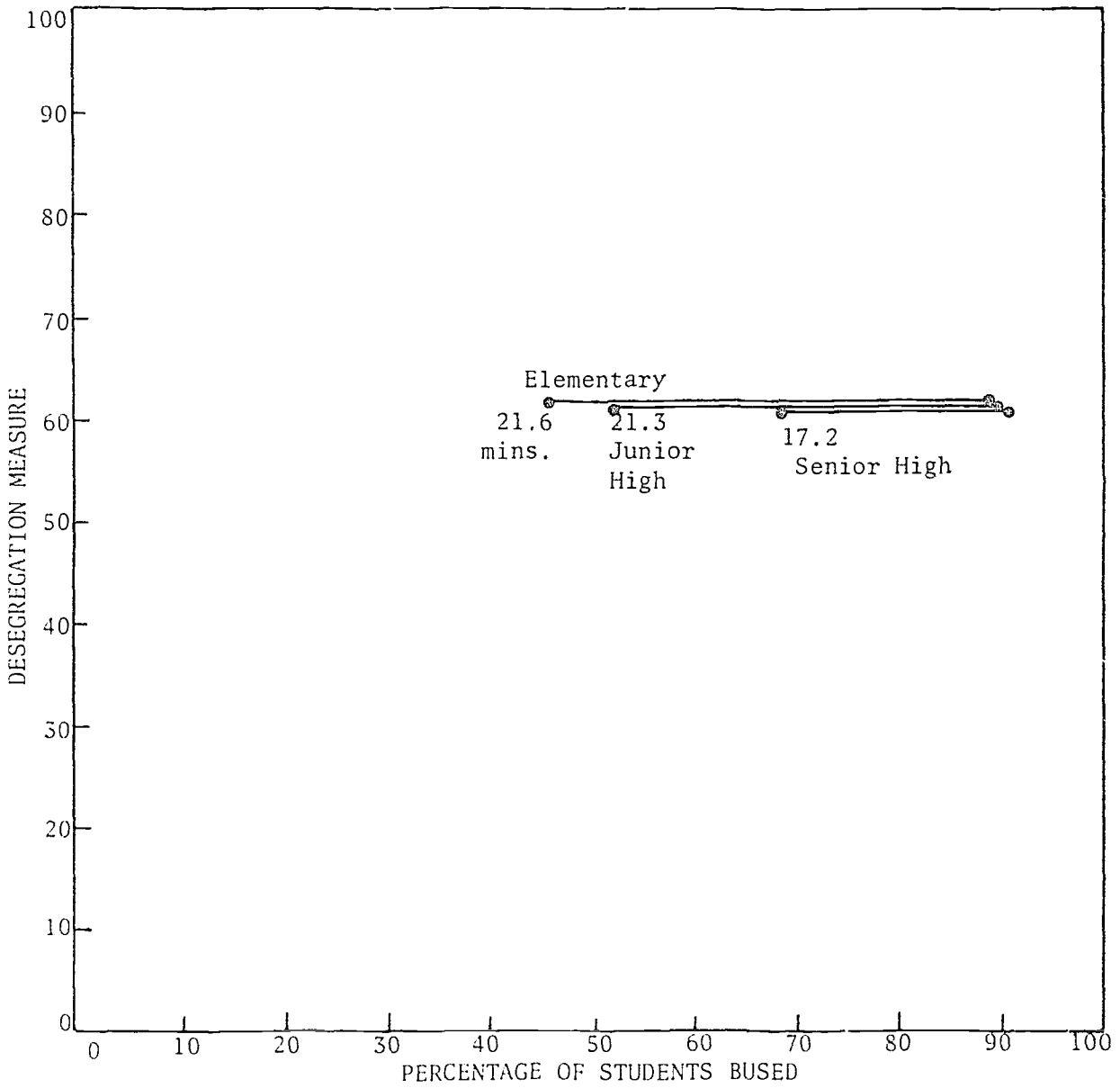
For the metropolitan area, the analysis is not sufficient to determine a full range of desegregation alternatives. Results for the metropolitan case 5 analysis indicate, however, that travel times would be relatively high -- and in turn suggest that travel times in the center-city analysis might also be quite high.



Graph of Achievable Desegregation

Birmingham, Alabama

Center-City Analysis



Graph of Achievable Desegregation

Birmingham, Alabama

Metropolitan Area Analysis

Boston, Massachusetts

The Boston center-city analysis used the city of Boston itself as the area of study; the Boston Public School system serves precisely that area.

The Boston metropolitan area was defined as those cities and towns lying within the circumferential highway Route 128, including:

Arlington	Watertown
Belmont	Winchester
Cambridge	Woburn
Everett	Dedham
Lexington	Milton
Medford	Quincy
Melrose	Boston
Newton	Chelsea
Somerville	Revere
Stoneham	Winthrop
Wakefield	

About 525 schools are included in the metropolitan area, some 177 of which are in the city of Boston.

The population file used in this study lists 66.5 percent majority students, compared with 64.1 percent reported by the school district to HEW. This is quite good agreement, much better than average for large cities. The minority includes 4.2 percent Spanish-surnamed students and 1.7 percent Oriental students.

The transportation file was last updated in 1971 and includes peak hour speeds (a critical factor in Boston, where rush hour times differ substantially from off-peak times). The file is of high density and covers the area of interest very adequately.

The grade-level organization in Boston schools is complex. For this survey the results are reported on the basis of junior-high-school organization: 1-6/7-9/10-12.

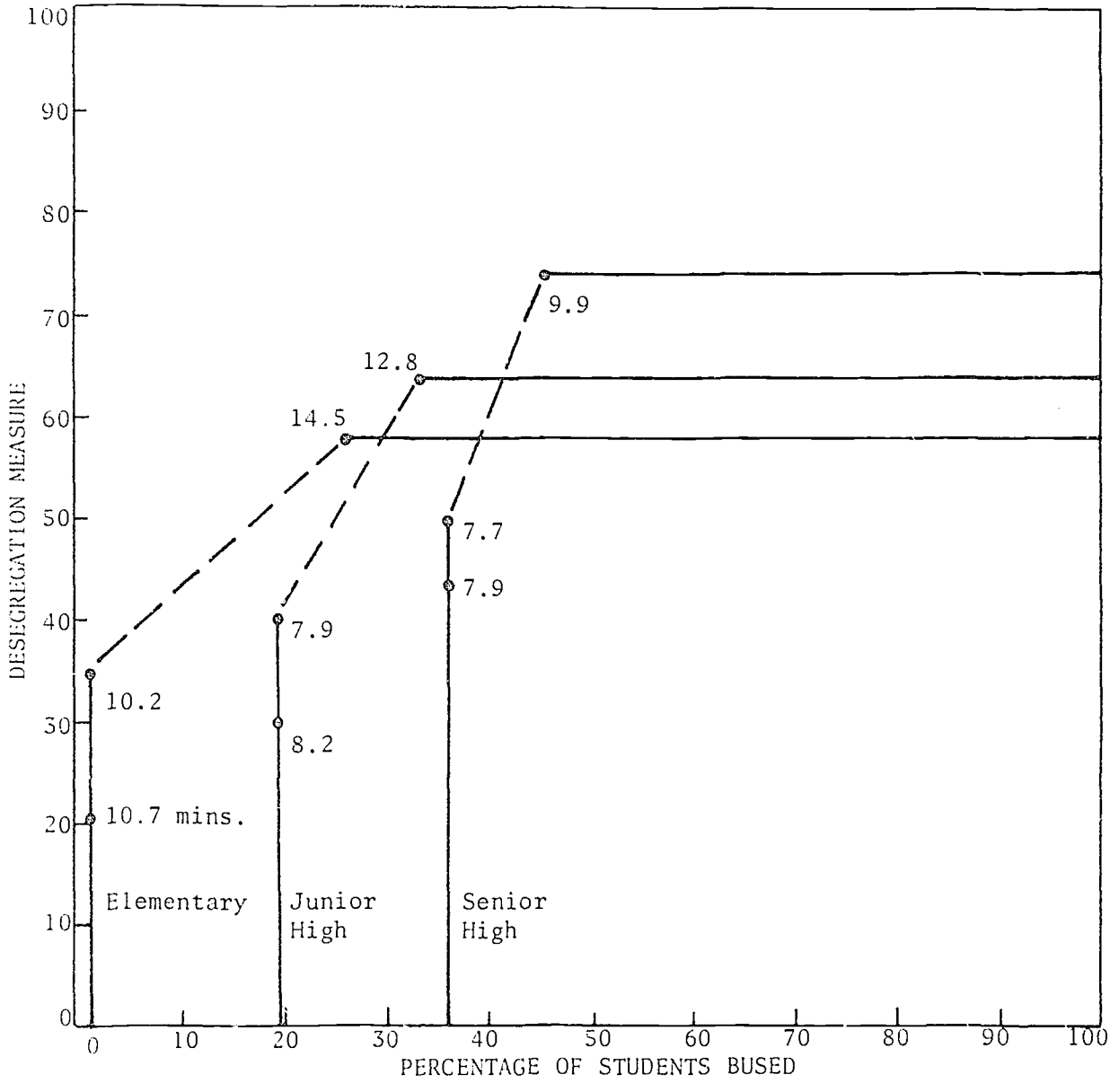
For the center-city analysis, cases 1, 2, and 5 were run. For the metropolitan area analysis, cases 1 and 5 were run. In all cases all transportation parameters were minimized, so that the resultant times and distances in the computer outputs can be regarded as reasonable indications of what could be achieved.

In Boston itself the results are quite different from those of the typical city examined in this survey, although they are not unlike the results obtained for a few cities like Philadelphia. First, the levels of desegregation attained in case 2 -- a minimum-transportation analysis -- are quite low at all grade levels, even in the senior high schools. Case 5 produces in Boston, as it does in almost all districts studied, virtually complete desegregation, but the increase over case 2 in terms of students bused is relatively large, again even in the senior high schools. The increase is largest for elementary schools; less than 2 percent of these students would have to be bused in the minimum-transportation assignment, compared with 26 percent to achieve case 5. As can be noticed from the graph, the travel times represent a significant increase over the times in case 2 although they are still moderate in absolute time.

In the metropolitan area, as in Boston itself, the level of desegregation achieved in a minimum-transportation case is extremely low. In this instance,

however, the minimum-transportation assignment is a "colorblind" one, in which desegregation is not an objective. If the analysis included a run of case 2 -- a minimum-transportation assignment in which those students who must be bused are assigned in such a way as to reduce racial isolation -- the desegregation level attained would be much higher than in case 1. In any event, compared with the center city, a relatively smaller percentage increase in students bused is required to attain (in case 5) more than 95 percent of complete desegregation. The horizontal lines on the graph indicated are drawn at the full desegregation level; the dashed lines from each case 5 data point to the horizontal line reflect the fact that we have not calculated how much additional busing would be required to close this small gap. Indeed, it is quite likely that the gap could not be closed unless the 35-minute travel limit were relaxed. It should be noted that travel times increase significantly for elementary and junior high schools.

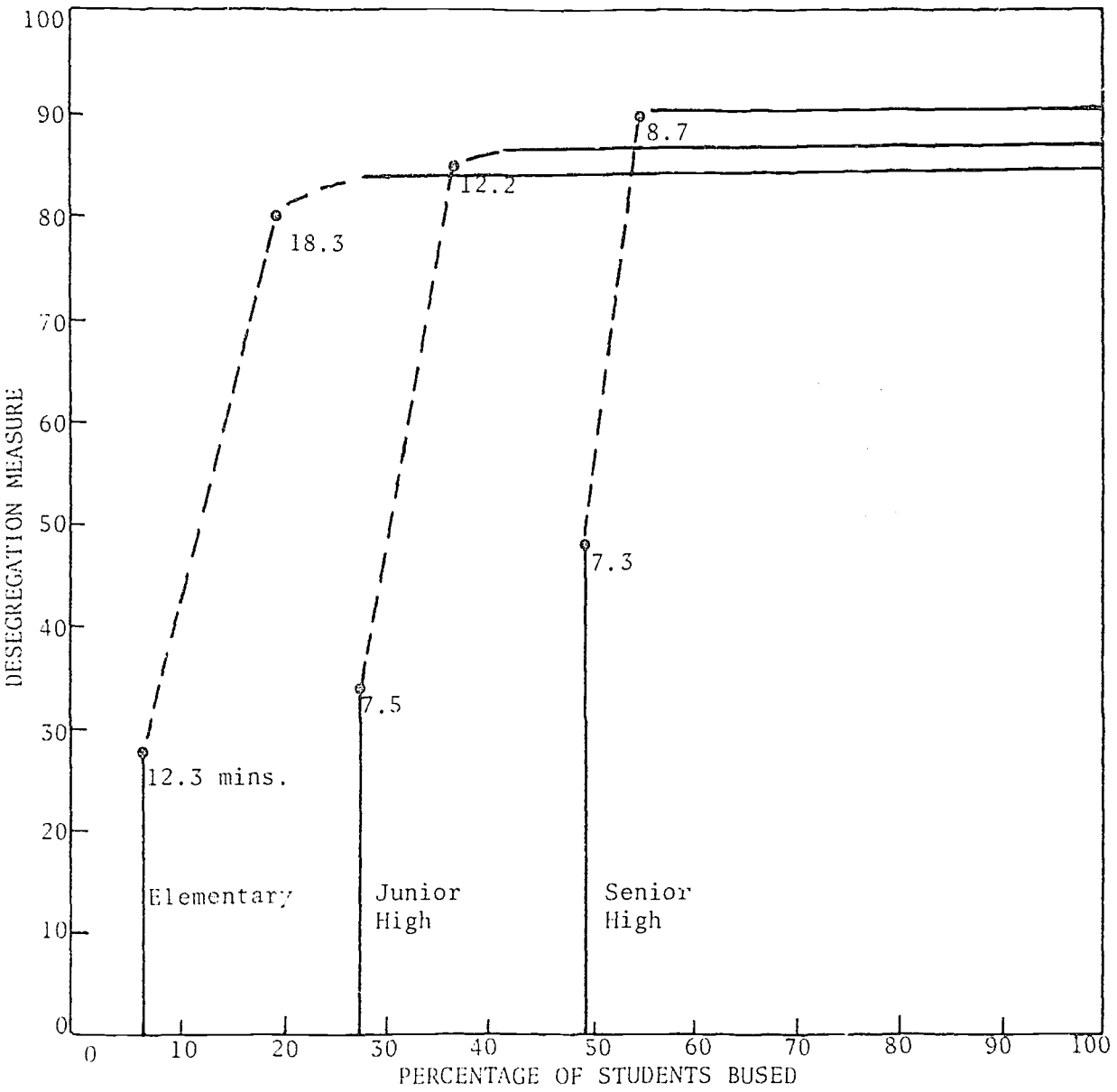
The Boston central city was the subject of a separate study, more intensive and more accurate than was called for in this survey. That study is discussed in the Lambda report Feasibility of School Desegregation, Boston City Schools: Preliminary Analysis, September 8, 1972.



Graph of Achievable Desegregation

Boston, Massachusetts

Center-City Analysis



Graph of Achievable Desegregation

Boston, Massachusetts

Metropolitan Analysis

Broward County, Florida

Broward County, which includes the city of Fort Lauderdale, was a single county school system, so that metropolitan and central city cases were not differentiated, and the county was run as a whole for all cases.

The school population file contained 77.2 percent majority students, while the OCR file lists 74.9 percent. Only a small part, 1.6 percent, is Spanish-surnamed. The overall quality of the demographics is very good.

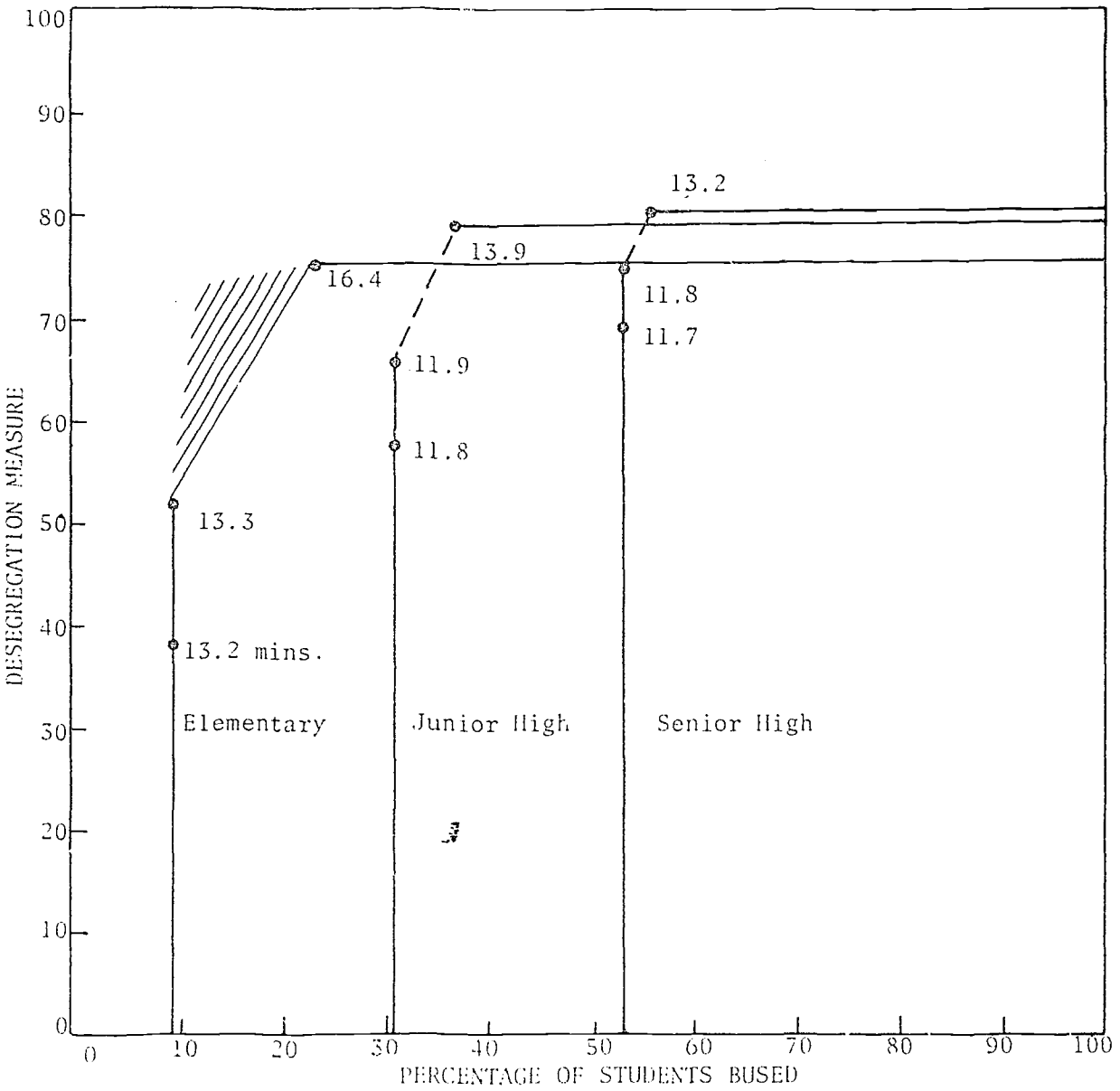
The transportation file was last revised in 1965 and contains peak season speeds, when tourist traffic is heavy. The intersection density is quite high, at 42 per square mile, but only 37 square miles surrounding Fort Lauderdale are included. Thus those students who live well west of Fort Lauderdale must, according to the model, travel in a straight line at 15 mph until they reach the coded road network. In fact, however, the area involved is in the Everglades and the only settlement marked on the Rand McNally Road Atlas is Andytown, which is about 10 miles outside the network. We do not feel that any significant error is introduced by this small coverage of the road network.

For Broward County, cases 1, 2, and 5 were run. Both travel times and distances were minimized, together with numbers of students bused. Thus the travel times indicated on the graph and on the computer outputs are considered to be reasonable estimates of what would be required in an actual plan.

Extensive desegregation of the upper grade levels can be achieved with little additional busing. Desegregation of elementary schools, in contrast,

requires significant busing in addition to the levels required simply to get all children to school -- 24 percent in case 5, compared with 10 percent in case 2. Other assignments could be produced in which substantial reductions could be achieved at the expense of a modest reduction in desegregation goals. The shading in the graph shows the area in which such intermediate assignments between cases 2 and 5 would lie.

Generally, busing for desegregation purposes will place a greater transportation burden on the minority students. Broward County is a classic instance of this phenomenon. In case 2 -- in which as many children as possible are assigned to schools within walking distance but the children who are bused are assigned in such a way that desegregation is increased -- 11 percent of white elementary school children are bused, and only 6 percent of the minority children are bused (although it should be noted that the minority students travel somewhat longer distances and times). In the case 5 desegregation case, in which considerable busing is accepted if it contributes sufficiently to desegregation, only 17 percent of the majority students in elementary school are bused, while 44 percent of the minority students are bused; the average busing time for the minority students increases to 45 percent from 8 percent in case 2. In the junior high and senior high schools, the relative situation is even worse: the percentages of majority bused remain about the same in case 5 as they were in case 2, while the minority students' busing increases dramatically.



Graph of Achievable Desegregation

Broward County, Florida

Charleston, West Virginia

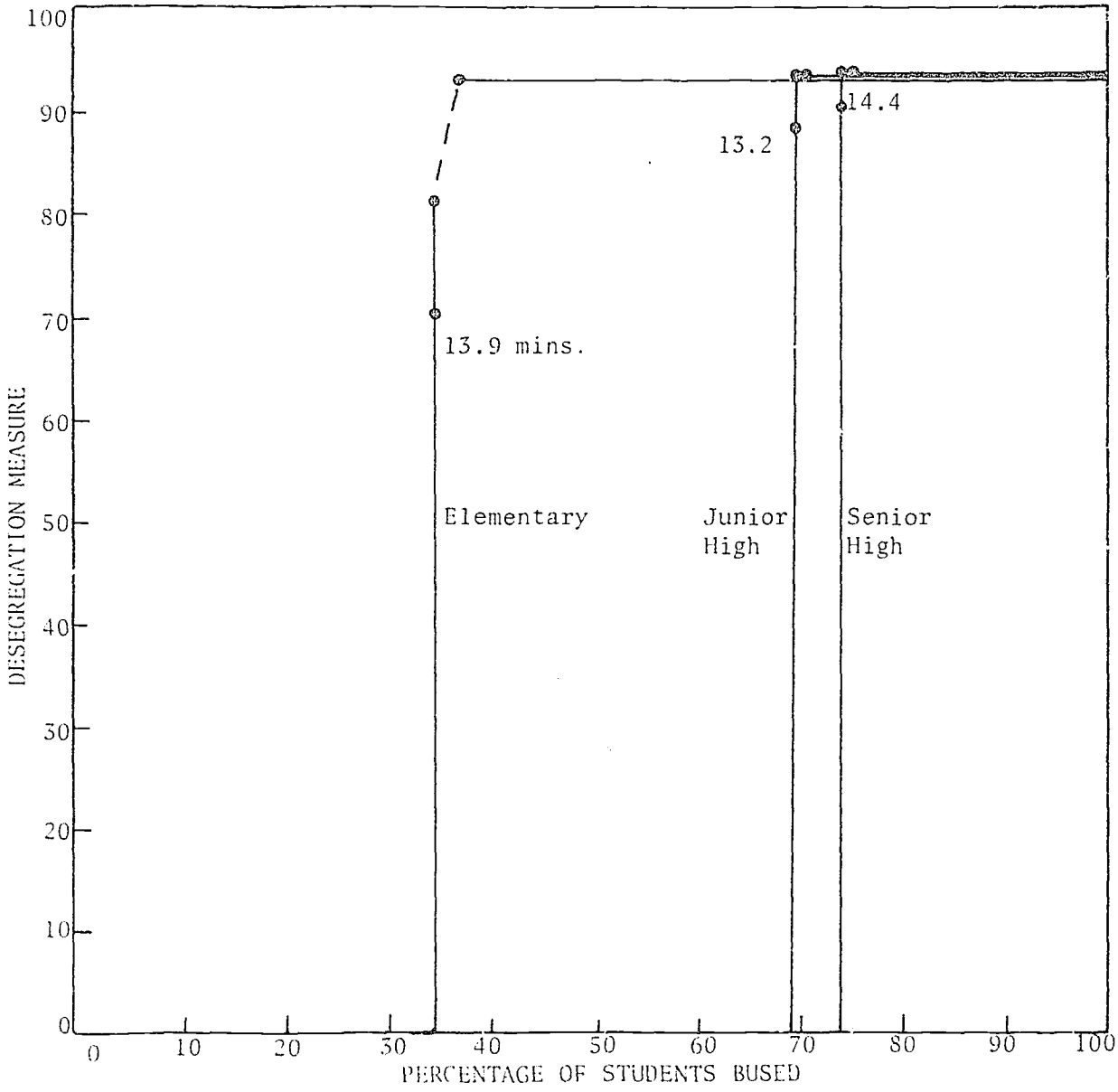
The City of Charleston and the entirety of Kanawha County are served by one system, the Kanawha County school system. Thus it was not meaningful to define both a center city and a metropolitan case and only one area was used -- Kanawha County.

The racial minority in Kanawha is nearly entirely black and comprises 6.7 percent of the school enrollment according to the Directory of the Office for Civil Rights. The school population file used also contained a 6.7 percent minority, so that the match was exact. The schools are organized by the JHS system, i.e. 1-6/7-9/10-12, and this division was also used to define the grade groups in the study.

The Charleston transportation network file was last revised in 1962 and contains ADT (average daily travel) times. It has an average intersection density of 15/sq. mile, adequate for the purpose of this analysis. The general quality of the file could be described as fairly good.

Four cases -- 1, 2, 5, and 6 -- were run for Charleston. In case 1, in which a neighborhood assignment is most nearly achieved, there is a simultaneous minimization of walking distance, riding time, and the number of students bused; as a result the attendance zones are relatively compact. In cases 2 and 5, only the number of students bused is minimized, and the times associated with these cases are exaggerations of the total busing time required. The only limit in case 6 is the standard 35-minute maximum on travel time.

The results show that complete desegregation of the junior high and senior high schools can be achieved without busing any more students than would be required to be assured that all students can get to school. Complete desegregation of elementary schools would require busing 38 percent of those students compared with the minimum of 34 percent. This unusually small increase relative to other districts studied undoubtedly reflects the low percentage of minority students in Charleston. The burden of busing falls more heavily on these students, as we have come to expect in cities of similar racial composition: in case 5, some 67 percent of the minority students are bused, compared with 53 percent of the majority students. Finally, it should be noted that, although the number of total students bused does not increase significantly in the cases studied, there might well be a larger increase in the average travel time.



Graph of Achievable Desegregation

Charleston, West Virginia

Chicago, Illinois

The city of Chicago is served by a single immense school district. Because of its size only a center-city case was defined: Chicago proper.

Information from the Directory of the Office for Civil Rights lists enrollment in the Chicago school district as 34.6 percent majority; the minority population has substantial black (54.8 percent) and Spanish-surnamed (9.8 percent) components. The school population file used in this study shows 37.8 percent majority, which is very good agreement for a city of this size.

The transportation file, last revised in 1969, lists posted speeds, so that it must be regarded as approximate. Its density and coverage are adequate.

Cases 1, 2, and 5 were run for Chicago. All significant transportation parameters were minimized in all cases -- numbers of students bused, total distance bused, and total walking distance. Reflecting practice as we understand it in Chicago, the maximum permissible walking distance was 1.6 miles in a straight line (which equates with 2.0 miles along roads); this is in contrast with the distance used for all other analyses in this survey, .75 miles straight line (about 1.0 mile along roads).

The results for Chicago are presented in three graphs, since if represented in one graph the curves would intersect at too many points to be read.

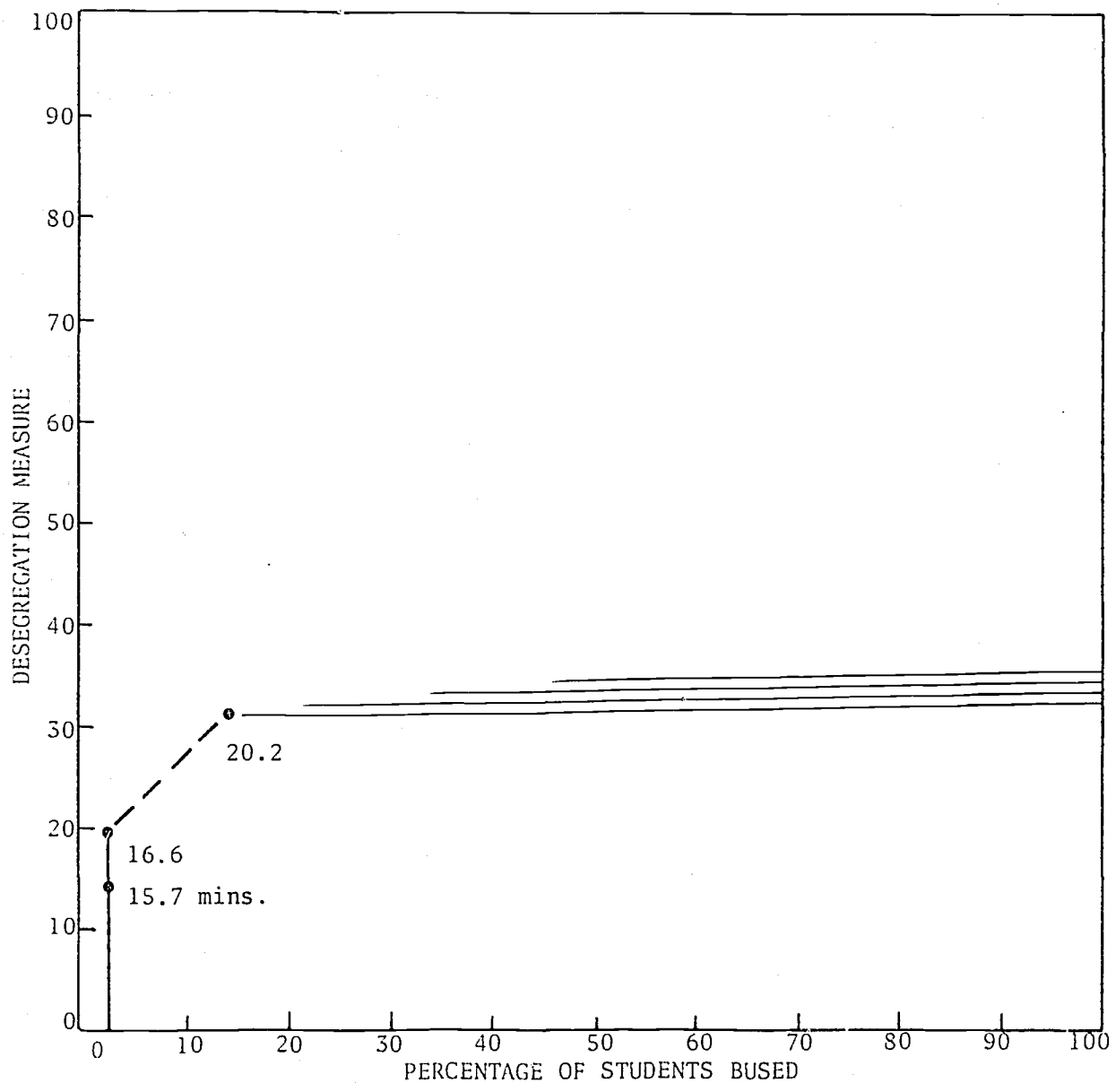
The first phenomenon of note is the extremely low percentage of students bused in the minimum-transportation cases (1 and 2) -- those cases in which no

student is bused who lives within the allowed walking distance of a school of his grade level. The reason is obviously that students are permitted in this analysis to walk up to two miles. The greater walking distance also has a dramatic effect on the increase in desegregation that case 2 can produce, relative to the desegregation level obtained in case 1. In most cities surveyed (in which, of course, the one-mile walking limit is in effect), case 1 requires a substantial amount of busing just to get all students to school when they do not live within walking distance. In case 1, this busing is used without regard to desegregation objectives, which is why it is sometimes called the colorblind neighborhood assignment. Case 2 is permitted to use this (usually substantial) amount of busing for desegregation purposes, in effect by redirecting the same buses to different destinations. In Chicago, however, the amount of necessary busing is so low that redirecting it improves the level of desegregation very much less than in other cities examined.

Moving from case 2 to case 5 -- extensive desegregation -- requires substantial increases in proportions of students bused in each grade level -- from 3 percent to 14 percent in elementary schools, from 3 percent to 17 percent for junior high schools, and from 11 percent to 22 percent for senior high schools. In absolute terms, these levels of busing are not high compared with other areas studied, but they are much higher proportionate increases than are usually found

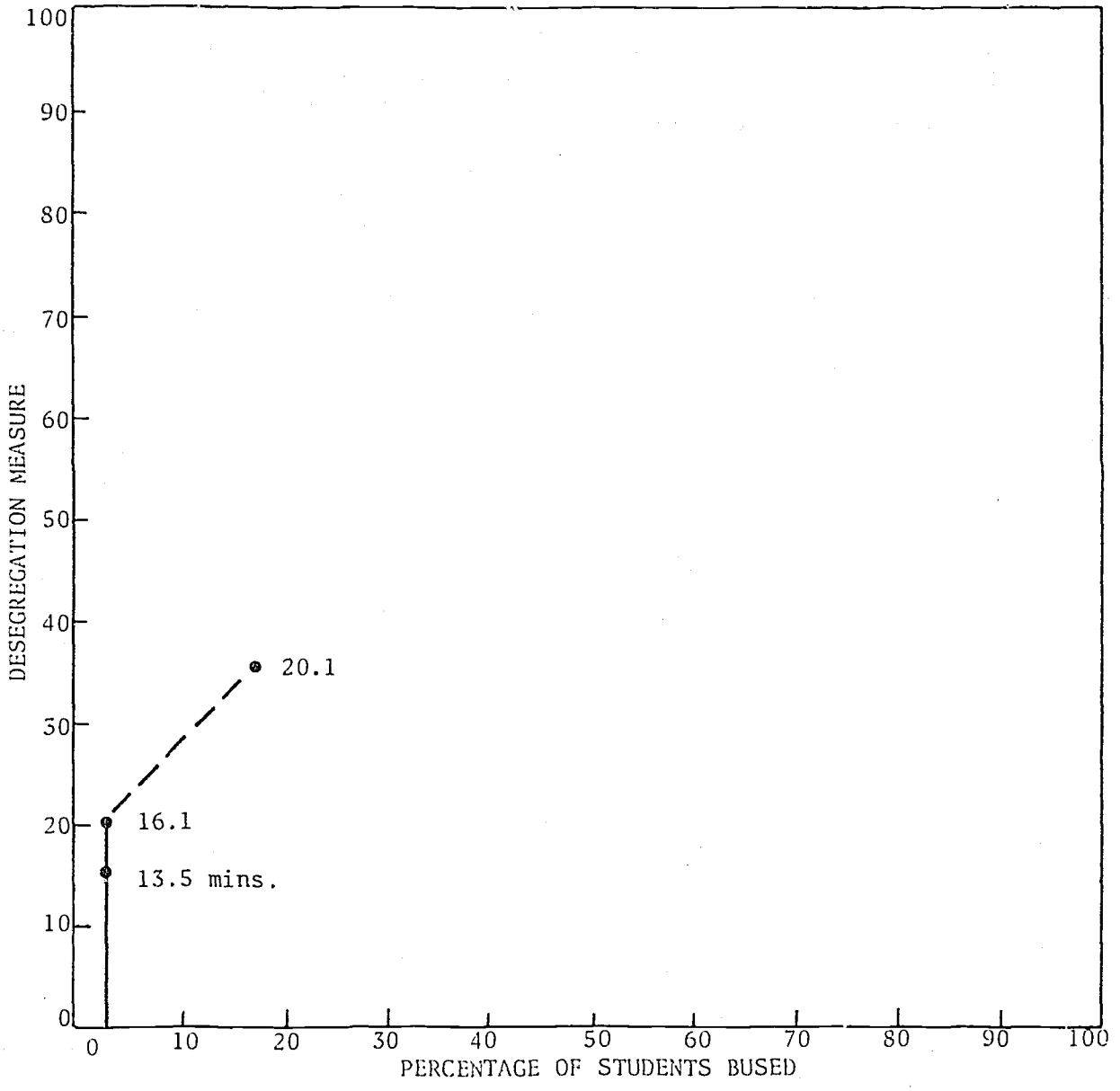
to be necessary to move from case 2 to case 5. The increases in average travel time from case 1 to case 2 to case 5 are large, but not unusually so.

Perhaps the most important result is that case 5 produces only 93 percent of complete desegregation in the elementary and junior high schools and only 95 percent in the senior high schools. This is a very high level of desegregation, of course, and probably satisfactory from a practical viewpoint. It is of technical interest, however, that this is one of only a few center cities in which case 5 fails to produce 99 to 100 percent desegregation. Only a relaxation of the 35-minute travel time limit, as well as a relaxation of the constraint on average travel time, could produce an assignment in which complete desegregation could be obtained without increasing the number of students bused to levels that cannot be predicted from this analysis alone. Because we cannot be sure that complete desegregation would be achieved even with much higher levels of transportation we cannot extend, as we can for all other survey areas, the horizontal line from the case 5 data point. Using the elementary schools as an example we indicate with shading the area in which the results of assignments using additional busing beyond case 5 would lie. All in all, the results indicate that a practical program for reducing the effects of racial isolation in Chicago schools might well include combinations of transportation and other components, such as compensatory education.



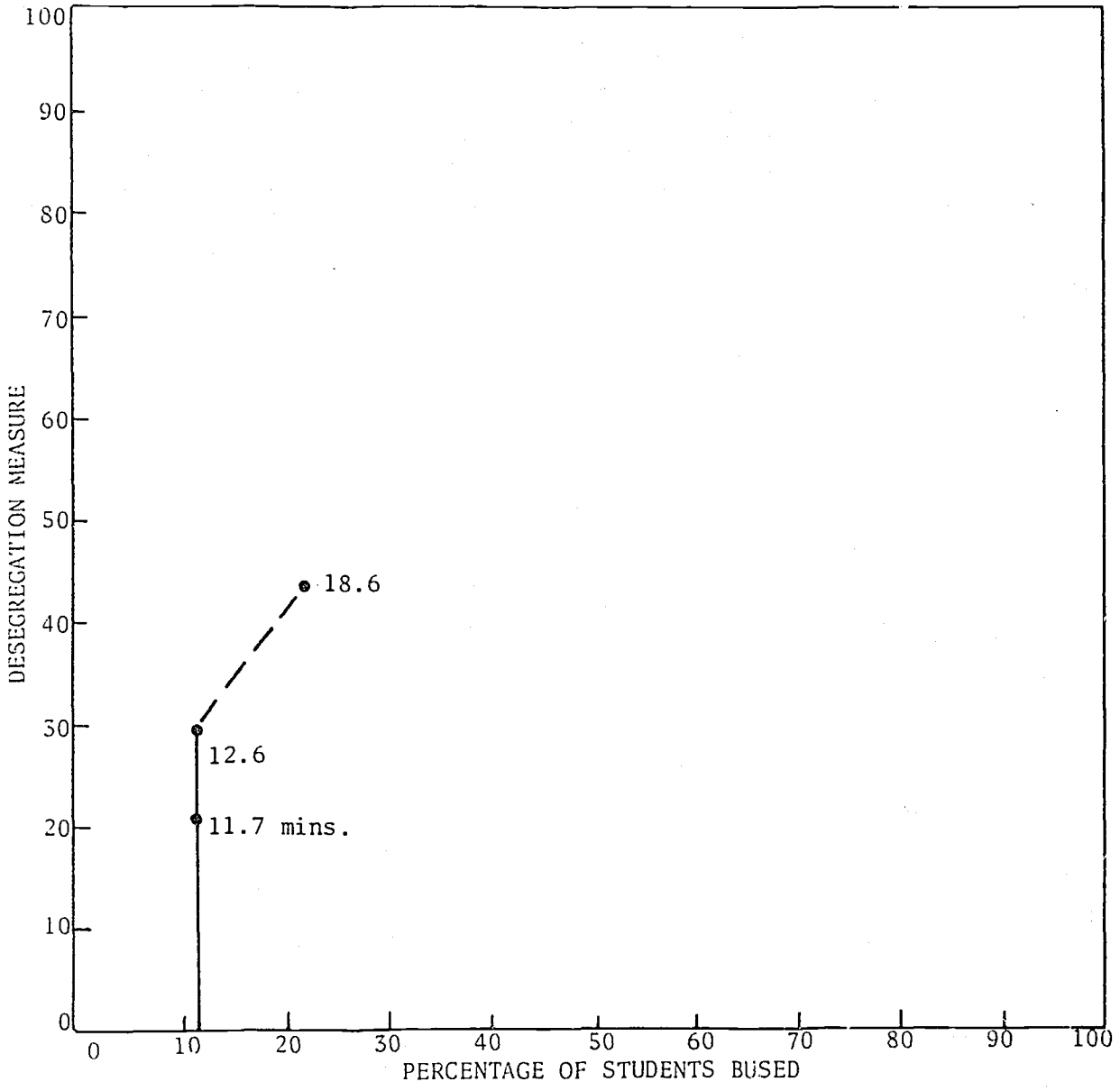
Graph of Achievable Desegregation

Chicago, Illinois
Elementary Schools



Graph of Achievable Desegregation

Chicago, Illinois
Junior High Schools



Graph of Achievable Desegregation

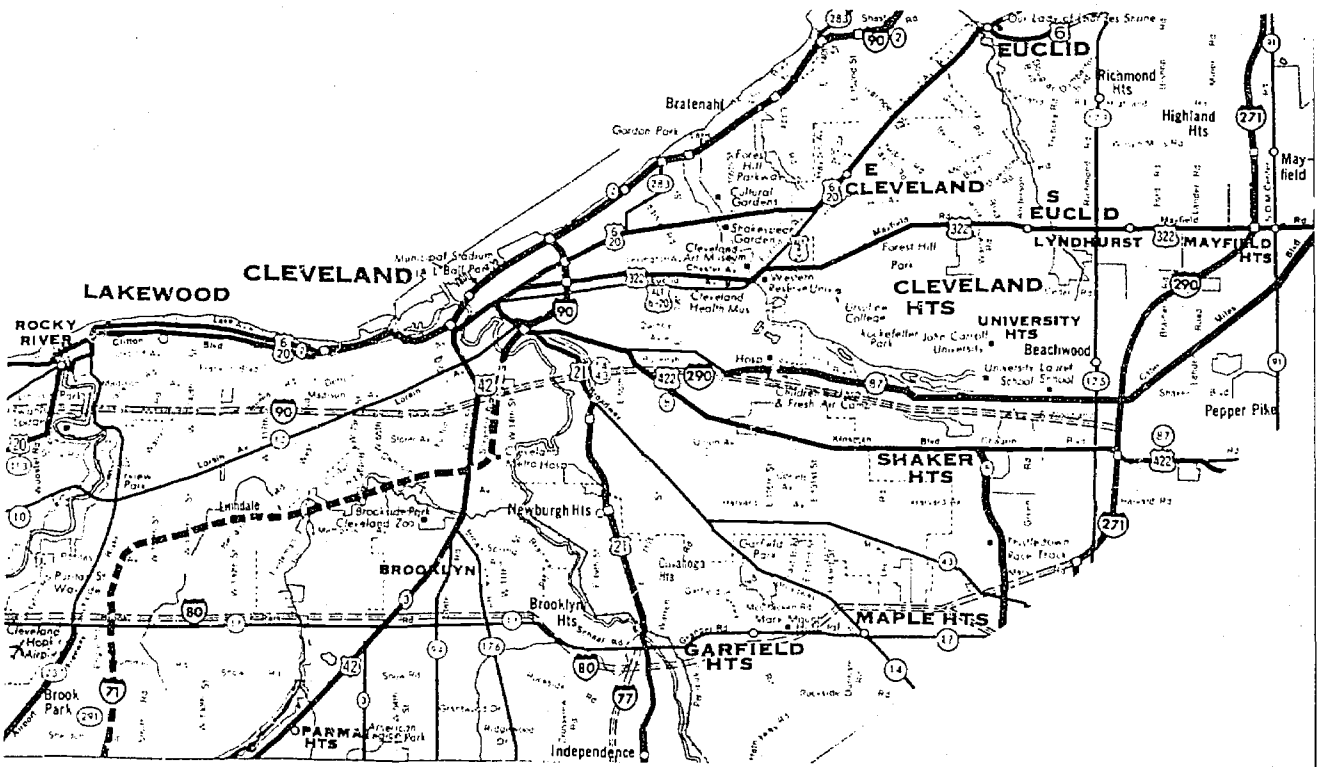
Chicago, Illinois
Senior High Schools

Cleveland, Ohio

Cleveland is served by a central school system; the surrounding suburban area of Cuyahoga County is served by about 30 separate school systems, including 21 systems each with an enrollment of over 3,000. The central school system has a majority of black students while the suburban schools are overwhelmingly white, with the exception of the East Cleveland, Shaker Heights, and Warrensville Heights systems, all on the eastern border of Cleveland City. The central city was defined, of course, as the city itself, while the metropolitan area was taken as the entirety of Cuyahoga County. The demographic picture is one of a central black region surrounded by a white region; in such cases relatively large increases in busing are normally required to achieve substantial desegregation.

The following table and map list major school districts and identify some of them by location:

School District	Total Enrollment	Percent Majority
Bay Village	4,379	99.7
Bedford	7,754	95.6
Berea	17,250	98.0
Brecksville	4,575	99.2
Cleveland	153,619	40.3
Cleveland Heights	12,603	94.6
East Cleveland	7,925	11.3
Euclid	11,125	99.3
Fairview Park	3,443	99.3
Garfield Heights	5,906	95.8
Lakewood	10,728	99.1
Maple Heights	6,519	95.8
Mayfield	6,024	99.4
North Olmsted	7,865	99.6
Parma	25,734	99.6
Rocky River	3,915	99.4
Shaker Heights	7,477	74.9
South Euclid-Lyndhurst	8,994	99.7
Strongsville	4,228	99.6
Warrensville Heights	3,192	61.9
Westlake	3,513	99.3



Cleveland and Close-in Suburban Portions of Cuyahoga County

The school population file for Cleveland City showed a majority population of 48.6 percent, compared to figures from the Directory of the Office for Civil Rights, which show an enrollment of 40.1 percent majority in the city schools. Thus the demographic match is not very good; we have come to expect this effect in large-city, substantially black, systems. The effect is apparently due to a much larger private school enrollment of white urban students than was accounted for in the preparation of the population file.

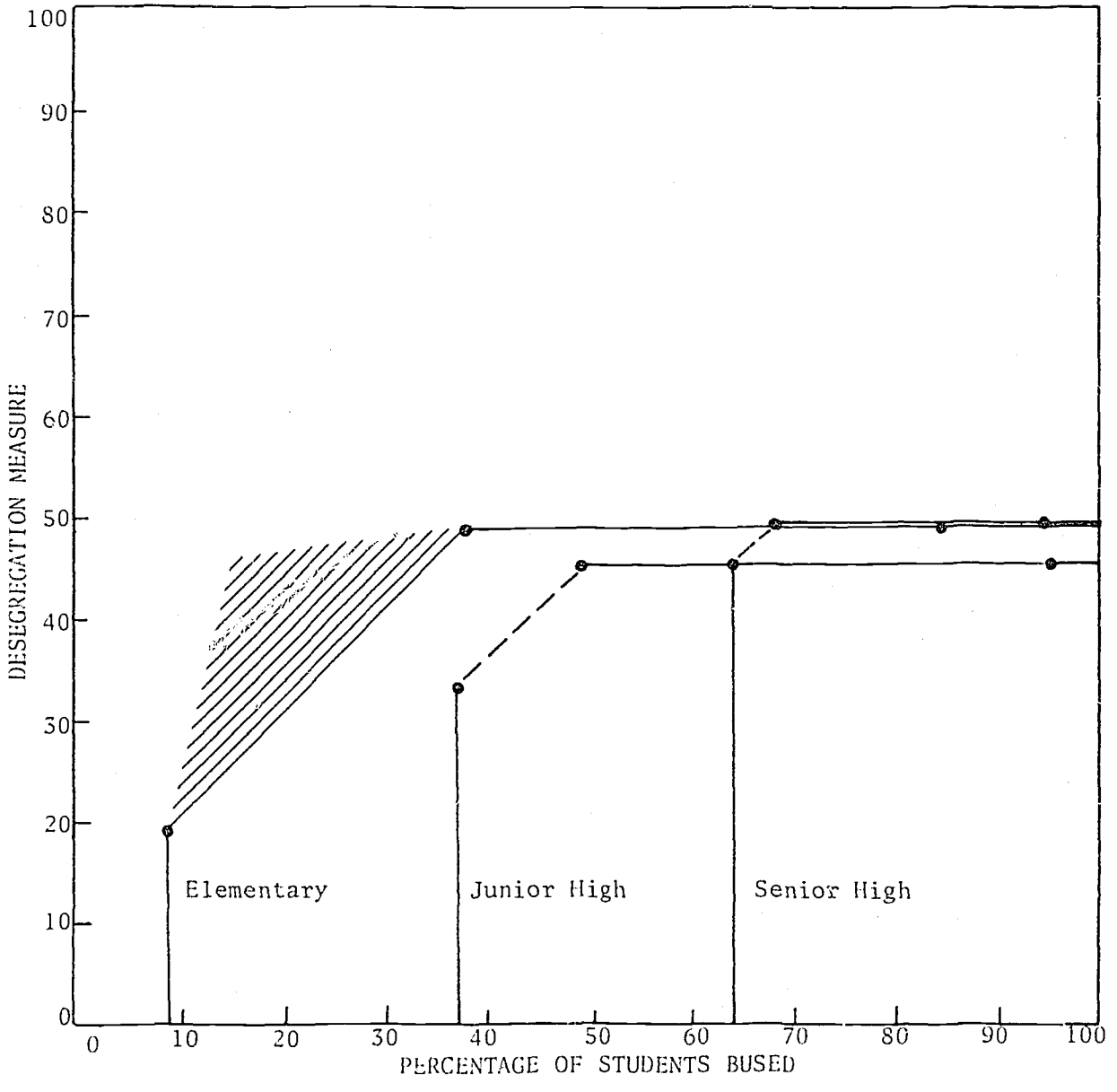
The transportation file, listing ADT (Average Daily Travel) speeds, was last revised in 1970. The coverage extends well beyond Cuyahoga boundaries and has a relatively high density of intersections (45 per square mile). Thus, the overall quality of the file must be judged as very good.

In Cleveland, cases 2, 5, and 6 were run for the center city and case 6 for the metropolitan area. Only the percentage of students bused was considered as a transportation penalty, so that resultant busing times and distances are overestimates for what may actually be achieved.

Results in the central city case are typical for areas with such demographic constituency; relatively substantial new busing is required (for elementary students, an increase to 38 percent over the minimum of 9 percent) for complete desegregation. The effect is weaker for upper grade levels because of the substantial transportation they now require, and because of their larger attendance zones, but it is still substantial. If the Cleveland system were to be studied in greater detail it would be desirable to study assignments, particularly for the elementary schools, that would result in more desegregation and busing than are obtained in Case 2 but less than in the levels of Case 5. The shaded areas on the graph indicate the range in which the results of such assignments would fall.

A special analysis was made of Cleveland, as for several other cities, labeled in the computer outputs as Case 2B. While these are also identified as grade reorganization cases, it is important to note that the definition used here differs from that usually used. We mean that each school is allowed to have a mixture of all three grade levels regardless of what grade level the school serves at present. Other assumptions are as those in Case 2, i.e., no more students are bused than is absolutely necessary. The grade organization assumption removes the distinction between the levels of schools; the quite large high

school zones and junior high school zones are eliminated and effective attendance zone sizes are the same at all levels. Thus, we expect less desegregation and less busing, as the results indeed indicate. (Grade reorganization, as usually construed, reduces the number of grades at each school, so that effective zone sizes are greater, and the opposite effects in desegregation and busing occur.) The results of the case 2B analysis are not reflected on the graphs.



Graph of Achievable Desegregation

Cleveland, Ohio

Center-City Analysis

Colorado Springs, Colorado

Colorado Springs Division of El Paso County, Colorado, is served by four different school districts, as listed in the table below. Harrison District also has one school in Cheyenne Mountain Division, so that the minimal geographical unit which includes the city and any other MCDs (Minor Civil Divisions) served by central city school districts would include these two divisions. The urban area, as defined by the U.S. Census, includes Cheyenne Mt., Colorado Springs, and Black Forest-Peyton Divisions, as well as portions of two others. For the purposes of the study, the metropolitan area was defined as including the three divisions named. However, this left only six more schools in the urban area than in the central city; for this reason the cases were not distinguished in the study and the only geographical unit studied includes the four named school districts and in addition two small districts (five schools) serving Black Forest-Peyton Division.

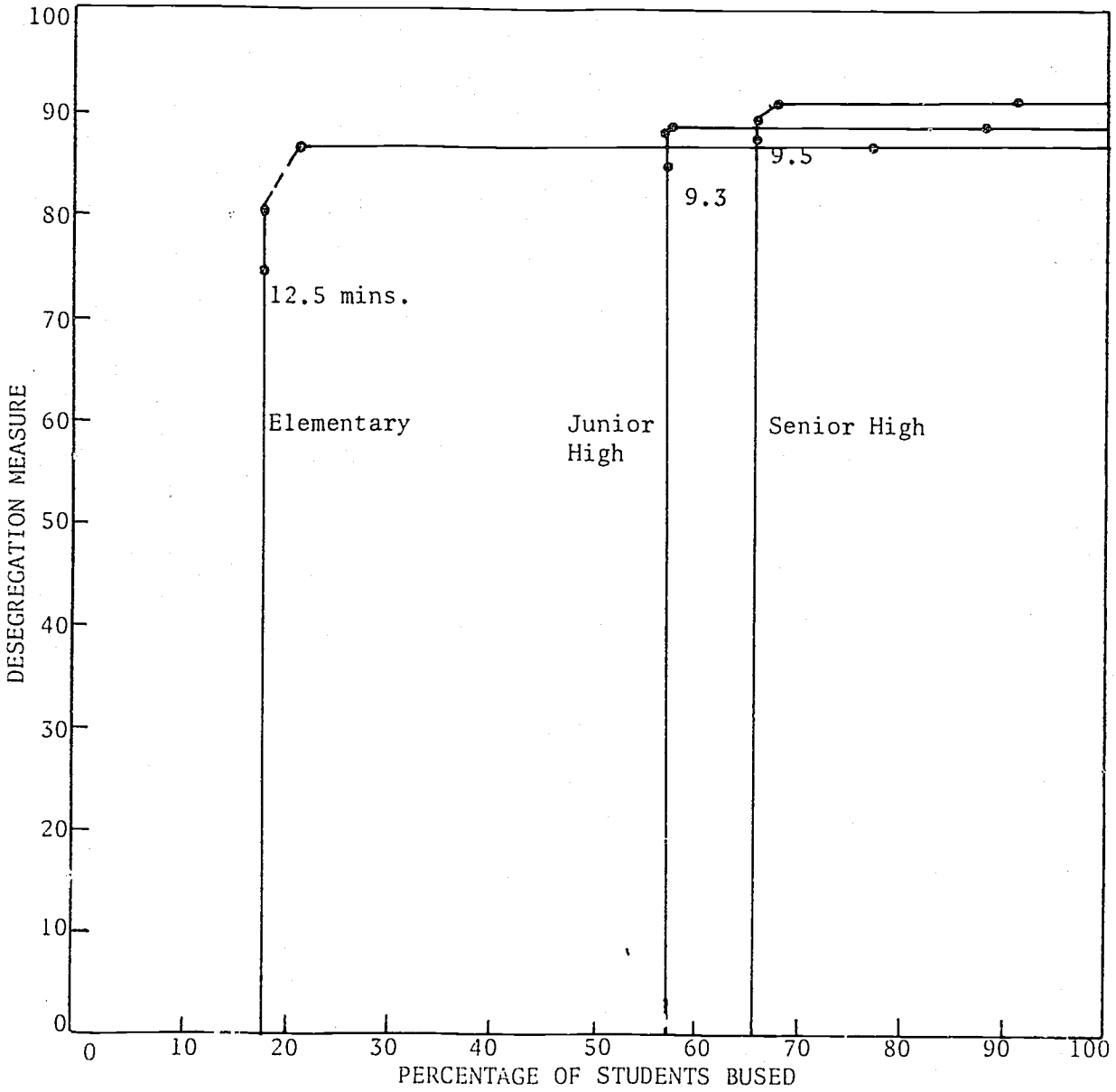
District	Number of Schools	Percent Majority	Number of Students
Colorado Springs	43	83.6	33,025
Cheyenne Mt.	5	98.4	3,131
Air Academy	6	95.5	4,440
Harrison	6	80.6	5,993
	60	85.0	45,589

The overall majority percentage, as reported in the Fall 1970 OCR Directory, is about 85 percent, while the school population assigned by the program was 88 percent majority. The difference in these figures is due to the difficulties involved in determining the number of Spanish-surnamed students in each block group (the data does not exist on the First-Count census tapes). The results obtained are certainly not invalidated by this small error.

The road network data includes 1529 intersections and 2253 links, quite sufficient for the area. The speeds are based on ADT (Average Daily Travel) times, and the last revision was in 1964. Digitizing was performed for 94 percent of the intersections. Because of the age of the data, the quality of the network can be considered only fair, but it is adequate to the purpose of analysis.

Cases 1, 2, 5, and 6 were run; only in case 1 were all transportation parameters minimized, and thus only in this case are the travel times and distances really meaningful.

The results of the analysis show that essentially no busing, beyond that required by a limit of about 1 mile by street (.75 mile direct), is required for almost complete desegregation of the schools. It is not surprising to see this kind of result for the secondary schools, but it is unusual that it is possible to desegregate elementary schools with so small an increase in busing over what would be required as minimum. This conclusion would also obtain for any of the school districts separately as well, and most certainly for Colorado Springs District, which includes the bulk of the schools studied.



Graph of Achievable Desegregation

Colorado Springs, Colorado

Columbia, South Carolina
(Richland County)

Columbia, South Carolina is served by Richland County School Districts Numbers 1 and 2, as is the remainder of Richland County. It is not possible to separate the districts along governmental lines so that the central school district was run as a combination of the two districts, i.e. the whole of Richland County. Lexington County, served by several school districts, forms the remainder of the SMSA and, for the purposes of the study, the remainder of the metropolitan area.

Demographic statistics, according to OCR, are as follows:

	Total Enrollment	Percent Majority
District #1	39,433	50.2
District #2	9,104	81.2
Total	48,537	56.0

The school population for the same geographical area on the school file used in the study was 58.7 percent majority, very close to the OCR figure. The demographic base for the study appears to be excellent. The minority population is entirely black, so that no errors regarding adjustment for Spanish-surnamed Americans could occur.

The school grade organization is mixed; for this study it was arbitrarily defined as the junior high school system (1-6/7-9/10-12).

The transportation file was revised in 1969 and has an intersection density of 46/sq. mile. Speeds are so-called "calibration speeds"; this implies

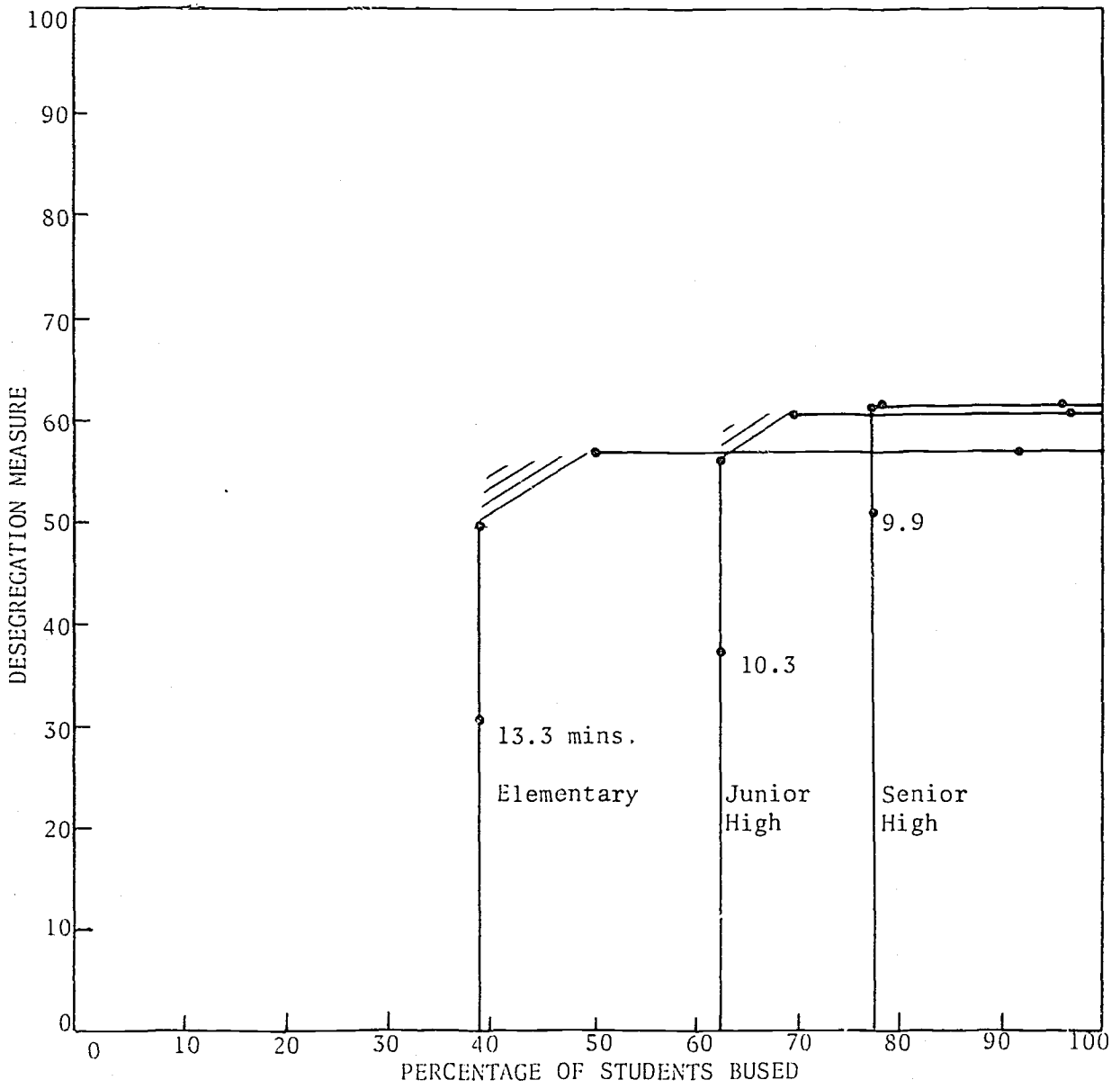
that all of the links were classified by number of lanes, type of roadway, etc., and speeds typical for each class of link then attached to the link records. The overall quality of the transportation file may be characterized as excellent.

Four cases were run for the central district, including case 1 (unbiased, i.e. colorblind, neighborhood assignment), case 2 (desegregation achievable with minimum transportation), case 5 (extensive desegregation), and case 6 (maximum feasible desegregation). Case 1 involved simultaneous minimization of numbers transported, distance transported, and distance walked. Cases 2 and 5 minimize only the numbers of children transported; as a result the travel times and distances are overestimates of what could be achieved. Cases 5 and 6 were run for the metropolitan area; in case 5 the various measures of transportation were simultaneously minimized, while in case 6 the total distance traveled was ignored, subject to the standard 35-minute limit on travel time.

The results for the central-city study indicate that a relatively high degree of busing is required merely to assure that no child walks more than about a mile to school. Almost no additional busing beyond these levels is required to desegregate high schools completely, but modest increases are necessary for the lower grades. However, the elementary and junior high schools can be very substantially desegregated (86 percent and 92 percent, respectively, of maximum desegregation) with almost no increases in busing above the minimum, as an inspection of results for case 2 shows. Intermediate cases between 2 and 5 would produce results lying somewhere in the shaded areas shown on the graph

for elementary and junior high schools. By comparing the student busing results and the summary results for cases 2 and 5, it can be seen that the increase in elementary school busing in case 5 -- 51 percent compared with 39 percent in case 2 -- falls most heavily on minority students.

In the metropolitan area study, the only case of value is case 5, in which limits are placed on numbers bused and also on travel time and distance. As can be seen by reference to the graph, the percentage of students bused is not much higher than the analogous cases in the central-city study. Additional runs would have to be made to assess a fuller range of assignments that might be produced so that busing levels could be significantly reduced with only a relatively slight reduction in the level of desegregation. The relatively small increase in average bus travel time between case 1 in the central city and case 5 in the metropolitan area suggests that travel time increases for desegregating the metropolitan area should be modest for the cases considered.

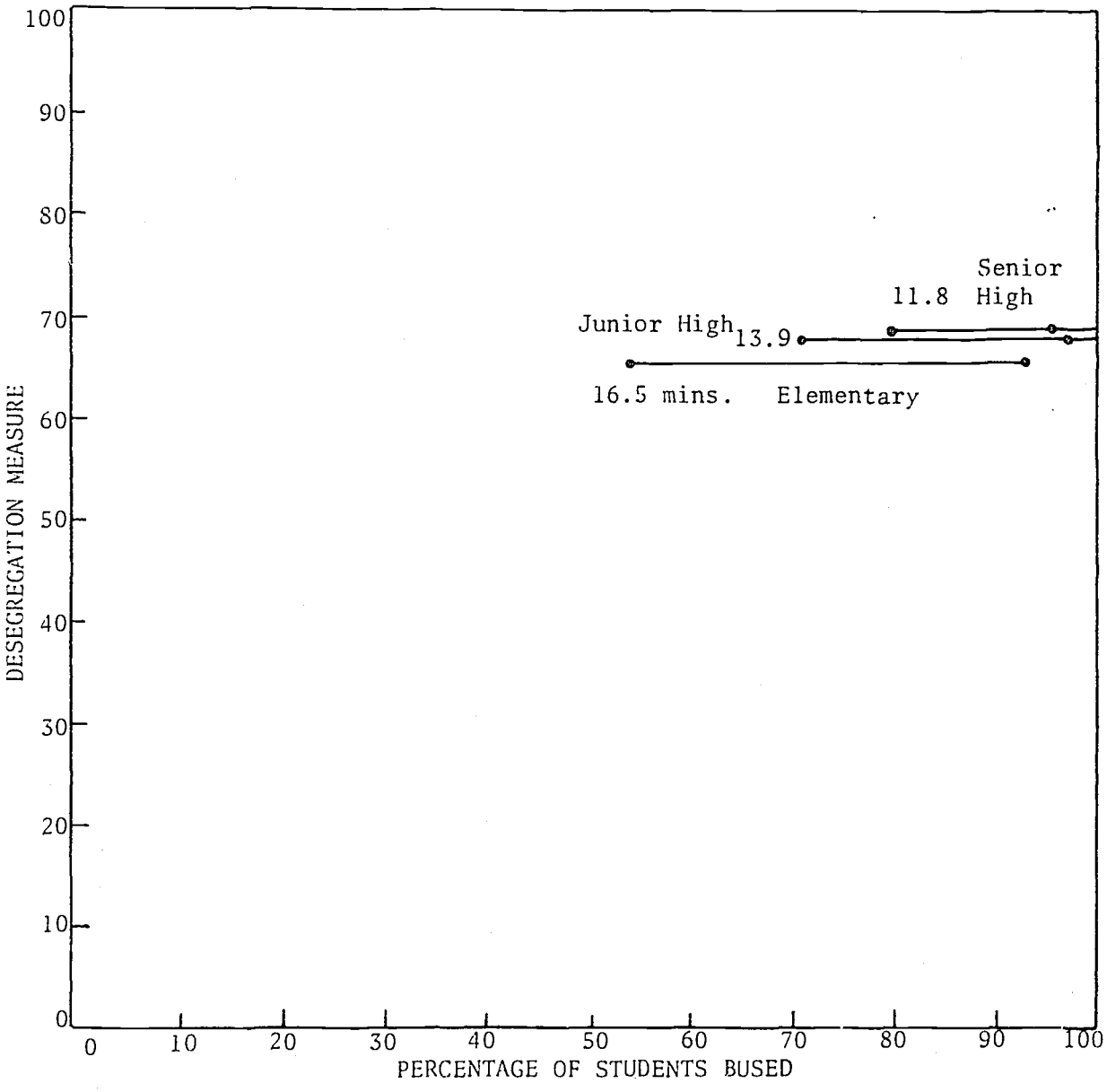


Graph of Achievable Desegregation

Columbia, South Carolina

Center-City Analysis

(Richland County)



Graph of Achievable Desegregation

Columbia, South Carolina

Metropolitan Analysis
(Richland and Lexington Counties)

Dade County, Florida

The schools of Miami, Florida, and surrounding suburban Dade County are administered by a single county school district. For this reason the study involved only this area -- Dade County in its entirety -- and no distinction was made between central city and metropolitan cases.

The Dade County school system has, according to the Directory issued by the Office for Civil Rights, about 53.8 percent majority students; the minority is distributed principally between Negro students (25.4 percent) and Spanish-surnamed students (20.5 percent). The population files used in this study were based on the best available computerized data at that time to calculate the school population, but it is sometimes in significant error. This was the case in Dade County, despite reruns and manual correction efforts. The school population file prepared in this way is 61.4 percent majority, so that there is an error of 7.6 percent, large enough to identify the demographic data quality as poor. With the census files available at the time of this study, the determination of the Spanish-surnamed portion of the minority school population was subject to error; at this time Fourth-Count census files are available for determining more accurately the actual public school population by race.

The transportation files were last revised in 1965 and contain, as do all of the Florida files, peak seasonal speeds. The density of intersections is good,

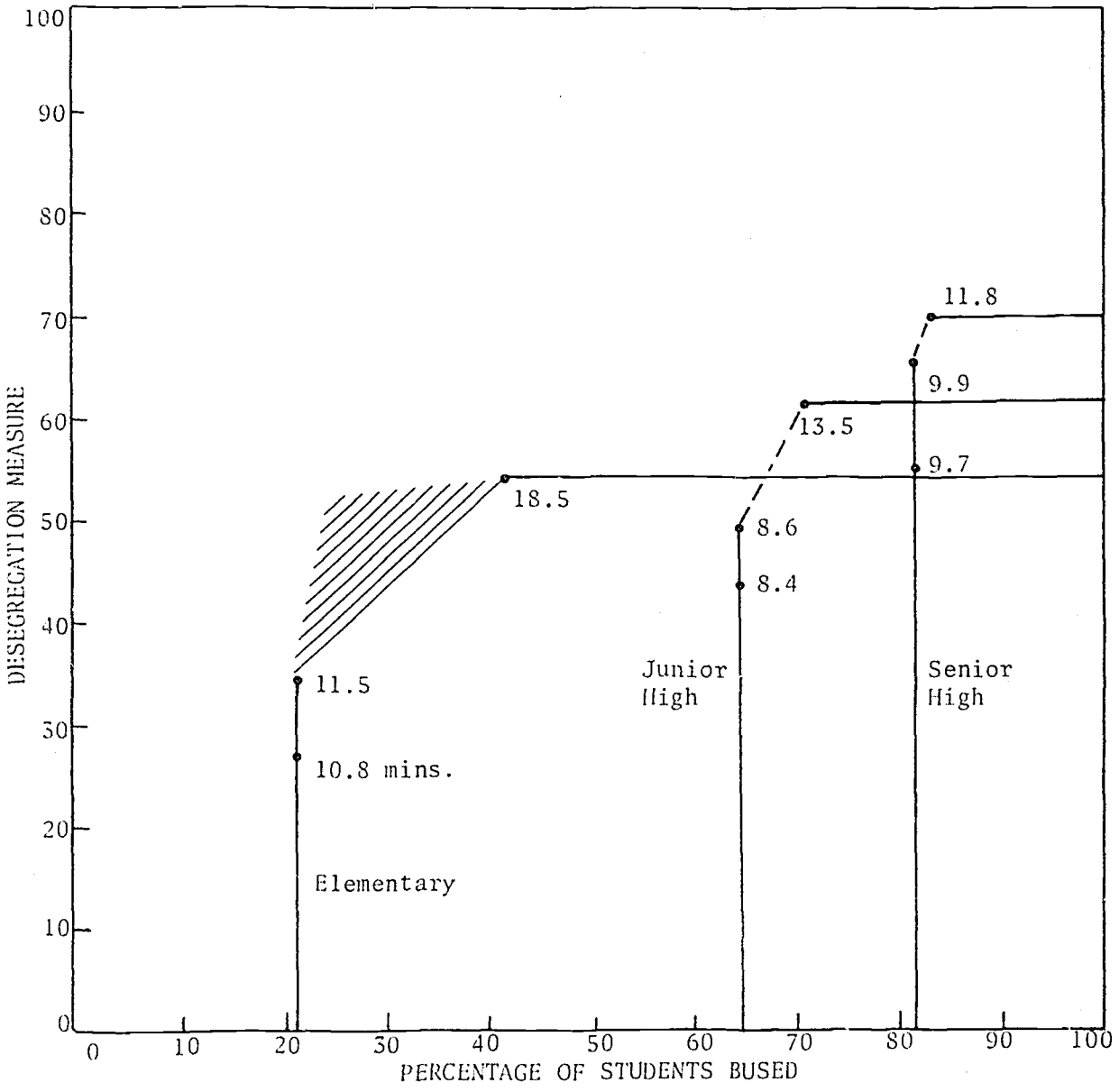
at 38 per square mile, but the file covers only about 56 square miles. Almost all of the omitted area is in the Everglades, however, and the population density is very small, so the errors induced by the lack of coverage are not very large. Nonetheless we cannot rate the file as better than fair.

The school grades are divided into grade groups by the JHS (1-6/7-9/10-12) system.

Cases 1, 2, and 5 were run for Dade County. In all three cases, the program minimized travel times and distances, including walking distances, as well as the numbers of students bused. The results, and in particular the travel times and distances, can therefore be regarded as reasonable estimates of what would be required.

The results are quite typical: Senior high schools can be essentially completely desegregated with no busing in addition to what is required simply to get students to school; desegregation of junior high schools would require a very slight increase in such busing; and desegregation of elementary schools would require substantial additional busing. In the elementary schools some 42 percent of the students are transported in case 5, compared with 22 percent in case 2, the minimum-transportation assignment. Moreover, the average travel time for elementary students increases from 11.5 minutes in case 2 to 18.5 minutes in case 5. A more complete study would aim at investigating cases that are intermediate between cases 2 and 5 -- cases that could significantly reduce busing

requirements with relatively minor reductions in the levels of desegregation achieved. On the elementary school curve shown in the graph, the shading indicates the area in which the results of such intermediate cases must lie.



Graph of Achievable Desegregation

Dade County, Florida

Dallas, Texas

The central city case was selected as the city of Dallas itself, and the metropolitan area was defined as the surrounding urbanized area, which is distinct from the Fort Worth urbanized area. This includes Plano Division of Collin County and Dallas, Grand Prairie, Irving, Northeast, Northwest, South, and Southeast Divisions of Dallas County. The counties are divided into independent school districts, not necessarily corresponding to other governmental units. In fact, the center city includes a slightly larger area than does Dallas ISD, so that a few schools belonging to other ISDs are included.

Figures published by the Office for Civil Rights, based on information supplied by the school district, list the racial composition of Dallas ISD as 57.3 percent majority; the minority is largely Negro but does include 8.5 percent Spanish-surnamed students. The school population file used in the study was 61.1 percent majority for the central city, so that its quality is fairly good.

The school system is a mixed one; a substantial number of students is on the 1-6/7-9/10-12 schedule and another group is on the 1-7/8-9/10-12 schedule. The former schedule is used in this analysis.

Transportation data was last revised in 1964 and includes ADT travel times. The density is high (57 intersections per square mile). Its coverage of the urbanized area is adequate and the overall quality is fairly good.

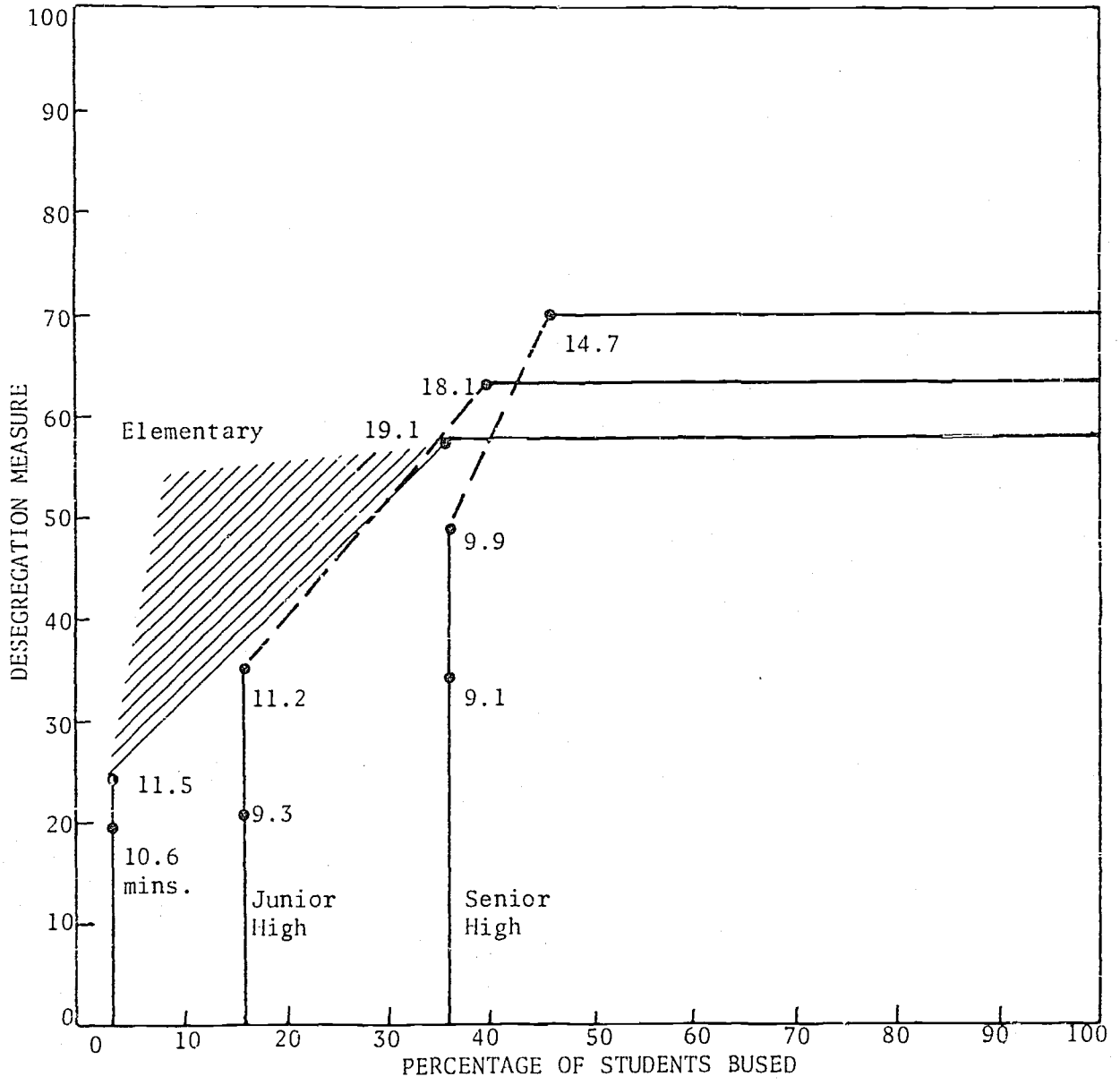
Cases 1, 2, and 5 were run for Dallas city and case 1 for the metropolitan area. All cases were run so as to minimize the three transportational elements

considered: percentage of children transported, the total time (and distance) travelled by children and the distances walked. Thus the figures on the graph represent reasonable estimates of what could be achieved, given the assumptions used in the study.

In Dallas itself, the two minimum-transportation assignments -- cases 1 and 2 -- produce levels of desegregation far below proportional racial balance. Moreover, considerable busing in addition to the minimum is needed to attain complete desegregation. It has generally been found in this survey that this increase is largest for elementary schools, least for senior high. The rule applies to Dallas, the difference being in the size of the increase. In senior high schools, the increase is to 46 percent, compared with the minimum of 37 percent, much larger than is usually required for these schools.

In the elementary schools, full desegregation would require busing some 36 percent of these children, compared with less than 4 percent that is required so that no child walks more than about one mile to school. This is of course not the full range of options for desegregating elementary schools -- or, for that matter, the other grade levels. Additional assignments could be developed with desegregation goals defined between cases 2 and 5, to produce a satisfactory level of desegregation (although somewhat less than complete) and a much lower busing burden (although somewhat more than the minimum). The shaded area on the graph shows, for elementary schools, where the results of such intermediate assignments must fall.

The metropolitan area was studied with only case 1, which is not shown on the graph. Since this "neighborhood" assignment leaves the schools segregated, it suggests that the metropolitan area analysis, if expanded with additional cases, would mirror that of Dallas itself.



Graph of Achievable Desegregation

Dallas, Texas

Dayton, Ohio

The Dayton School District administers schools in approximately the same area as Dayton City, but the District extends slightly into neighboring townships. The surrounding area is served by several different systems, which are, however, under the further supervision of a county school board. For the purposes of the study, the central city was defined as Dayton City itself, and the metropolitan area was defined as all of the urbanized area except for urbanized areas in Warren County (which are in the Cincinnati SMSA), and for Beaver Creek Township in Greene County (which was absent from the source files). The metropolitan area as defined here includes:

County		MCD	
57	Greene	5	Bath Township
57	Greene	15	Caesar Creek Township
57	Greene	55	Sugar Creek Township
113	Montgomery	5	Butler Township
113	Montgomery	15	Dayton
113	Montgomery	25	Harrison Township
113	Montgomery	35	Jefferson Township
113	Montgomery	40	Madison Township
113	Montgomery	45	Mad River Township
113	Montgomery	50	Miami Township
113	Montgomery	55	Moraine Township
113	Montgomery	60	Oakwood Township
113	Montgomery	70	Randolph Township
113	Montgomery	75	Van Buren Township
113	Montgomery	80	Wayne Township

Dayton was one of the first cities analyzed and difficulties in reconciling the population files, the school files, the actual district area, and governmental units, were first experienced here. As a result, quality controls and procedures were developed for use in all of the remaining cities.

The OCR files list the central district attendance as 59 percent majority, with the minority of almost entirely black composition; the files used in this study were 58 percent majority in the center city. This is extremely close agreement, so that we judge the demographic data as very good.

The transportation file contains ADT speeds and was last revised in 1968. The density of intersections is high and the coverage adequate. The file is in general of very good quality.

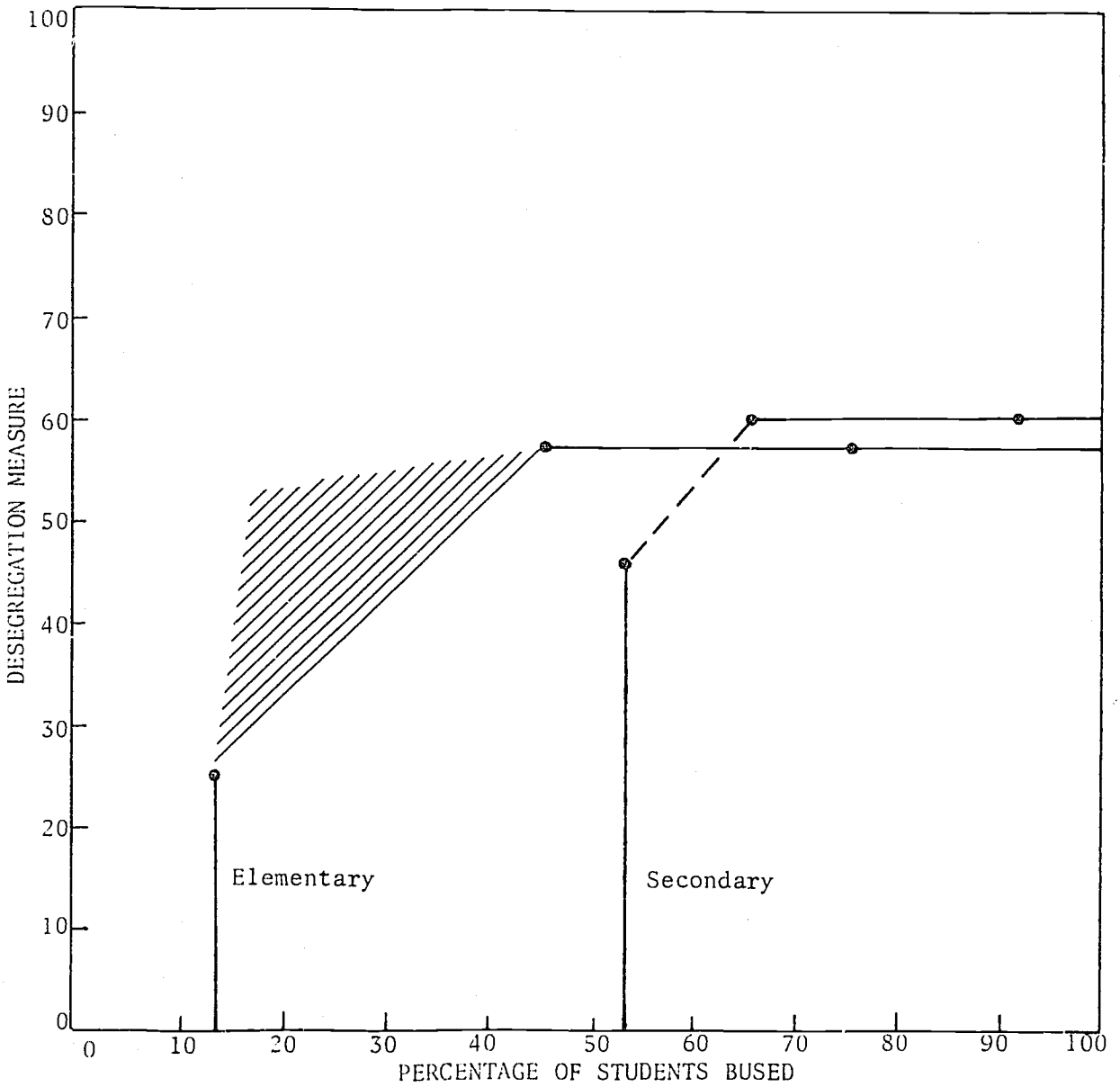
Schools are organized on a largely 1-8/9-12 system, so the study dealt with only these two grade groups in the analysis. They are labeled "elementary" and "secondary" on the accompanying graphs.

Cases 2, 5, and 6 were run for the central city, and case 6 for the metropolitan area. The only transportation parameter minimized was the number of students transported, so that significantly lower figures for busing times could be achieved with only a slight increase in the number of students bused.

The Dayton results show that considerable busing is necessary to achieve extensive desegregation. An increase of busing up to a total of 46 percent is required for elementary schools, compared to 13 percent that is required to get all students to school. This effect is largely due to extreme racial isolation in

housing; the Miami River essentially separates a black area to the West and a white area to the East. Thus complete desegregation would require extensive interbusing across the Miami River.

It is possible to produce assignments, either for all schools or only for elementary schools, that would require significantly less busing than is required in case 5 while relaxing desegregation goals only slightly. The range of such possible assignments for elementary schools is shown by the shaded area on the graph.



Graph of Achievable Desegregation

Dayton, Ohio

Center-City Analysis

Denver, Colorado

Denver is served by the Denver School District, which is coterminous with Denver City, so that the center city was defined as Denver itself. The metropolitan area was defined as the urbanized area, excluding Golden Division of Jefferson County (which is only partially urbanized). The divisions included, in addition to Denver City, are as follows:

County		Minor Civil Division	
1	Adams County	5	Brighton
1	Adams County	8	Commerce City
1	Adams County	20	N. Aurora
1	Adams County	35	Westminster-Thornton
5	Arapahoe County	5	Cherry Creek
5	Arapahoe County	17	Englewood-Littleton
5	Arapahoe County	25	S. Aurora
59	Jefferson County	10	Arvada-Wheat Ridge
59	Jefferson County	20	Lakewood

Some unusual digital errors occurred in preparation of the school file; two schools were repeated (thus doubling their capacity) and four schools from Arapahoe and Adams Counties were mistakenly assigned to Denver. Since there are about 120 schools in Denver the resulting errors in the summary data as presented in this report should not be great, although of course the results here must be regarded as somewhat less reliable than the results for other areas.

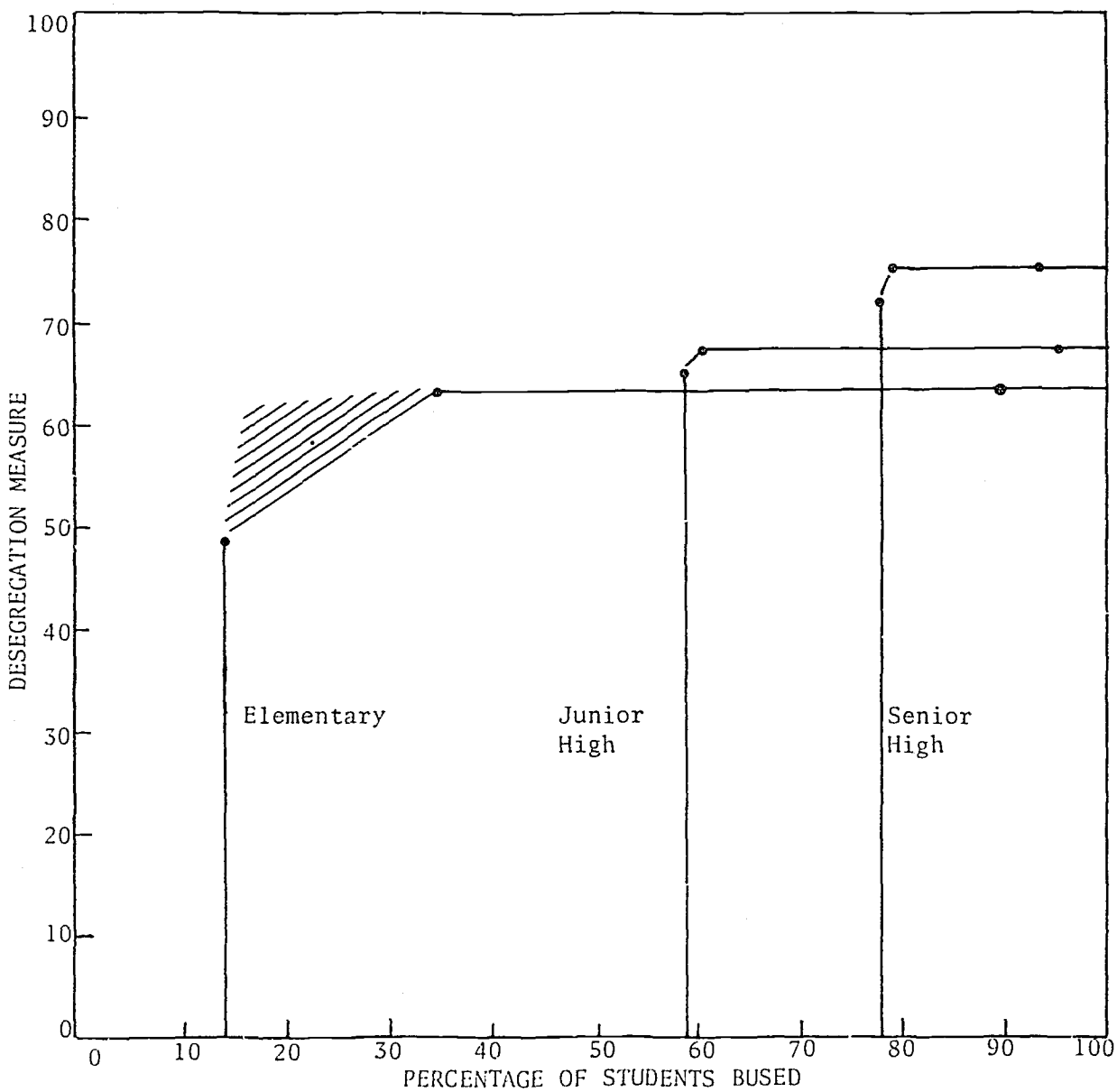
The OCR school register for Fall 1970 lists a majority school attendance of 61.7 percent and minorities of 22.4 percent Spanish-surnamed and 14.7 percent Negro. The school population file used in this study lists a majority of

67 percent, and is thus in error by more than 5 percent. Most of this error is probably due to problems with calculating the Spanish-surnamed minority.

The transportation file was last revised in 1970 and includes so-called "calibration" speeds. These are speeds assigned uniformly by roadway type and section of the city and should be entirely adequate. The intersection density is high, at 79/square mile, and the file adequately covers the urbanized area.

Cases 2, 5, and 6 were run for the city, while case 6 provided a bounding value for the metropolitan area. The transportation penalty was based only on the numbers of students bused, so that times and distances obtained will tend to be overestimates of what could be achieved.

The results show that nearly complete desegregation can be obtained for junior high and senior high schools with no transportation beyond what is required for students who would otherwise walk more than about one mile. Desegregation of the elementary schools, on the other hand, would require transporting some 34 percent of the students, compared with 14 percent who must be bused simply to get to school. In view of this large difference, it would be of interest to examine assignments for elementary schools that are intermediate between cases 2 and 5. The results of such assignments would fall somewhere in the shaded area shown in the graph.



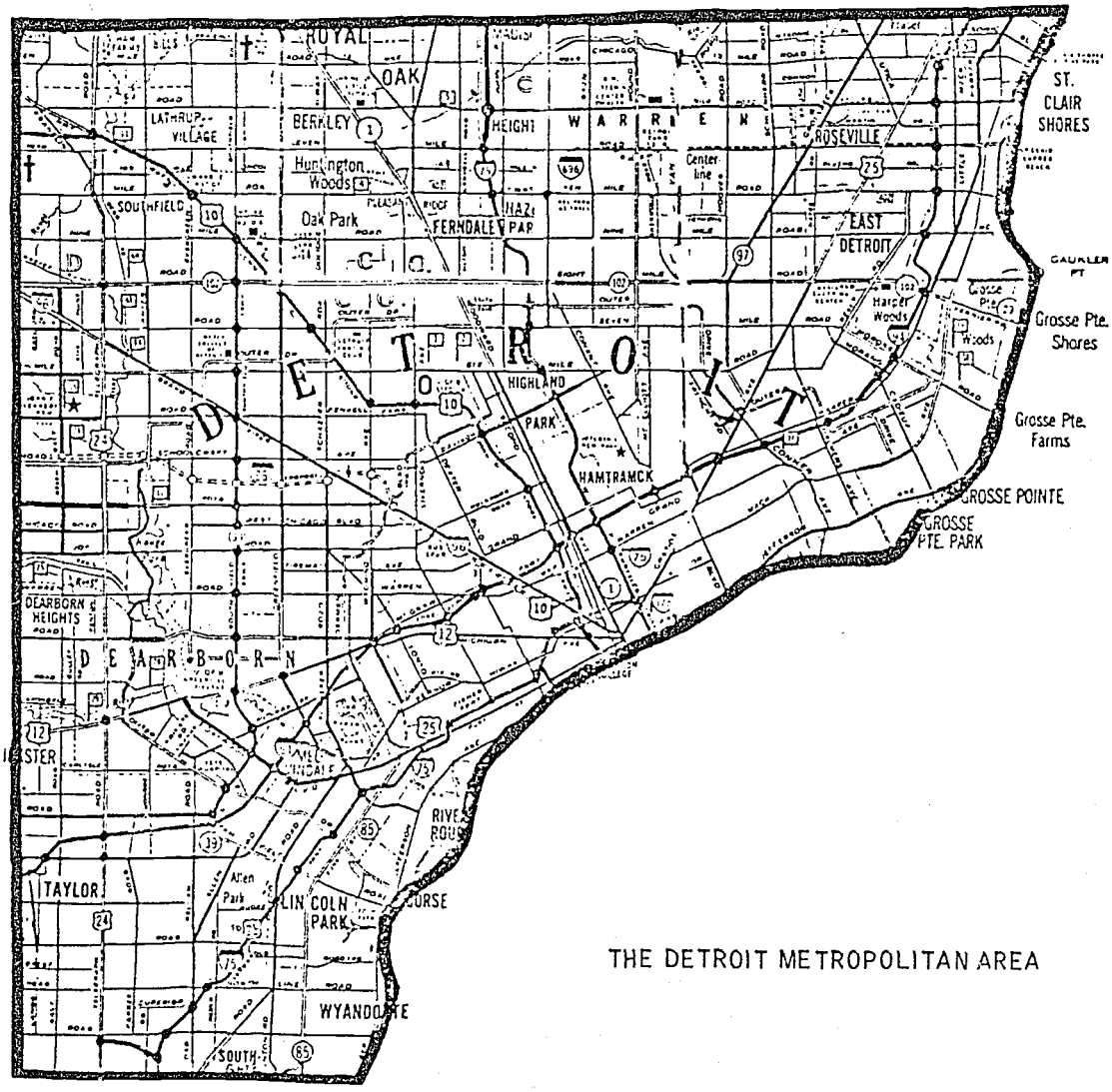
Graph of Achievable Desegregation

Denver, Colorado

Central-City Analysis

Detroit, Michigan

The Detroit center city area was selected as precisely the city of Detroit. The metropolitan area was delimited by latitudinal and longitudinal lines so as to include the area shown in the following map. This area includes Detroit City and the bulk of close-in suburbs; the bounds are Fourteen Mile Road to the north, Inkster Road to the west, the southern limits of Taylor, Wyandotte, and Southgate to the south, and the Canadian border to the east.



THE DETROIT METROPOLITAN AREA

The Detroit City School District serves the city and a host of small systems, the surrounding areas in suburban portions of Wayne, Macomb, and Oakland Counties. These suburban systems are not coterminous with other civil divisions, so that there are problems in defining study areas matched closely to existing school districts. (The study separately examined two northern areas, Pontiac and Ferndale, and we refer the reader to the reports on those districts.) It was the confusion of so great a number of imprecisely related civil divisions and school districts which led to our definition of the Detroit metropolitan area by latitudinal and longitudinal determination rather than by listing MCDs to be included.

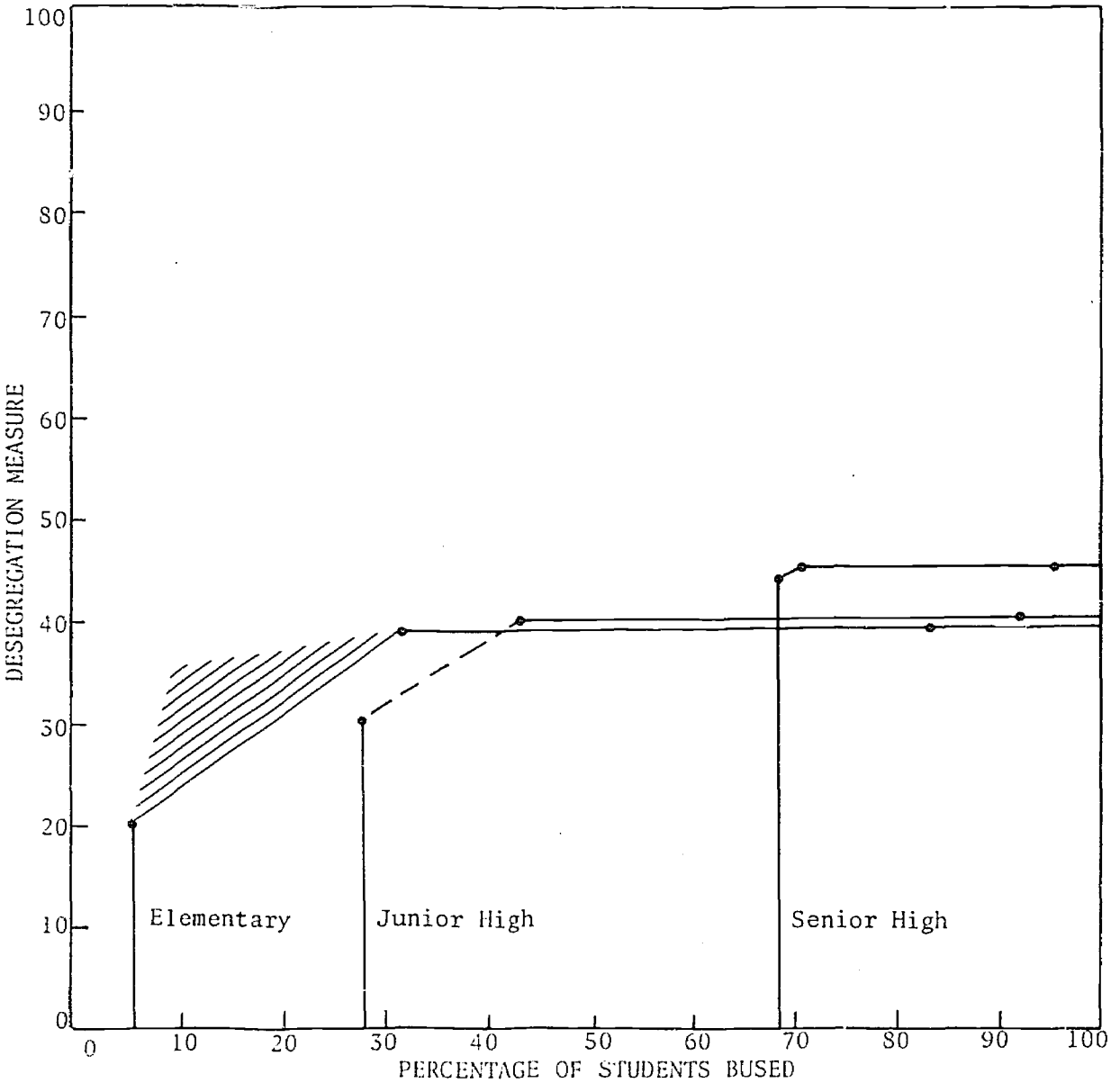
The population file used in the study lists a majority public school population of 40.5 percent in Detroit City, while the OCR Directory records 34.5 percent. Errors in this range are to be expected for large cities with heavy minority populations and is probably due to a much larger reliance of whites on private schools than was reflected in our files. The data, at any rate, can be considered only fair in quality.

The transportation files were last revised in 1967 and contain ADT (Average Daily Travel) speeds. The network more than covers the metropolitan area as we have defined it, but at a relatively low average density of intersections (9.1 per square mile). However, the inner areas are probably coded much more densely than this -- over 6000 intersections are coded altogether. All in all, the quality of the transportation network is good.

Cases 2, 5, and 6 were run for Detroit City and case 6 was run as a bounding case for the metropolitan area. In cases 2 and 5, only the number of students transported was minimized, so that times and distances of transport are overestimates of what is actually required. In the case 6 analyses, the only transportation constraint was the standard 35-minute limit on student travel time.

Results are quite typical for a city with the same general demographic and geographic characteristics: The senior high schools can be almost completely desegregated with no busing beyond the levels required to get all children to school, and the junior high schools can be desegregated with moderate increases in busing. Complete desegregation of the elementary schools would, however, require busing 28 percent of these children, compared with the minimum of 6 percent. The shaded area in the graph shows the range of results that could be produced in assignments intermediate between cases 2 and 5.

The metropolitan area case shows that desegregation is also feasible in the entire area, but since no limit was placed on transportation parameters, not even on the number of students bused, the results are of technical interest only and are not graphed.



Graph of Achievable Desegregation

Detroit, Michigan

Center-City Analysis

Duval County, Florida

Jacksonville and the remainder of Duval County are served by a single county school district. Thus no distinction was made between central city and metropolitan cases, and the area for all runs was the whole of Duval County.

The OCR Directory reports the school population of 122,493 to be 70.6 percent majority; the minority is entirely black with essentially no Spanish-surnamed Americans, American Indians, or Orientals. The population files used in the study had a total of 72.6 percent majority, so that the demographic quality is quite high.

The transportation files were last revised in 1970 and give peak season speeds, appropriate for our case. The intersection density of 28 per square mile is adequate, and the grid covers the entire county. The file must be rated as excellent in quality.

Cases 1, 2, and 5 were run for the county. In all cases, the computer program minimized not only the percentage of students bused but also the other transportation parameters -- walking distance and busing times and distance. Thus, the figures in the outputs for these parameters can be regarded as reasonably good estimates of what could be achieved.

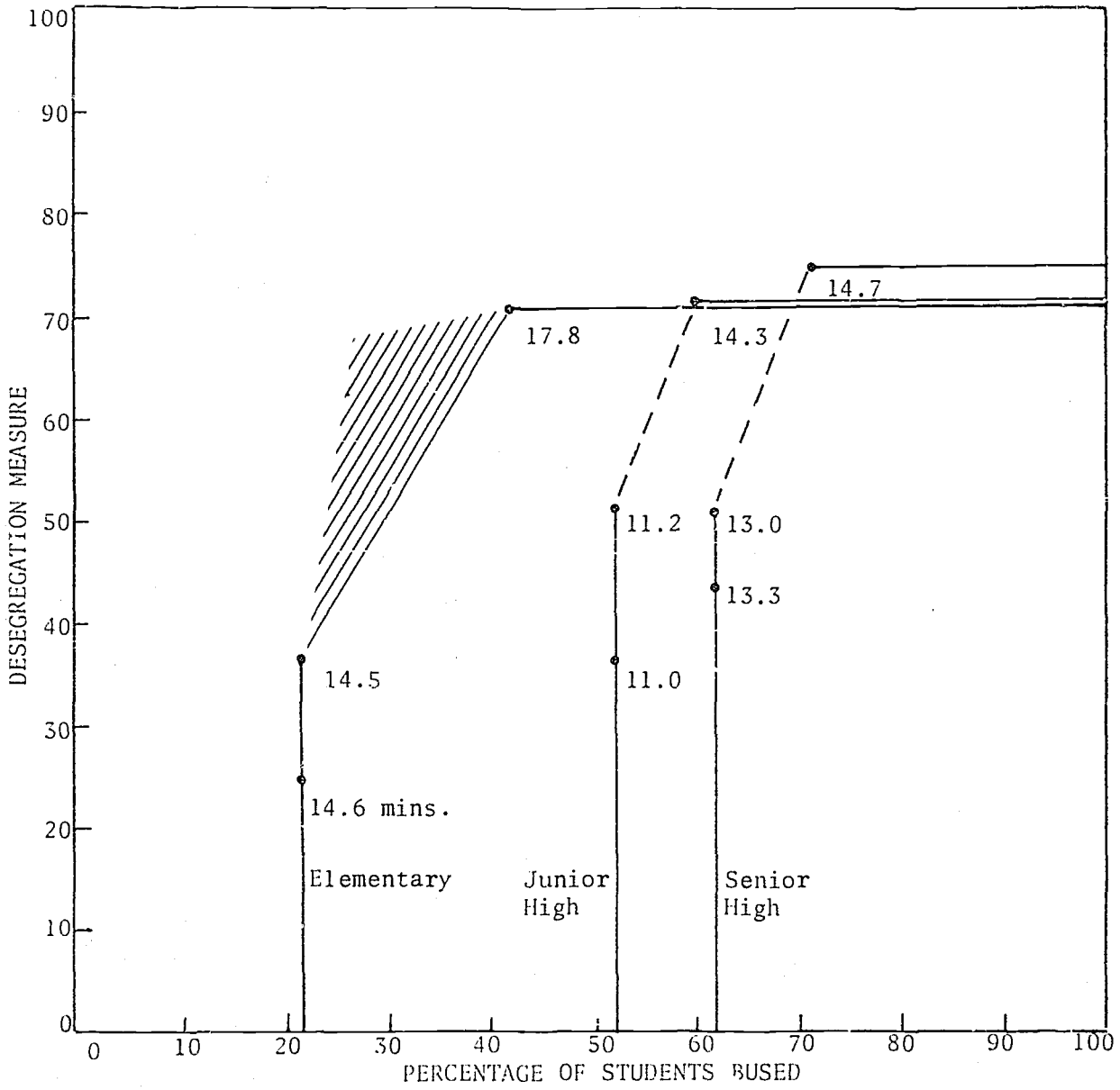
The results for Duval County are quite interesting. In the senior high schools, desegregation requires some 71 percent of the students to be bused, compared with 63 percent that would be required simply to get senior high students to their schools. The high level of busing, in the absolute, is typical, and

stems from the fact that such schools are relatively few in number and therefore distant from the bulk of the student population. It is unusual, however, that case 2 -- a minimum-transportation case -- produces a desegregation level of 42 (which is 58 percent of complete desegregation in the County); in most districts studied, case 2 produces more nearly complete desegregation. It should be noted that the increase in busing from 63 percent as a minimum to 71 percent in case 5 is indeed modest, and that other assignments could probably be produced that would approach complete desegregation without substantially more than 63 percent bused.

The junior high school situation is more like that found in other districts. The increase in busing required to desegregate -- from 52 percent as a minimum to 61 percent in case 5 -- is moderate.

In the elementary schools, a substantial increase in busing beyond the minimum is required to achieve complete desegregation -- 42 percent compared with 22 percent in the minimum-transportation assignment. The shaded area in the graph indicates the range of results of possible assignments that would be intermediate between cases 2 and 5 -- that is, assignments that might sacrifice a slight amount of desegregation achieved for a substantial reduction in transportation requirements.

Travel times in the neighborhood assignments are relatively high, reflecting the nature of the area. The increases in travel time to effect higher levels of desegregation are moderate.



Graph of Achievable Desegregation

Duval County, Florida

East Chicago-Hammond, Indiana

East Chicago, Hammond, and Gary are the most populous jurisdictions of Lake County, Indiana, which borders Cook County, Illinois. Three areas in all were analyzed in this survey: Gary, the East Chicago and Hammond area, and the whole of Lake County. This section reviews the latter two studies; the Gary analysis is presented in another section of this report.

The following table lists the racial makeup of the school population for several of the townships which form Census MCDs and which include the principal jurisdictions of our study:

MCD	Township	Places Within Township	Majority	Minority
5	Calumet	Gary	15,747	23,970
30	Hobart	Gary, East Gary	11,059	147
35	North	East Chicago, Hammond	35,371	10,028
--	All Others		21,463	49
			83,640	34,194

The term "center-city analysis" is inapplicable to these areas. Instead, the East Chicago and Hammond area is studied using the cases ...dinarily applied in center-city analyses. The metropolitan area is defined here as Lake County, even though this area has a higher percentage of minority population than the smaller area.

Lake County's townships are in turn divided into school districts (none of which crosses township lines) for a total of 14. The division into districts

in itself represents de facto segregation of schools, as the following breakdown illustrates:

Calumet Twp. Districts	Enrollment	Percent Majority
Gary	46,595	26.0
Griffith	4,468	97.6
Lake Ridge	5,925	83.7
Total	56,988	37.6
North Twp. Districts		
East Chicago	9,986	24.4
Hammond	4,320	87.5
Highland	6,868	99.0
Munster	4,295	98.5
Whiting	1,138	95.9
Total	26,607	68.9

The racial compositions shown in the table are from 1970-1971 enrollments as reported to the Office for Civil Rights. The school population file used in this study for North Township is 77.8 percent, a difference of 9 percentage points. Thus, the quality of the demographic information for the East Chicago-Hammond analysis is only fair, and the results should be interpreted in that light. The population file used for the separate Gary analysis shows 37.6 percent majority, an exact match; therefore the combined data used for the whole of Lake County is somewhat better than that used for the East Chicago-Hammond analysis.

The transportation data was part of the Chicago area file, which was last revised in 1969. The speeds are posted speeds, which are difficult to relate to speeds that would actually be experienced. For this reason the times of travel as calculated in the study must be regarded as only fair estimates of actual times.

The school grade organizations in Lake County are mixed, with two methods predominant: K-6/7-9/10-12 and K-6/7-8/9-12. The study used the former of these systems, the so-called junior high system.

For the East Chicago-Hammond area, cases 1, 2, 5, and 6 were run; all transportation parameters were minimized in all these cases except case 6. For Lake County as a whole, cases 1, 5, and 6 were run; in cases 1 and 5 all transportation parameters were minimized. The time estimates for the cases in which travel distances were minimized can therefore be regarded as meaningful, with the reservations we have noted above concerning the speeds in the transportation file. In the other cases, no attempt was made to minimize travel times and therefore these times are overestimates of what would be required.

The analysis of the East Chicago-Hammond area indicates that the junior and senior high schools can be desegregated without any great increase in the number of students transported in excess of that which is required to transport children who live more than a one-mile walk from school. However, a significant increase in the average travel time is required. In the elementary schools complete desegregation would require busing some 26 percent of these students,

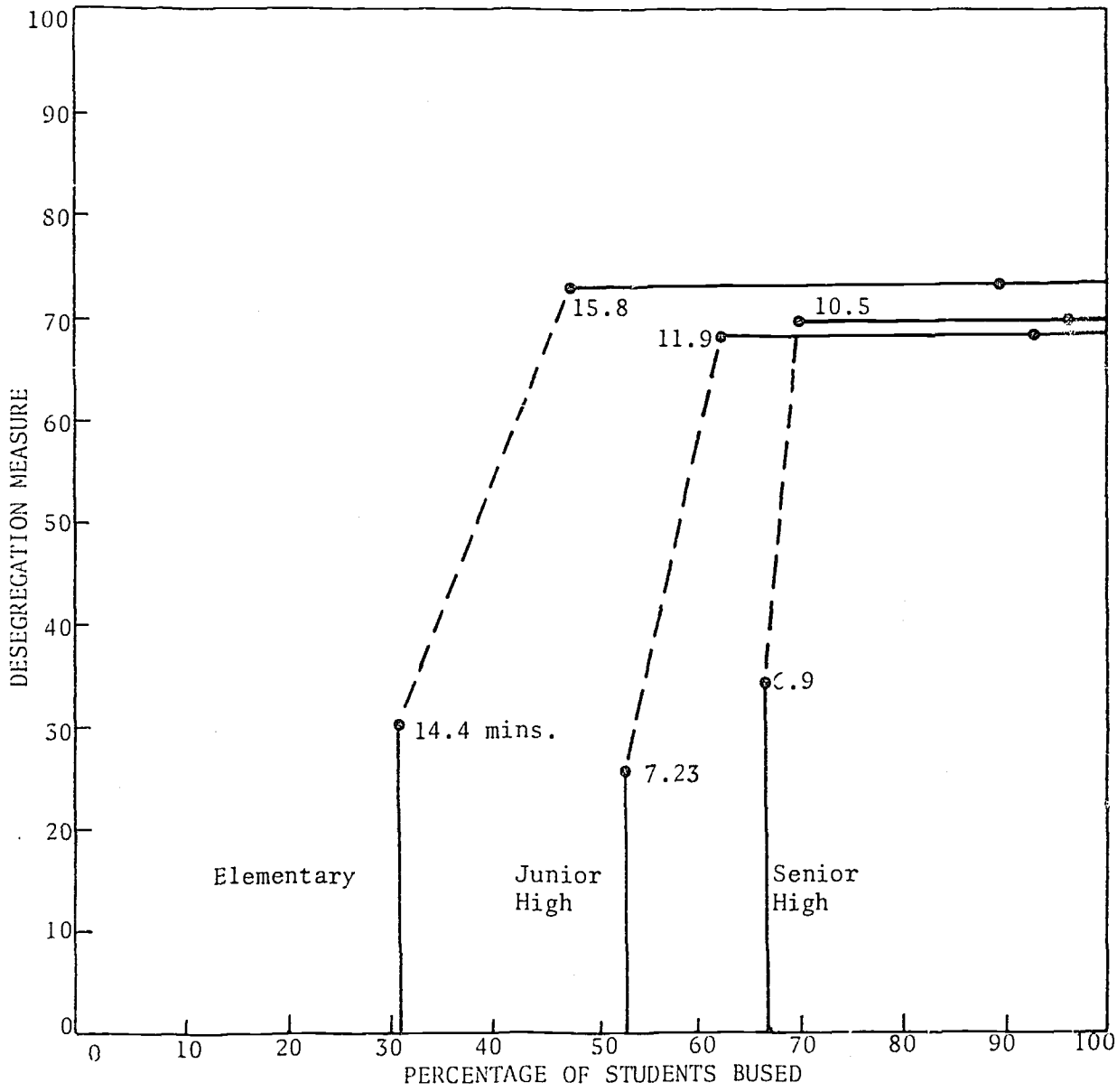
compared with 16 percent who would have to be transported in any event. Because this is a relatively large increase, it would be of interest to develop additional assignments intermediate between cases 2 and 5 -- assignments that might significantly reduce busing requirements from case 5 levels with only a relatively small lowering of the desegregation achieved. The shaded area in the graph indicates where the results of such intermediate assignments would lie for the elementary schools.

Note that for all three grade levels the average travel times almost double in moving from case 1, the "colorblind" minimum-transportation assignment, to case 2. This is because in case 1 the students who must be bused are assigned to relatively nearby schools, whereas in case 2 the buses are loaded in much the same way but are then redirected to reduce racial isolation.

The analysis of Lake County is similar to that of the East Chicago-Hammond area in that case 5, in which extensive desegregation is sought, produces very nearly complete desegregation at very modest increases in busing for the secondary schools but with a somewhat larger increase in the elementary schools. Again, intermediate assignments for elementary schools could probably be produced that would provide a better balance in transportation at relatively small sacrifice in desegregation achieved.

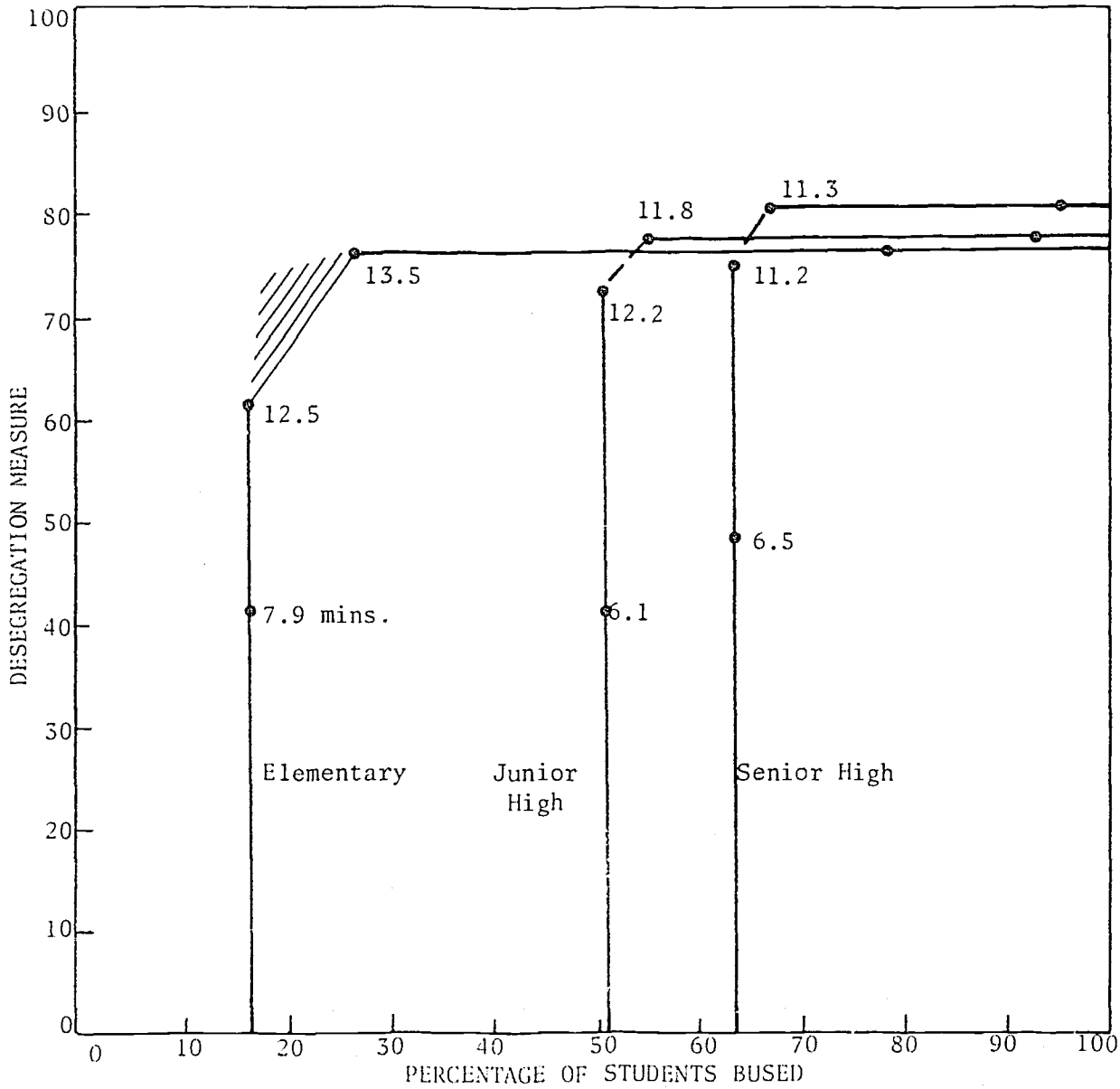
In reflecting on these results it is necessary to keep in mind the tabulation presented above. There is district-to-district segregation (as, within districts there are racially identifiable schools). It should be noted, however, that much

of the desegregation effect achieved in assignments in this study is due to assigning children to schools outside their current school districts. Thus -- even though, except for the Lake County cases, the children are assigned within their townships -- the assignments may not be consistent with the intent of court orders in the area.



Graph of Achievable Desegregation

Lake County, Indiana
(Gary, East Chicago, Hammond)



Graph of Achievable Desegregation

East Chicago, Indiana
(including Hammond)

East St. Louis, Illinois

East St. Louis Township is served by five school districts in all, the two largest being the East St. Louis system and the Cahokia District. These five districts serve not only East St. Louis but also Canton, Caseyville, and Centreville Townships. Therefore this combination of districts and townships was selected for the center city case. The metropolitan East St. Louis area examined in this study was that portion of St. Clair County defined as urbanized area by the U. S. Census. This area comprises the following townships of the County.

	Under-18 Population	Percent Majority
Belleville	9,462	99.2
Canton	4,627	100.0
Caseyville	9,675	99.9
Centreville	16,651	67.1
East St. Louis	26,076	18.1
O'Fallon	3,443	99.5
St. Clair	6,498	100.0
Shiloh Valley	4,318	90.3
Stites	743	6.6
Stookey	3,610	100.0
Sugar Loaf	2,521	98.0

The school population assigned in Lambda programs was 51.9 percent majority in this central area, while OCR reports about 44 percent majority in the schools involved. Errors of this size have been difficult to avoid because the

fraction of whites attending schools in black majority schools is significantly lower than expected from our data sources.

The transportation file was combined with that of St. Louis; this file, last corrected in 1966, has an average intersection density of about 11 per square mile, one of the less dense systems we have used. The speeds listed were simply speed limits, but the average speeds obtained on the bus routes selected are quite reasonable, a little over 20 mph. All in all the transportation data quality may be judged as fair.

The schedule of runs made for East St. Louis was different from that for most of the other cities and seems, in fact, superior for the costs involved. First of all, all runs involved a walking penalty and a riding penalty per mile, so that a simultaneous minimization of numbers bused and distances walked or transported was achieved.

Cases 1, 2, and 5 were run for the central city. Cases 1 and 5 were run for the metropolitan area; these cases give some idea of the relationship of busing with desegregation results in the metropolitan area, in contrast to the analyses (using case 6) applied to most other school districts.

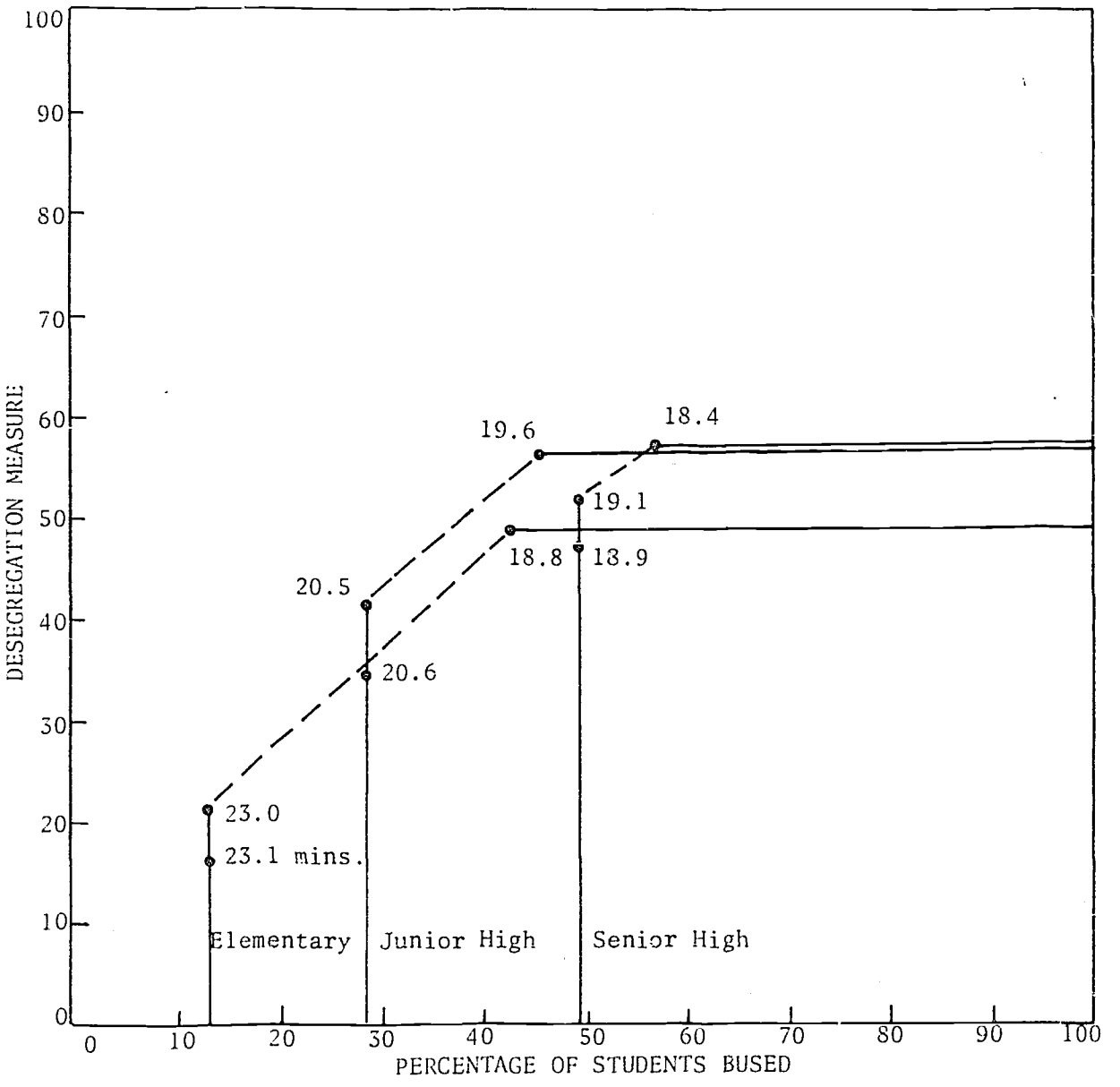
The results show that the extreme degree of racial isolation in housing requires quite extensive additional busing as a remedy. The reader is reminded, however, that our center city is larger than the actual East St. Louis school district, so that the percentage of whites in the area is much higher than in

East St. Louis proper, which is a black city. Thus some measure of meaningful desegregation is possible in our case, although this is debatable for East St. Louis proper.

In the center-city analysis, the levels of busing to achieve desegregation are quite large, as can be expected when racial isolation in housing is as pronounced as it is here. Although the increase in the senior high schools -- to 56 percent compared with 49 percent that would be required in any event -- is moderate, it is still larger than is required in many other districts studied. In the junior high and elementary schools, however, the increases are substantial. The shading on the center-city graph indicates the area in which would lie results for intermediate assignments between cases 2 and 5 for the elementary schools.

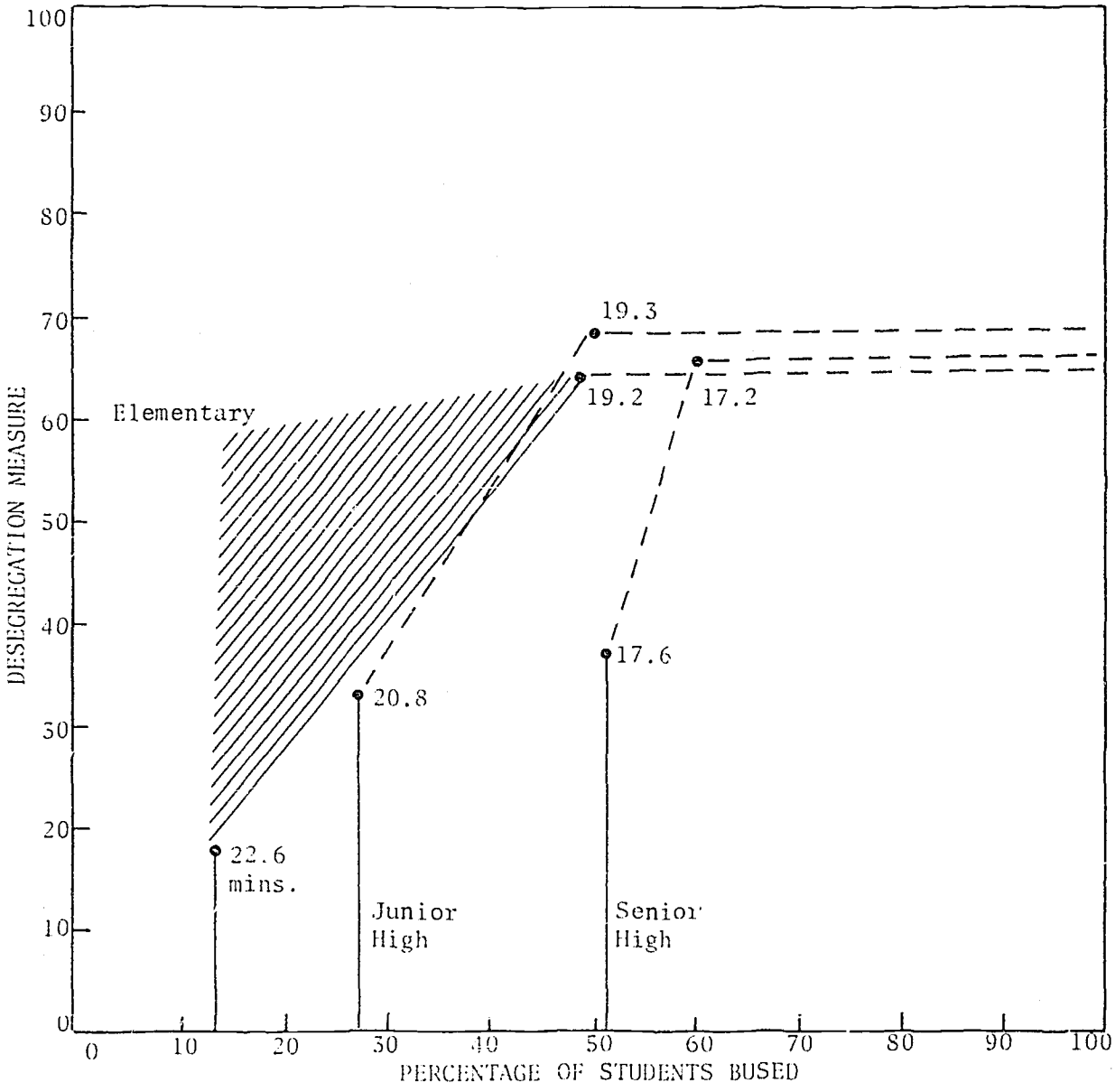
Very much the same results appear to apply in the metropolitan area analysis as in the center-city analysis. The shaded area in the graph depicts the range of results that would be produced from cases intermediate between case 1 and case 5 for the elementary schools.

It is interesting to note that, in the desegregation cases analyzed both for the central school district and the metropolitan area, there is either no increase or actually a decrease in travel times occasioned by desegregation assignments. Travel times for all assignments are higher than in many other areas, however, which is a function of the areas and the road network.



Graph of Achievable Desegregation

East St. Louis, Illinois
Center-City Analysis



Graph of Achievable Desegregation

East St. Louis, Illinois
Metropolitan Area Analysis

El Paso, Texas

The El Paso urban area, as defined by census, includes three divisions of El Paso County, as follows:

Minor Civil Division	
5	East Central Division
10	El Paso Division
15	North Central Division

El Paso Division is served by both the El Paso School District(# 18300) and by Ysleta District (# 46680). El Paso District also serves North Central Division and East Central Division in part. The latter division is also served by Socorro Division, consisting of only two schools. This intertwining of school districts makes it difficult to treat El Paso School District separately, or even El Paso Division separately, so that the three divisions and three school districts were analyzed as a unit.

The following data shows the racial composition of the school districts:

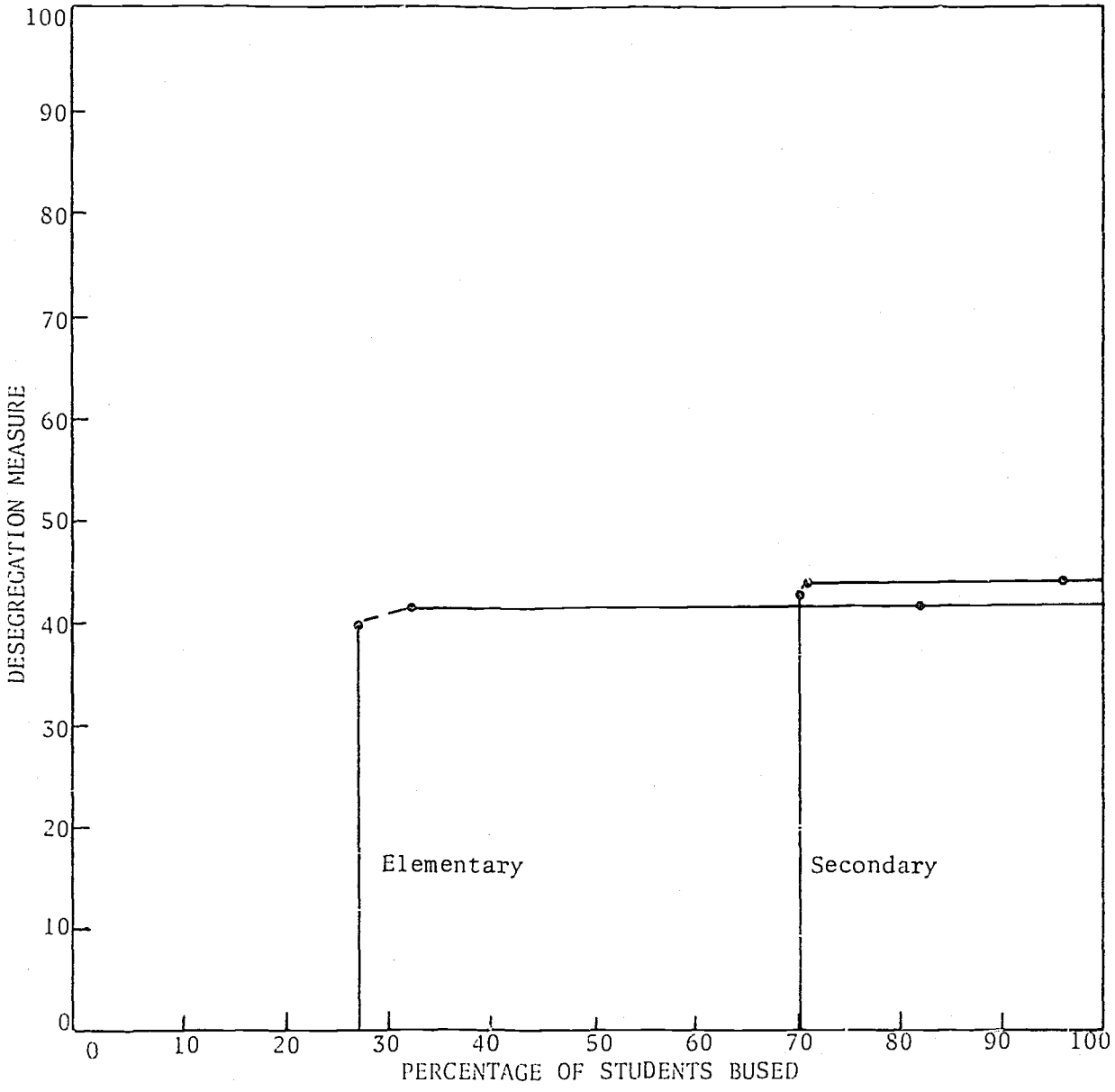
	Total Enrollment	Percent Black	Percent Mexican-American	Percent Other
El Paso	62,545	3.0	56.5	40.5
Socorro	1,483	0.3	81.7	18.3
Ysleta	33,262	2.7	61.6	35.7
Total	97,288	2.9	58.6	38.5

Almost the entirety of the minority student population is composed of Spanish-surnamed children. El Paso is typical of the difficulties in dealing with this minority group (essentially because they are not identified as such on the First-Count census tapes.) The method used here resulted in the student population file containing 42 percent of "other" students so that Chicanos are slightly under-represented in the files as analyzed, but not so severely as to invalidate results.

The road data employed was revised in 1970, and speeds are average daily travel (ADT). The 2,191 intersections, spread over about 49 square miles, have an average density of 45 per square mile, so that they are spaced at average .15 mile intervals, sufficient for good accuracy in attaching schools and block groups to the network. The overall quality of the road network is good.

Cases 2, 5, and 6 were run for El Paso; only the number of students bused was minimized, so that travel times and distances shown in the computer outputs are higher than could be achieved in an assignment designed to minimize travel distance.

The results of the analysis show that nearly complete desegregation is possible with no transportation more than that required for children who live more than one mile from school. The results are unusual: In many districts it is possible to desegregate secondary schools with no additional busing; but in very few is it possible, as it is in El Paso, to desegregate elementary schools with no additional transportation burden. Enrollment figures for the 1970-1971 school year, on the other hand, indicate that a number of schools were racially identifiable at that time.



Graph of Achievable Desegregation

El Paso, Texas

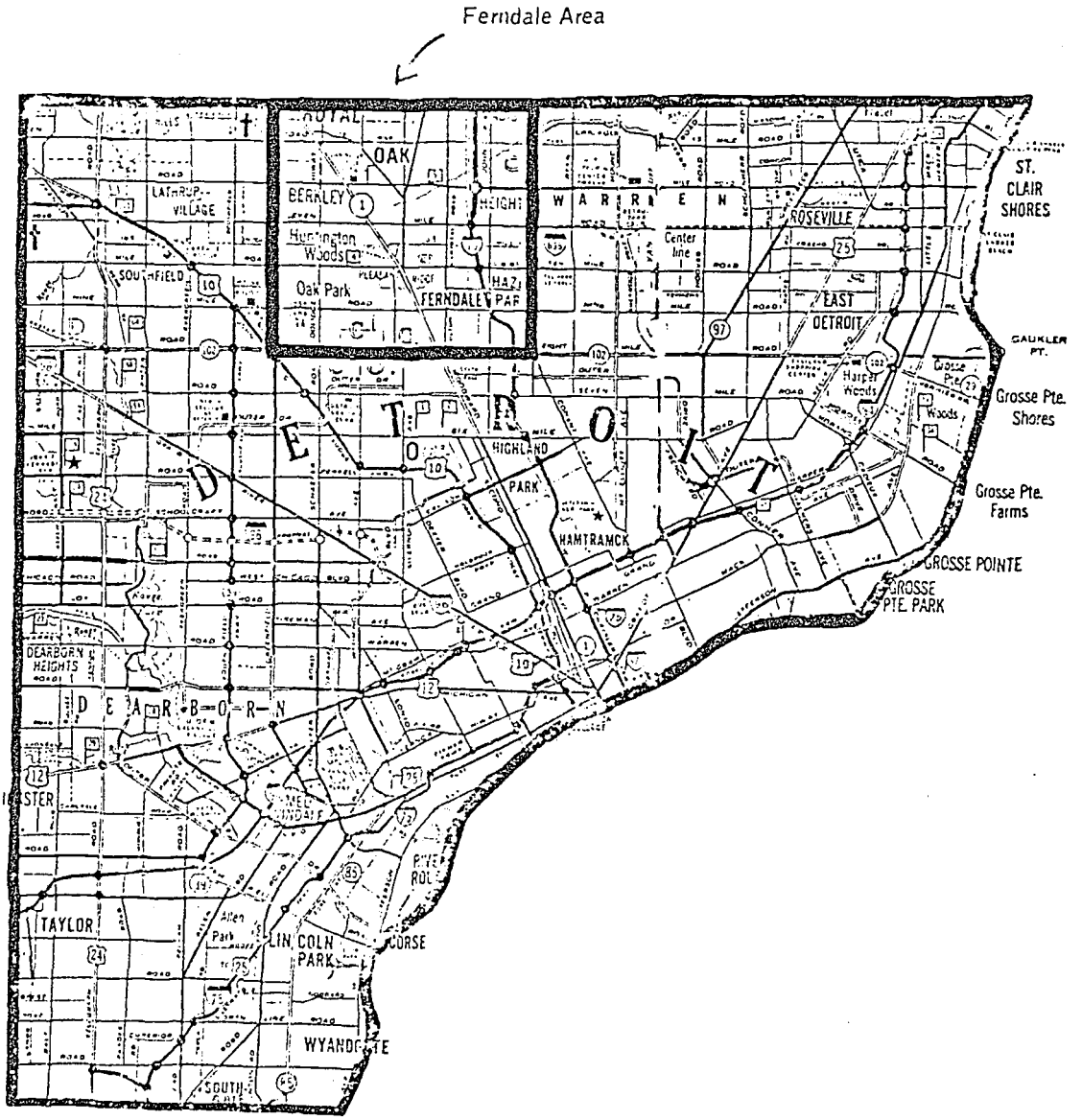
Ferndale, Michigan

The Ferndale City School District is administered from Ferndale, Michigan, but actually serves an area composed of Pleasant Ridge, one fifth of Oak Park, a small part of Royal Oak, and almost all of Ferndale. Royal Oak and Oak Park also have school systems headquartered in those towns, and these districts are similarly confusing as regards their boundaries, in relationship to boundaries of Minor Civil Divisions. At the stage in the study that Ferndale was to be treated, it was not possible to select the study area except by the choice of MCDs to be included, or by a rectangular delimitation, as was done for Detroit. Therefore it was decided to run a number of intertwined districts as a unit, including all those checked on the table listing major Oakland County school districts. In addition to the communities listed as district names, Huntington Woods and Pleasant Ridge were included. The map shows the Ferndale area as a six-mile square bordering Detroit.

Practically all of the area's Negroes of 18 years or less, about 1600 children, live in Royal Oak Township (as distinct from Royal Oak). These children are split up principally between the Ferndale and Oak Park city school systems, with a few attending Royal Oak schools. In Ferndale nearly all of the Negroes of elementary school age attend the same school (one of ten in the district). In Oak Park City School District a similar situation exists, with about two thirds of the children attending nearly totally black Carver School, one of six elementary schools.

Major School Districts in Oakland County, Michigan

School	Enrollment	Percent Majority	Included in Ferndale Area
Avondale	3866	99.1	
Berkley City	8194	99.3	√
Birmingham City	16912	99.4	
Bloomfield Hills	9461	98.9	
City of Troy	6433	99.4	
Clarenceville	3831	99.7	
Clarkston Comm.	6620	99.0	
Clawson City	5088	99.2	
Farmington	16367	99.5	
Ferndale City	8138	89.7	√
Hazel Park City	7868	99.0	√
Holly Area	3609	96.8	
Huron Valley	7298	99.5	
Lake Orion	5545	98.9	
Madison Hts.	4646	98.7	√
Oak Park City	5524	89.6	√
Pontiac City	24055	62.2	
Rochester Comm.	8696	99.6	
Royal Oak City	18582	99.4	√
South Lyon Comm.	3079	99.1	
Southfield	16333	99.4	
Walled Lake Cons.	10615	99.3	
Waterford	18264	98.7	
W. Bloomfield	4967	98.9	



The Ferndale Area in Relationship to the Detroit Metropolitan Area

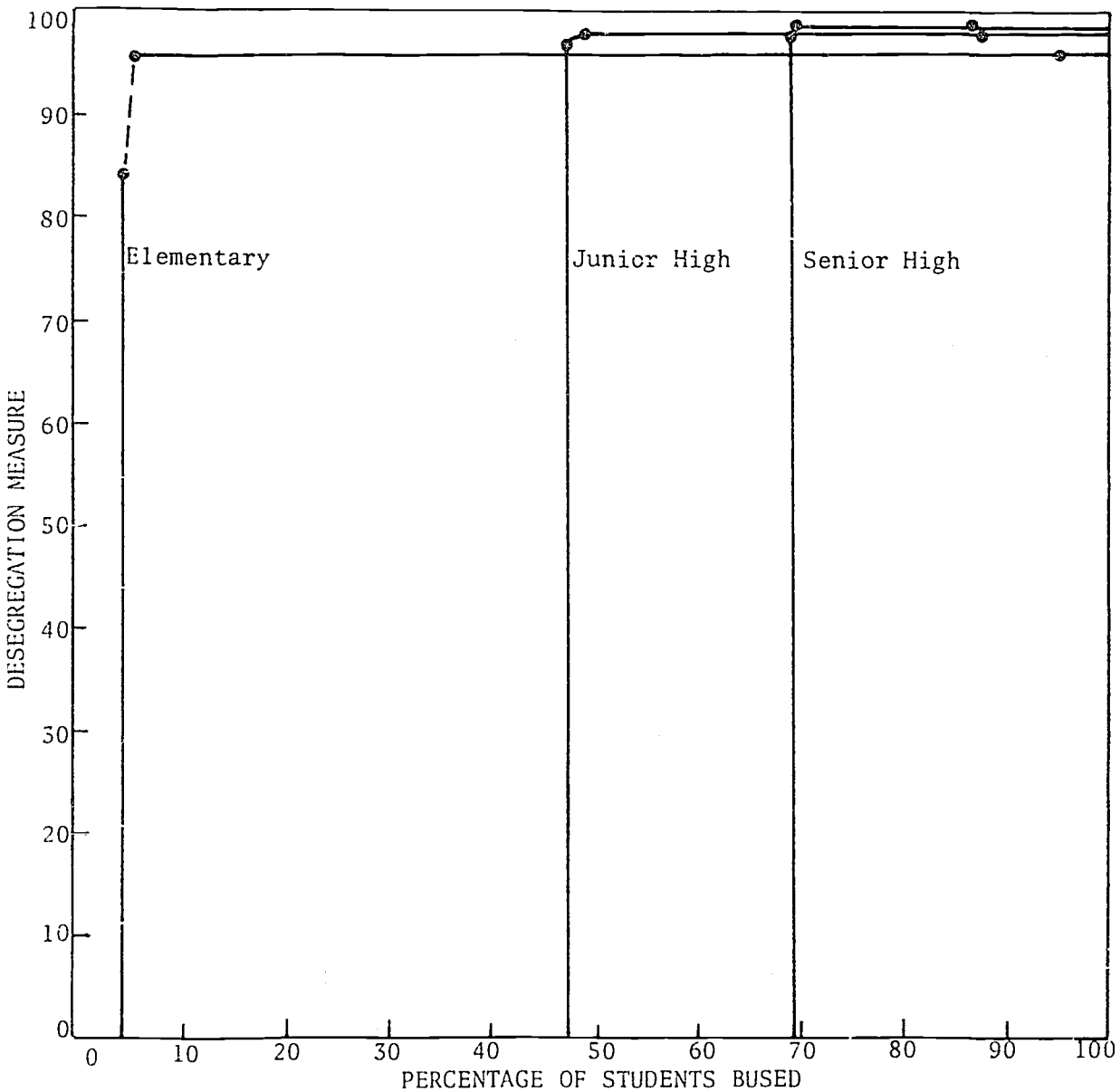
It is difficult to judge the quality of the demographic files because of the geographic problems involved. Basically, however, the population files locate about 1300 black students, and the OCR school files list an attendance of about 1500. This is close enough agreement to put some reliance in the files.

The transportation file used was the same as that used for Detroit, a file of good quality.

Cases 2, 5, and 6 were run for Ferndale. The only transportation parameter that was minimized is the percentage of students bused; travel times and distances reported in the computer outputs are therefore overestimates of what could be achieved. The conclusion is that virtually no additional busing is required for complete racial balance in the area. In practice, all that needs to be done is to desegregate a handful of schools in Ferndale, Oak Park, and Royal Oak City.

At the junior high and senior high school levels, case 2--a minimum-transportation assignment--provides such a high degree of desegregation that it is unnecessary to resort to additional busing.

In addition to the standard cases, a special case--not plotted on the graph--was run with grade reorganization permitted. In this case the capacity of each school is considered unspecialized by grade level, so that, for instance, high school students may attend what is now a grade school. As one expects, the lowered transportation requirement has the effect of lowering average distances from homes to schools, so that for the minimal transportation case, the level of segregation increases, and because the distinction between grade groups is lessened, the results for each group are now very similar.



Graph of Achievable Desegregation

Ferndale, Michigan

Fort Wayne, Indiana

Fort Wayne forms part or all of the following townships of Allen County, Indiana:

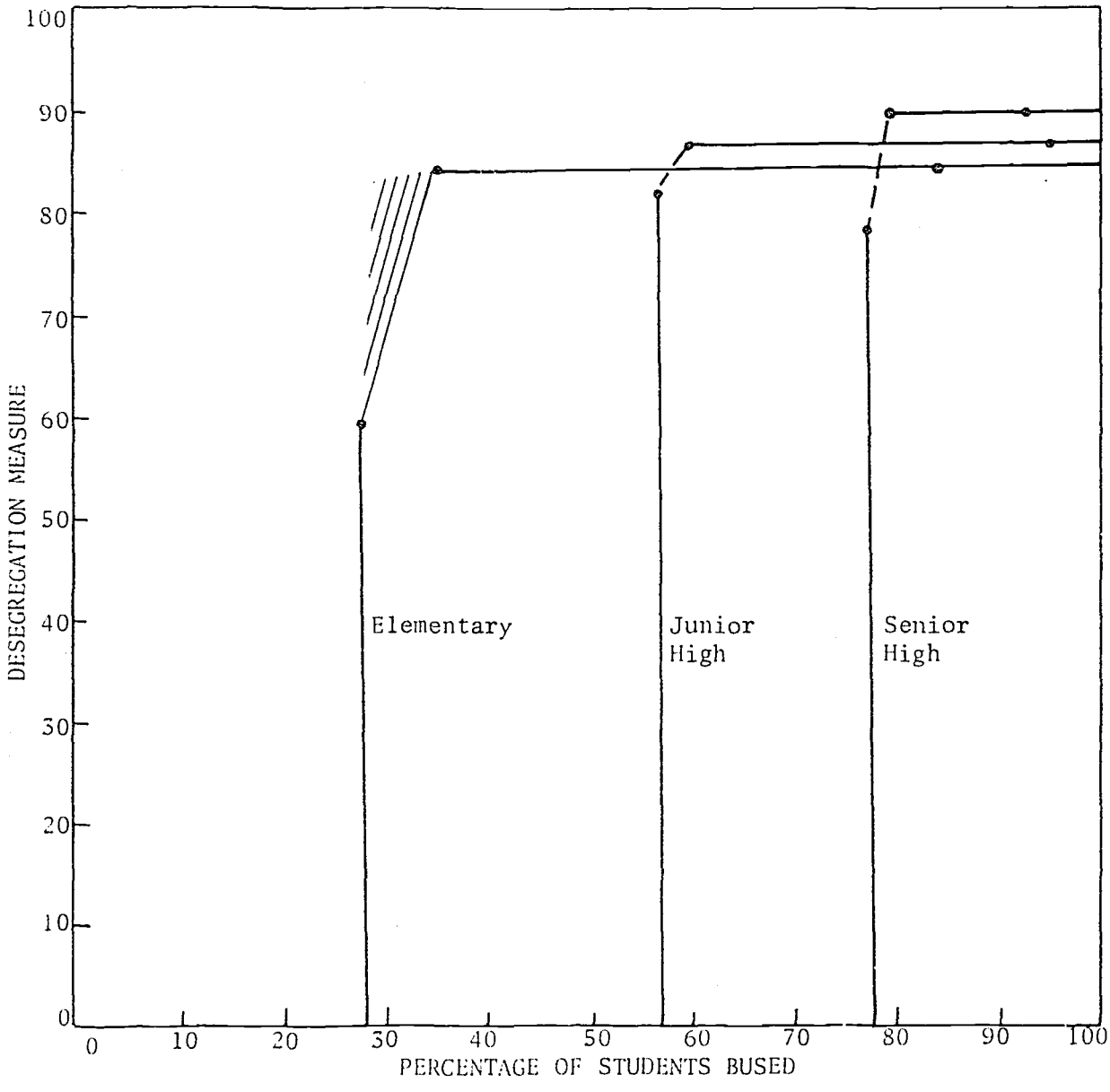
10	Adams Township (Part)
75	Pleasant Township (Part)
80	St. Joseph Township (All)
85	Scipio Township (Part)
95	Washington Township (All)
100	Wayne Township (All)

These townships are served by four different schooi districts, including the Fort Wayne Community School District, which extends into all of those townships except Scipio. For this reason the central city case was defined as the set listed above, except Scipio. A metropolitan case was not analyzed, since the urbanized area included very little more population than the central city as it is defined here.

The percentage of majority students in Fort Wayne Community School District is listed by OCR as 83.3, while the figure for our definition of the central district is 86.6. These figures are not directly comparable, however, since slightly different areas are involved. The match is actually closer than it first seems, since there are about 10 percent more people, mostly white, in the area analyzed than in the area served by the district.

The transportation file was revised in 1967 and contains average daily travel (ADT) times. The coverage is adequate and the density is high, so that the file is very good in overall quality.

Cases 2, 5, and 6 were run without penalty on transportation measures except for numbers of children transported. The results show that compiete desegregation can be achieved in junior high and senior high schools with very little transportation beyond the levels required to be assured that all children can get to school. To desegregate the elementary schools would require transporting 36 percent of these students, compared with the minimum of 27 percent. It might be desirable to consider assignments between cases 2 and 5, that would produce almost complete desegregation as case 5 but with significantly less busing. The range of results that would be produced from such assignments is shown in the shaded area on the graph.



Graph of Achievable Desegregation

Fort Wayne, Indiana

Fort Worth, Texas

The Fort Worth central district was defined as Fort Worth Division, which includes Fort Worth, as well as the communities of Westover Hills, Blue Mound, Edgecliff, Everman, Saginaw, Sansom Park Village, Lake Worth Village, Westworth, White Settlement, and River Oaks.

Fort Worth is served by several school districts in addition to the large central district. These are indicated in the accompanying table, with superintendents' office locations in parentheses, where these differ from the district name.

	Enrollment	Percent Majority	Percent Spanish
Arlington ISD	21,924	95.5	2.2
Azle	2,742	98.4	1.3
Birdville (Ft. Worth)	14,255	98.5	1.2
Castleberry (Ft. Worth)	4,254	95.3	4.0
Crowley	1,041	-	-
Eagle Mt. - Saginaw (Saginaw)	2,145	-	-
Everman (Ft. Worth)	3,083	-	-
Ft. Worth	84,057	63.7	9.2
Kennedale	910	97.2	2.2
Lake Worth (Ft. Worth)	1,846	94.5	5.3
Mansfield	2,430	90.0	1.7
Masonic Home (Ft. Worth)	213	-	-
White Settlement (Ft. Worth)	3,368	97.4	1.9

Six districts operate within Fort Worth Division, so that our central district combines several school districts. This group of districts has an

overall majority percentage of 72.5 percent, according to the OCR directory, compared to 74.2 percent on the school population file. A large number of minority students, especially in suburban locations, is Spanish-surnamed, so that three races are present in substantial numbers. The program, however, treats both Spanish-speaking and Negro students as indistinguishable minority students.

The transportation file, which includes Dallas, was last revised in 1964 and contains Average Daily Travel times. The link and intersection densities are good and the coverage is adequate.

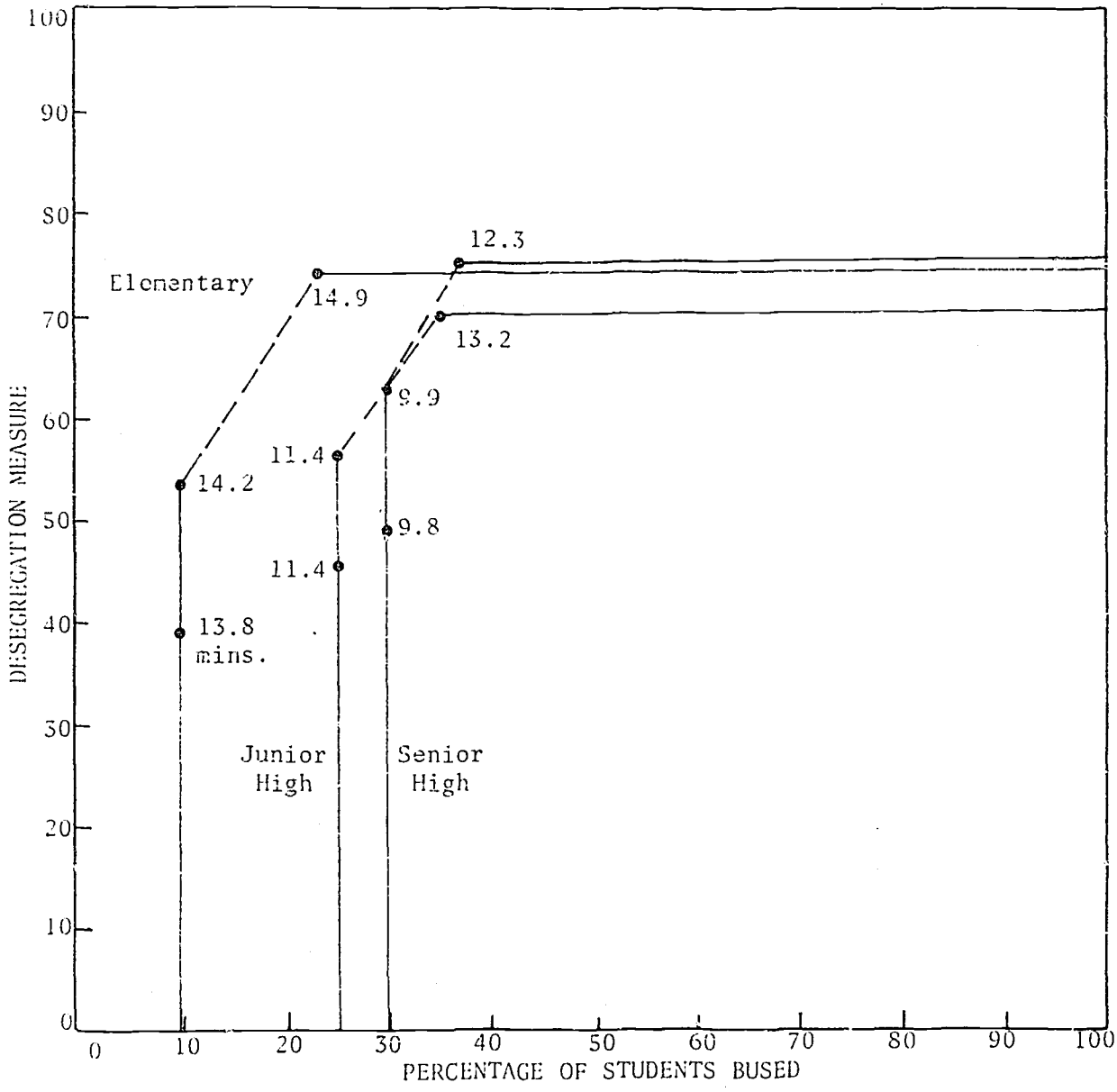
For Fort Worth, cases 1, 2, and 5 were run. For the metropolitan area, cases 1 and 5 were run. All transportation parameters were minimized in all cases, so that the travel times can be regarded as reasonable estimates of what could be achieved.

The results of the Fort Worth center-city analysis are interesting in several ways. As the graph clearly illustrates, the curves for all grade levels have approximately the same shape. The desegregation-with-minimum-transportation assignment--case 2--produces a level of desegregation significantly less than complete. This is to be expected, compared with results of analyzing other districts, for elementary schools, but, in general, case 2 almost completely desegregates senior high schools and approaches desegregation of the junior high schools. Case 5, as usual, produces essentially complete desegregation in all grade levels. It is also noteworthy that the secondary schools

in Fort Worth require so little busing relative to the results found from examining other school districts. Finally, it is interesting that travel time does not increase substantially in the desegregation assignment, case 5, compared with the minimum-transportation cases.

The results of the metropolitan area analysis are similar to results for Fort Worth itself, except for the larger increases in average travel time.

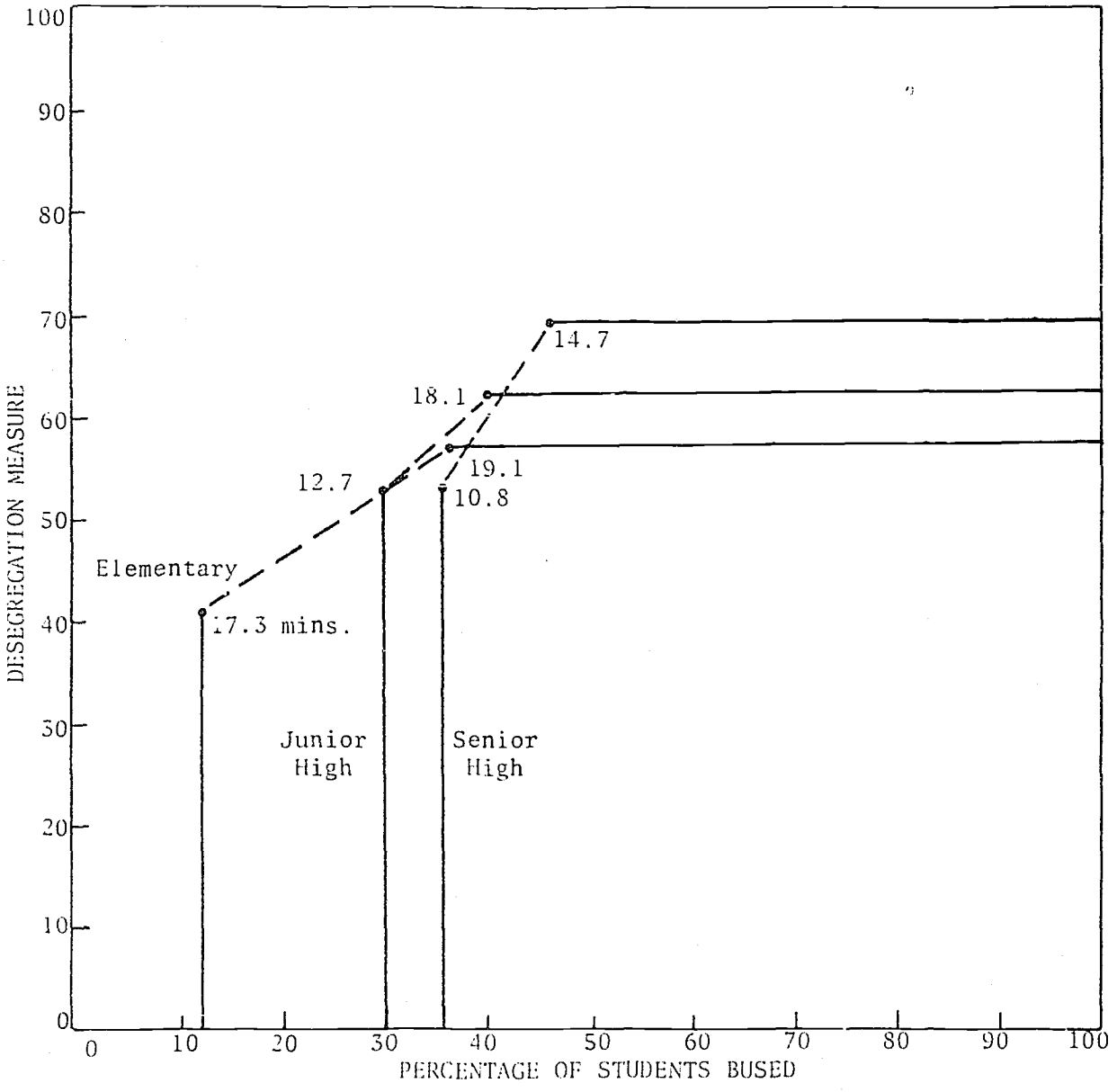
It should be noted that "desegregation" in the context of this analysis is determined by the proportionate assignment of majority and minority; no distinction is made here between the Negro and the Spanish-surnamed minorities. If schools were to be desegregated to balance these minorities separately, additional transportation would be required.



Graph of Achievable Desegregation

Fort Worth, Texas

Center-City Analysis



Graph of Achievable Desegregation

Fort Worth, Texas

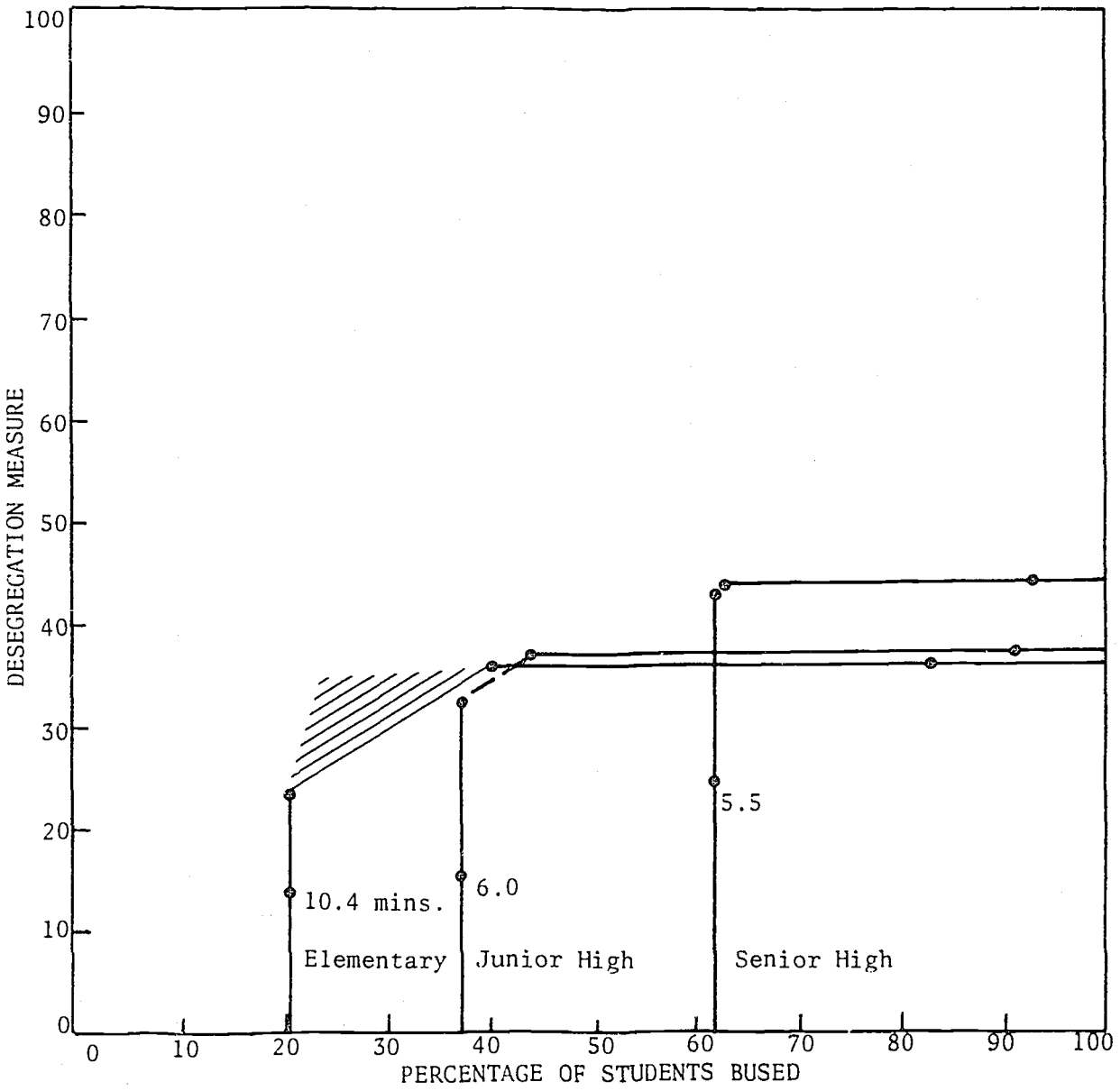
Metropolitan Area Analysis

Gary, Indiana

Gary is part of the complex which includes East Chicago (Indiana) and Hammond, which constitutes the bulk of the population in Lake County, Indiana. Three areas were analyzed for this survey: Gary, which is reported here; the East Chicago and Hammond area; and Lake County as a metropolitan area. The East Chicago-Hammond and the Lake County analyses are to be found in this report under East Chicago. The reader should also refer to that section for a discussion of the data files used for Gary.

Cases 1, 2, 5, and 6 were run for Gary. Only in case 1 are the travel times and distances meaningful, since only in this case did the program explicitly minimize these parameters.

The results are typical for areas examined in this survey. The senior high schools are very nearly completely desegregated in the case 2 minimum-transportation assignment. Desegregation of the junior high schools requires some busing other than what is required to transport students who live more than one mile from school -- some 44 percent of the students are bused in case 5, compared with 37 percent in the minimum-transportation assignments. In the elementary schools, however, considerable busing above the minimum is required for complete desegregation -- 40 percent, compared with 20 percent in case 2. In this kind of situation, it is prudent to consider alternative assignments that might sacrifice somewhat the level of desegregation to be achieved at a benefit of considerable reduction in the amount of busing necessary. Intermediate assignments such as these would produce results lying somewhere in the shaded area in the graph.



Graph of Achievable Desegregation

Gary, Indiana

Hartford, Connecticut

Hartford City is served by the Hartford School District, although a few children are bused to outlying towns as part of Connecticut's Project Concern. The number is not large enough to invalidate our selection of Hartford itself as the central district. Connecticut is divided into cities and towns, and these form the most important civil divisions; each surrounding town has its own school system, coterminous with town boundaries. The metropolitan area was selected as the urbanized area, except that Cromwell, in Middlesex County, is omitted. The following towns are included in the metropolitan area analysis:

	Enrollment	%Majority
Bloomfield	4,474	80.3
E. Hartford	12,374	97.5
Glastonbury	5,661	98.4
Hartford	28,754	33.2
Manchester	10,302	98.2
Newington	6,657	97.5
Rocky Hill	2,131	98.6
S. Windsor	5,334	97.9
W. Hartford	13,153	96.6
Withersfield	6,063	98.5
Windsor	5,701	95.4
Vernon	7,227	98.6

The population file used in this study lists the Hartford school population as 54.7 percent majority, so that it is in error by over 20 percent. This error would seem to indicate that an extremely high fraction of white students in Hartford attend private schools.

Hartford has fairly recently converted to a middle school system, so that each of the three high schools accepts students in grades 9-12. The attendance zones for middle schools will eventually be identical to those for the high schools, but this is not yet true. The JHS system -- 1-6/7-9/10-12 -- is used in this analysis.

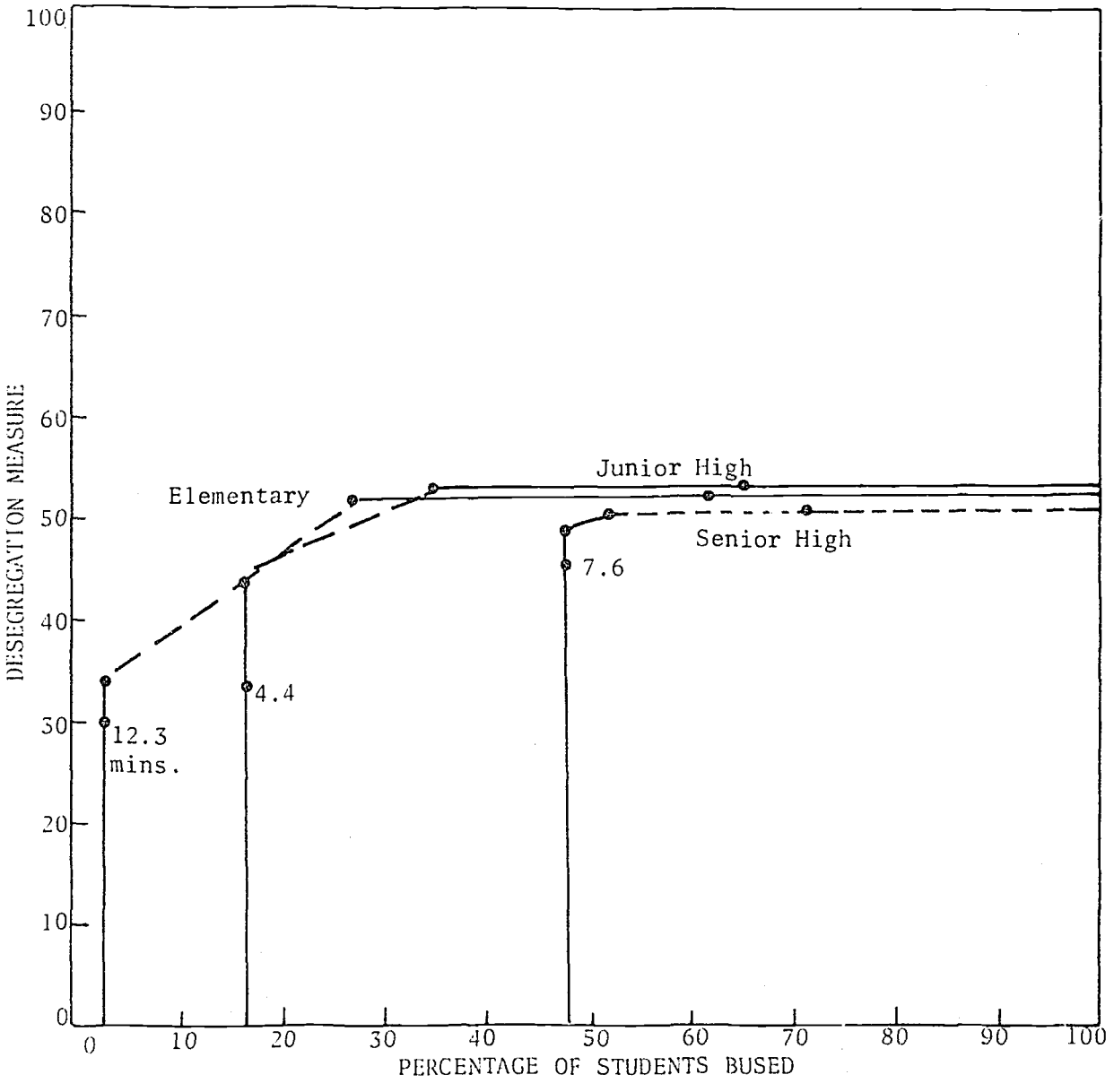
The transportation network files were last revised in 1968 and list off-peak times. Thus this might lead to underestimates of actual travel times. The coverage and density of the network are adequate.

More than the usual number of cases were run for Hartford. Cases 1, 2, 5, and 6 were analyzed for the center city; in case 1 all transportation parameters were minimized, while in the other cases the assignments were constrained only to minimize number of students bused with a 35-minute maximum on student travel time. Cases 1, 5, and 6 were run for the metropolitan area; all transportation parameters were minimized in cases 1 and 5.

The results are very interesting. As in many other center cities in which housing segregation is strong, substantial increases in numbers of students bused are needed at all grade levels to reduce racial isolation in schools. What is unusual is that cases 5 and 6 achieve only about 90 percent of complete desegregation for the senior high schools; since in case 6 no limit is placed on numbers bused, it is clear that only a relaxation of the 35-minute limit on student travel time would make it possible to desegregate fully these schools. The reader is reminded that the racial proportions in the population file used in the study were

in serious error, so that although the general direction of results may be useful, numerical results are not.

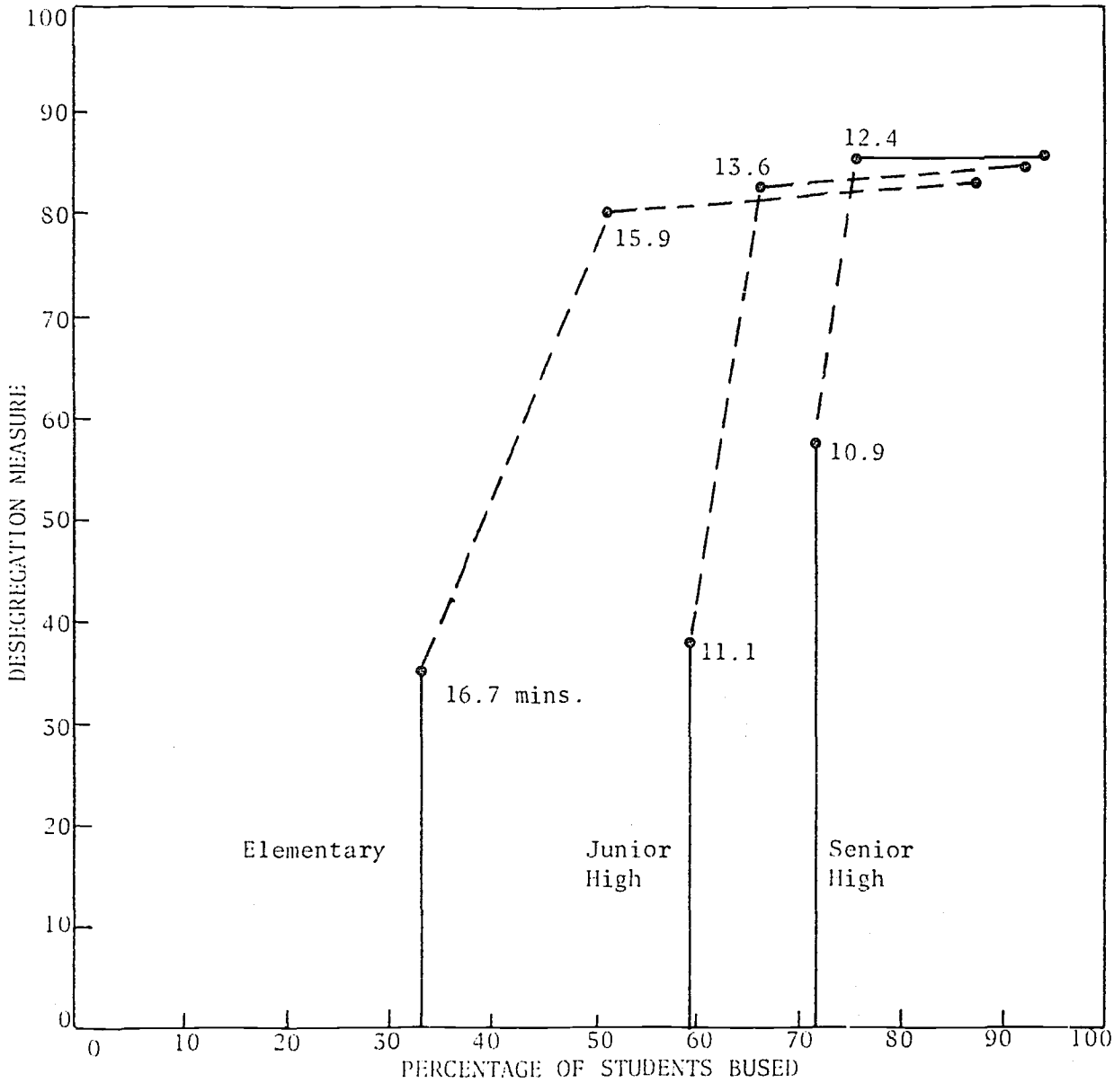
Results for the metropolitan area analysis are interesting also, particularly in view of the center-city results. Although the neighborhood assignment in case 1 produces levels of desegregation quite a bit short of 100 percent, very little increase in the number of students bused is required to progress to very high levels of desegregation in the secondary schools, and only moderate increases are required for the elementary schools. (As a matter of technical interest, it can be noted that case 5 produces slightly less than complete desegregation.) These results indicate that a metropolitan plan might be a feasible method for approaching reasonably high levels of desegregation with relatively less transportation burden than would be required if only the center city were to be desegregated.



Graph of Achievable Desegregation

Hartford, Connecticut

Center-City Analysis



Graph of Achievable Desegregation

Hartford, Connecticut

Metropolitan Area Analysis

Indianapolis, Indiana

The Indianapolis geographic situation is as confusing as any confronted in the study. The city itself extends wholly or partly into each of the nine townships which make up Marion County, Indiana. The county is served by more than ten school districts which are not coterminous with any other civil divisions. Eight of these districts have superintendents' offices in Indianapolis.

There is, however, a principal school district, the Indianapolis School District, with about 120 schools, 106,000 students, and a majority enrollment of 63.8 percent. This district extends into the following townships:

Beech	Warren
Lawrence	Washington
Pike	Wayne

These townships also have schools administered by Washington Twp. MSD, Wayne Twp. MSD, Speedway City, Lawrence Twp., and Warren Twp. districts. It was decided to define the townships listed above as the center city, so that several school districts are actually included.

The metropolitan area case was selected as the entirety of Marion County, which is the urbanized area.

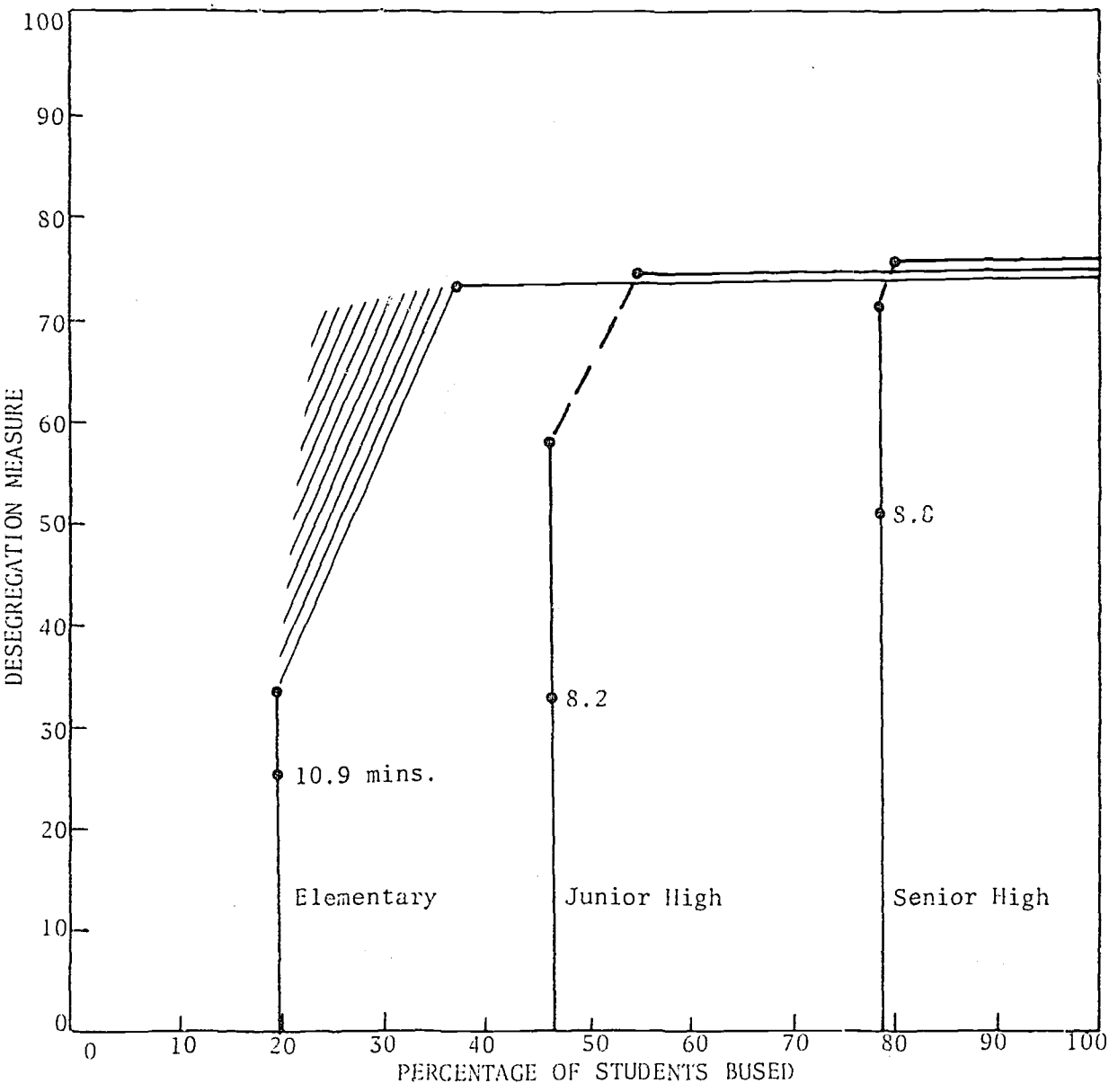
A tabulation through the school districts included shows a majority enrollment of 75.2 percent according to the figures supplied by the Office for Civil Rights; the school population file actually used lists 74.6 percent, so that the agreement is extremely close.

The transportation file was revised in 1965 and contains ADT (Average Daily Travel) times. The coverage and density are adequate.

A total of seven cases was run. For the central district, case 1 was run with full minimization of transportation parameters, while in cases 2 and 5 only the number bused was minimized. For the metropolitan area, cases 1 and 5 were run with full transportation minimization. In both areas, case 6 was run as a bounding case, with no restrictions on transportation.

In Indianapolis itself, case 2 -- in which transportation is minimized but is used to increase desegregation -- achieves nearly complete desegregation for the senior high schools; but the junior high schools are well short of desegregation and the elementary schools are less than half desegregated. Case 5 produces complete desegregation in all grade levels but requires substantial busing in the elementary schools, as we have come to expect. Additional assignments could be produced, between cases 2 and 5, that would sharply reduce busing with only slightly less than complete desegregation. The shaded area on the graph depicts the possible range of results for such intermediate desegregation assignments.

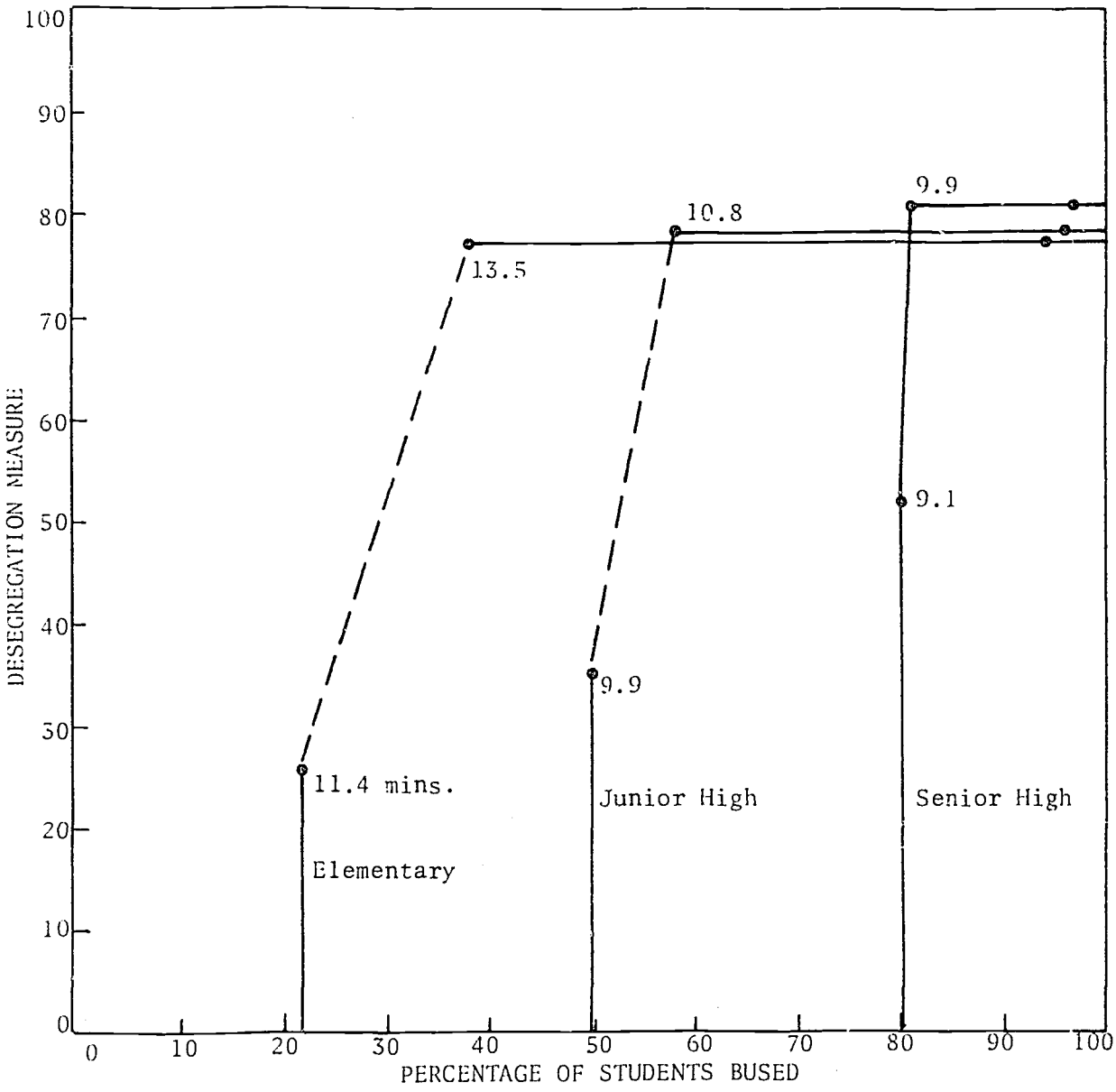
Results for central city and the metropolitan area are very similar, which is to be expected since the central city as we have defined it constitutes a very large fraction of the metropolitan area. Except for this peculiarity, the results are very typical for a city the size of Indianapolis. As is usual, desegregating the elementary schools would require an increase in busing -- 38 percent compared with the minimum of 22 percent -- and some increase also in average travel time. Again, however, intermediate assignments could be developed that would strike a better balance between desegregation goals and transportation burden.



Graph of Achievable Desegregation

Indianapolis, Indiana

Center-City Analysis



Graph of Achievable Desegregation

Indianapolis, Indiana

Metropolitan Area Analysis

Kansas City, Missouri

The largest school district in the area is the School District of Kansas City. It serves essentially that part of Kansas City which lies south of the Missouri River and a portion of Independence. The district is entirely within Jackson County. It covers only 80 of Kansas City's 316 miles and is but one of the seventeen districts operating within the city limits. Because of the geographic problem that it creates, it was necessary to include with the central district other, smaller districts, including the Independence school system. The school districts involved and their enrollments and racial makeups, according to figures obtained from the Office for Civil Rights, are as follows:

	Enrollment	% Majority
Kansas City	70,503	49.8
Center	5,789	98.9
Fort Osage	4,842	100.0
Independence	16,801	97.9
Raytown	15,832	99.3
Total	113,767	68.4

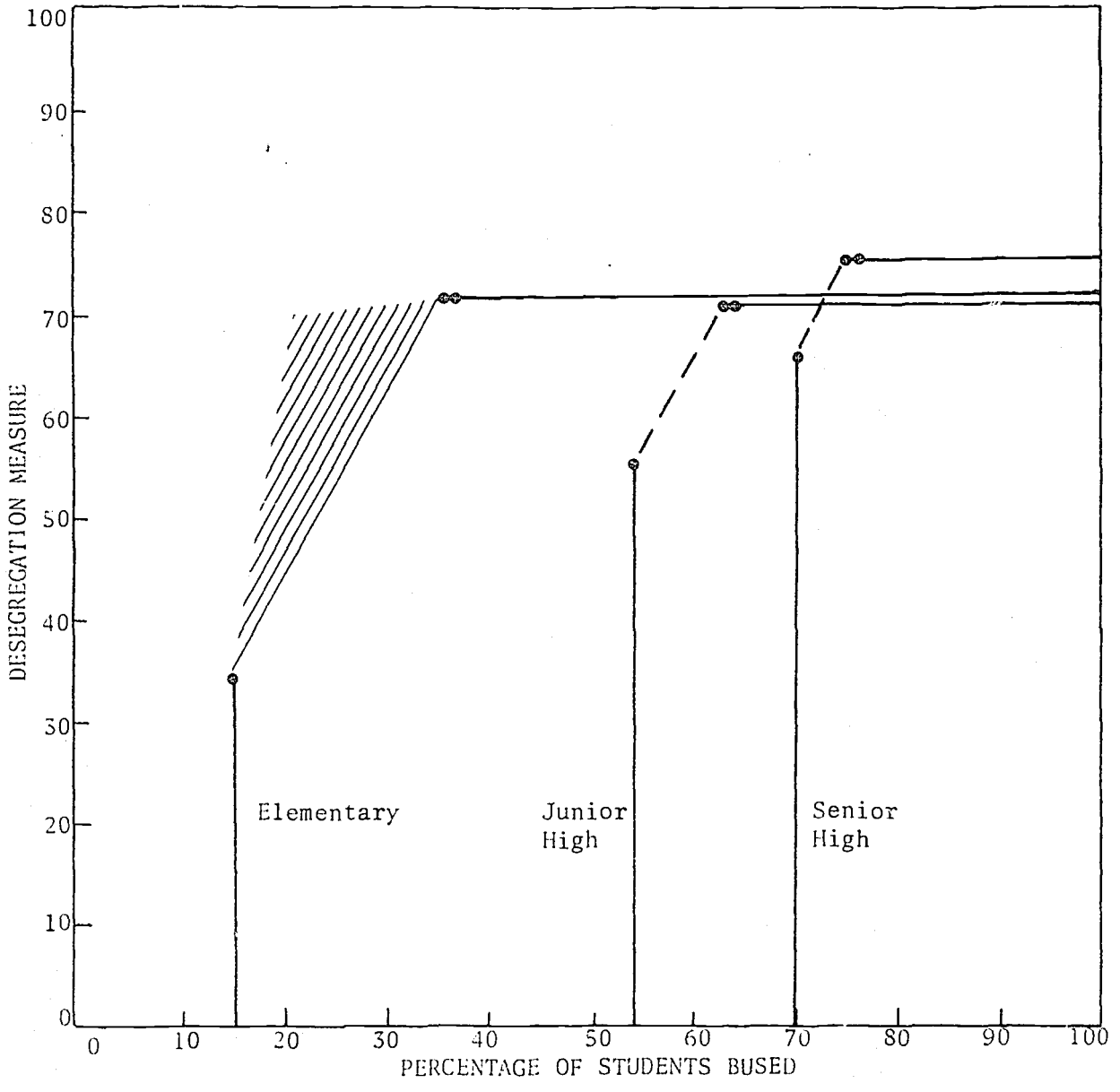
The racial composition on the school population file used in this study was 71.9 percent majority, so that the match seems quite adequate, and the demographic data may be considered trustworthy.

The transportation data was last revised in 1968 and contains calibration times, that is, times computed from a chart associating road type and

general location with a speed characteristic of that class of roads. The density is not very great, at 18 intersections per square mile, but the coverage is good and the file may be considered more than adequate.

Three cases were run for Kansas City -- cases 2, 5, and 6. In cases 2 and 5, only the number of children bused was minimized; the travel times listed in the computer outputs are therefore to be regarded as overestimates of what could actually be achieved. In case 6 no limit was placed on number of students bused, and for this reason it is of little practical interest. Cases were not run for the metropolitan area, but in fact the definition of the central district includes 60,000 students more than are in the actual Kansas City school district.

The results are quite typical. The junior and senior high schools can be desegregated with slight increases in busing over the levels required just to get all children to school. The elementary schools follow the trend for this grade -- complete desegregation would require transporting some 36 percent of the elementary school children, compared with only 15 percent required in the minimum-transportation assignment. Other assignments could be developed that would fall between cases 2 and 5, resulting in substantially less busing than case 5 requires and in substantially more desegregation than case 2 achieves. The area in which such results would lie is indicated by the shaded area on the graph.



Graph of Achievable Desegregation

Kansas City, Missouri

Mobile, Alabama

Mobile City and Mobile County are both served by the Mobile City-County School District. The central city is defined as Mobile City. The metropolitan area was defined as the urbanized area, according to the U.S. Census, and includes the following divisions of Mobile County:

MCD	Division
10	Chickasaw
30	Mobile
40	Prichard
45	Saraland
55	Tariner-Williams

These definitions mean that both the central city and the metropolitan area are subsets of the school district; in fact we are dealing with 48 of the approximately 83 schools of the district. This in no way invalidates any of the results, however, since those portions of the school district could, in fact, institute the plans which form the output of the analysis.

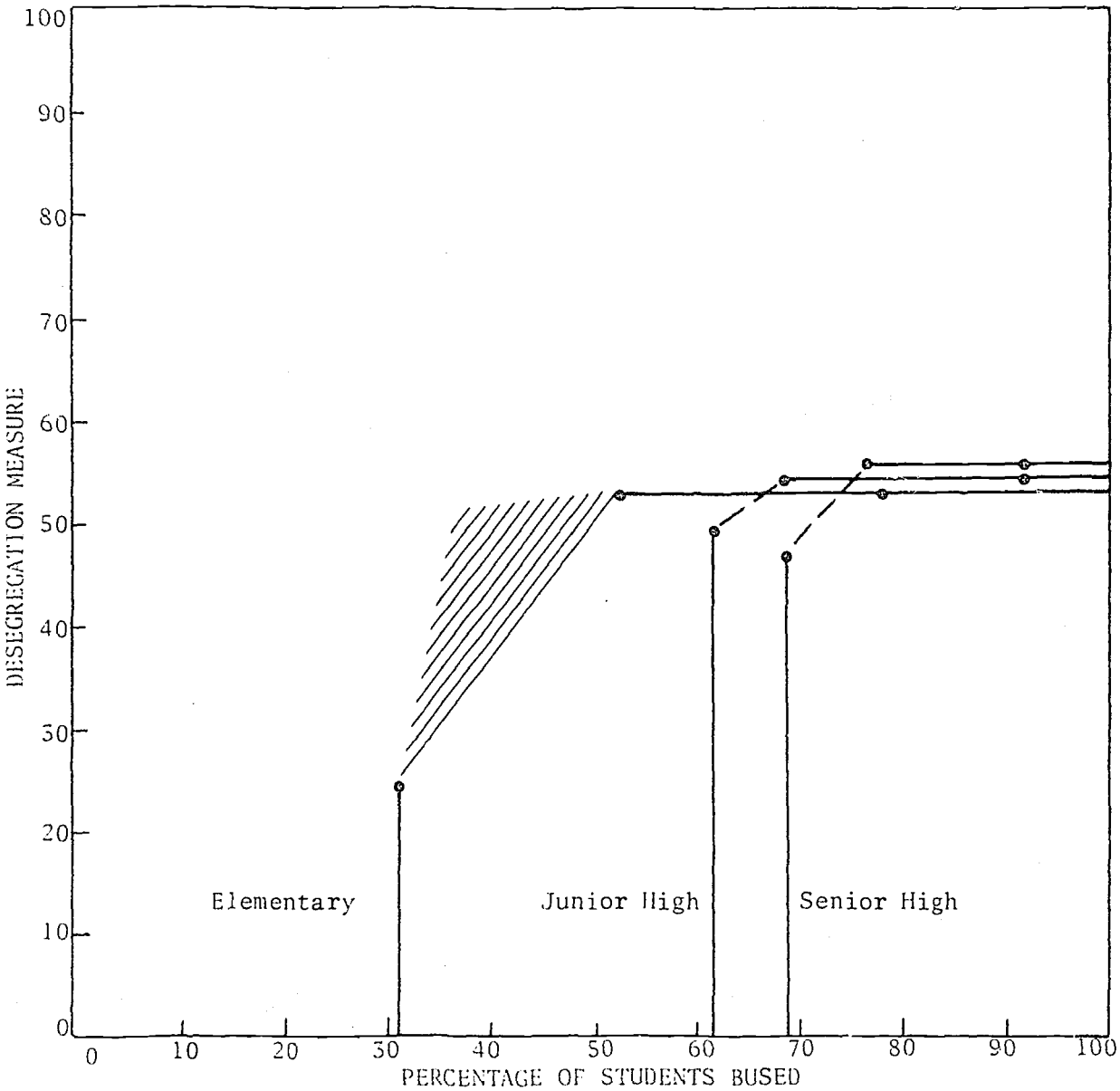
The school district, according to OCR, is 55.4 percent majority; the metropolitan area defined for this study was 55.7 percent majority. These figures are not directly comparable, since they refer to different areas, but they would seem to indicate that there are no gross errors.

The road network was last revised in 1966; the coverage and density are adequate.

Cases 2, 5, and 6 were run for Mobile City and case 6 for the metropolitan area. The numbers of students bused were minimized (except for case 6)

but average travel times were not. Thus the travel times that appear in the computer tables are probably considerably larger than necessary for the levels of desegregation achieved, and the differences in the travel times for different cases are not meaningful.

The demographic statistics were unusual in that the metropolitan area and the center city have about the same fraction of majority students. The geography of the area requires a great deal of transportation, regardless of desegregation objectives, assuming that transportation would be provided for students who live more than one mile from a school. With a redirection of this transportation, it is possible to achieve quite high levels of desegregation in junior and senior high schools. As is commonly the case, however, desegregation of the elementary schools requires somewhat more busing than the minimum that would be required in any event -- 51 percent compared with the minimum of 41 percent. It might be reasonable to seek elementary school assignments that would relax slightly the desegregation goal but that would provide a considerable reduction from the 51 percent busing level produced in case 5. The shaded area on the graph indicates where the results would lie for such intermediate cases.



Graph of Achievable Desegregation

Mobile, Alabama

Newport News, Virginia

The central district consists precisely of Newport News City. The metropolitan area was selected for this study as the urbanized area as defined by the Bureau of the Census and includes the following districts:

	MCD	
James City County	13	Roberts District
York County	5	Bethel District
York County	10	Grafton District
York County	25	Poquoson District
Hampton City	5	All Districts
Newport News City	5	All Districts

Virginia school districts are coterminous with the counties and independent cities into which the state is divided. In the case of the metropolitan area of Newport News, the following school districts are involved (enrollment data from OCR):

City	Enrollment	% Majority
Williamsburg City James City County	4,475	55.0
York County	9,688	82.5
Hampton City	31,899	71.9
Newport News City	31,581	63.5
Total	77,643	68.8

The school population file used in this study lists 65.5 percent majority in Newport News and 71.2 percent in the metropolitan area. Both figures are in good agreement with the OCR figures quoted above (although the metropolitan

area, since it excludes parts of James City County, Williamsburg City, and York County, is not directly comparable to the four school districts).

The road network file was last revised in 1964 and contains average daily travel (ADT) times. The density, at 20 per square mile, is adequate. There is, however, doubt about its coverage. The file is quite adequate for the center-city analysis but does not seem to cover the entirety of the metropolitan area, so that not a great deal of weight could be attached to time and distance results for the area. Only case 6, in which transportation parameters are not minimized, was run for the metropolitan area, so that this lack of coverage should have no effect on the results.

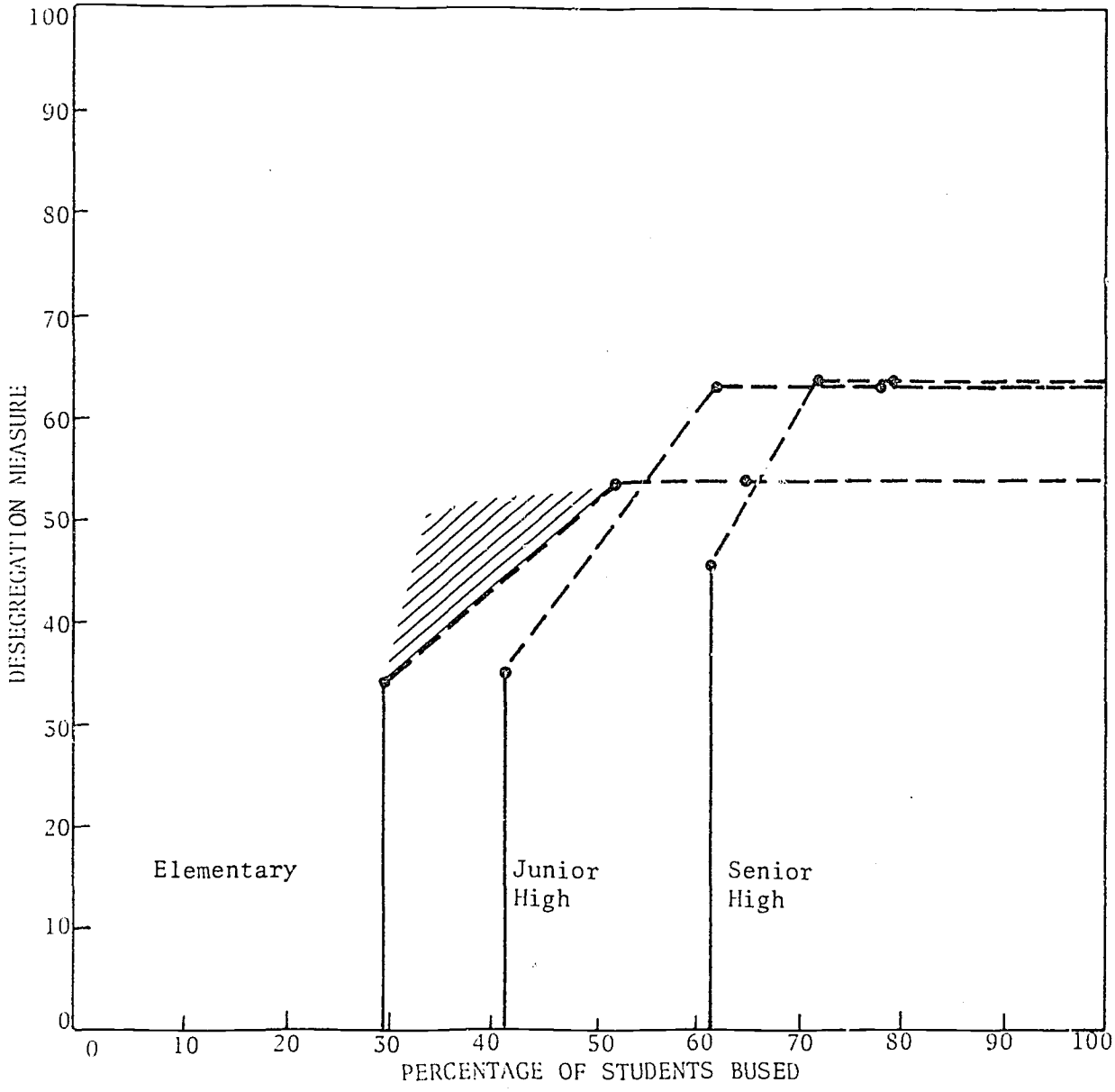
For the center city, cases 2, 5, and 6 were run. The only transportation parameter minimized was the number of students bused; thus the numbers in the computer outputs for travel times and distances are not shown on the graph since they are not indicative of what could be achieved if these parameters were minimized. The metropolitan area analysis was developed with no constraints on busing other than the maximum of 35 minutes on travel time; thus these results are of interest only in indicating that it is theoretically feasible to desegregate the area without exceeding 35 minutes travel time. They do not reveal the balance between desegregation level and busing level that would be obtained.

The results for Newport News are most unusual. In none of the grade levels is complete desegregation achieved in any cases run, including case 6, in which no constraints are placed on busing other than the standard 35-minute limit

on travel time. In the secondary schools the assignments fall short of complete desegregation by a few percentage points, which occurs in a few other areas as well; but in the elementary schools the highest DM achieved is 53 percent, well short of the 65 percent racial composition of elementary school students.

These results are the more exceptional because the area requires a fairly high level of transportation for students who live more than about one mile from school (the permissible walking distance in this study). Usually a redirection of the minimum required transportation approaches complete desegregation, particularly in the secondary schools. An inspection of the computer outputs shows that the average travel time for students is not unusually high, but it appears that the 35-minute travel time limit was making impossible some assignments that would bring the area to complete desegregation.

In view of these facts, the alternative to seeking complete desegregation -- by not only increasing the percentage of students bused to the levels indicated but also relaxing the 35-minute limit -- is to seek assignments that achieve substantial although less than complete desegregation at less transportation burden. The area in which the results for some such assignments might occur for the elementary schools is shown by the shading on the accompanying graph.



Graph of Achievable Desegregation

Newport News, Virginia

Northern Virginia

Northern Virginia is an imprecise term commonly used to denote the Virginia suburbs of Washington, D. C. As we use it here, it indicates the following civil divisions:

Arlington County
Fairfax County
Alexandria City

(Fairfax City and Falls Church City, relatively small enclaves in Fairfax County, are excluded.)

All three divisions operate their own school districts, with enrollments and racial compositions as follows:

	Enrollment	% Majority
Arlington County	24,768	84.6
Alexandria City	17,555	69.9
Fairfax County	133,368	95.6
Total	175,691	91.5

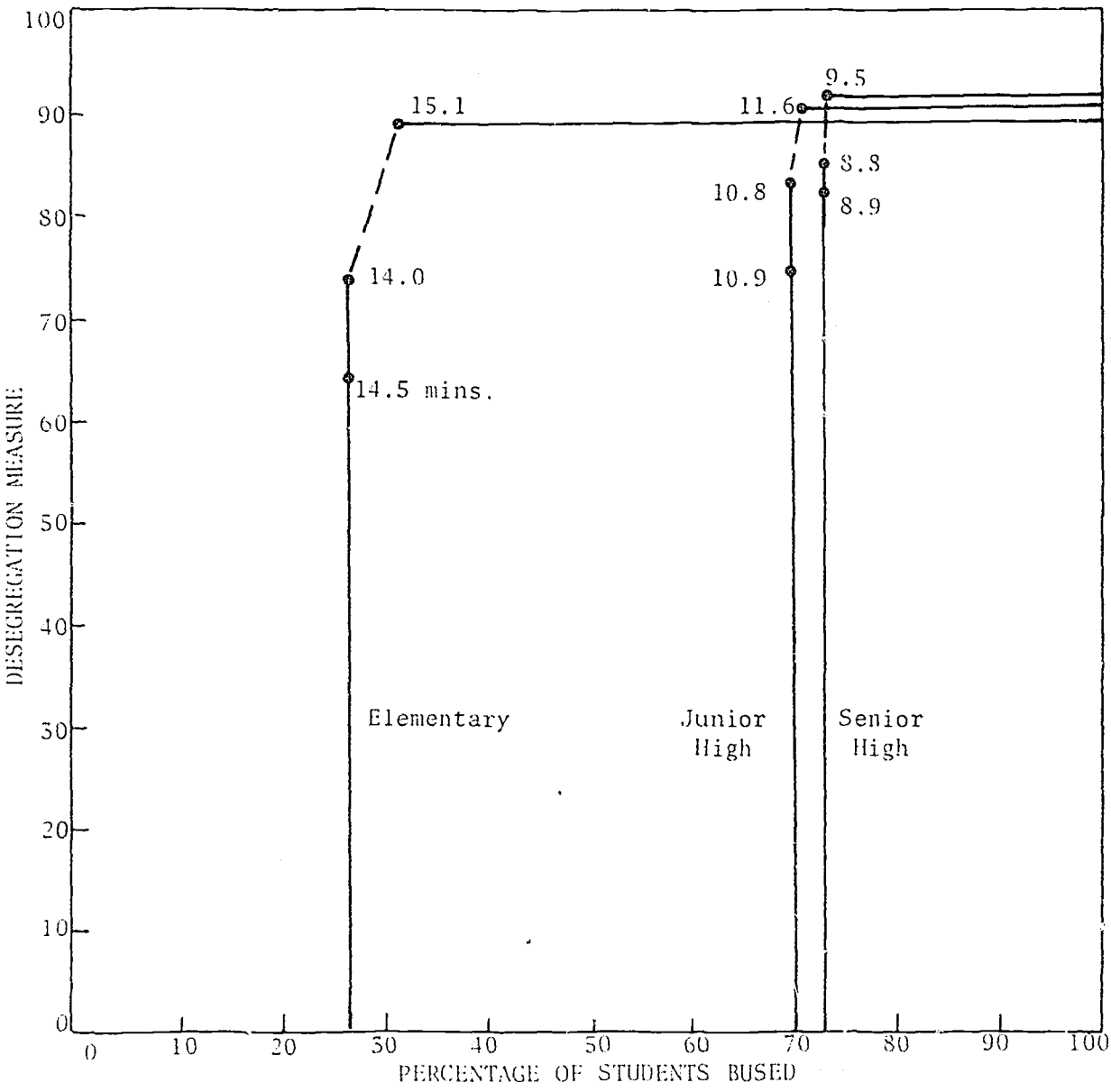
The school population file used in the study listed a 92.0 percent majority, so that agreement between reports from the schools (OCR data) and corrected census data is extremely good.

The transportation file (for the Washington, D. C. urbanized area) was last revised in 1968 and lists average daily travel (ADT) times. The coverage over Northern Virginia is good, and the overall intersection density of 29 per

square mile is quite high for a network covering so large an area. The file must be considered very good in quality.

Cases run included those that became standard in the later parts of the analysis -- Case 1 (Minimum Transportation Colorblind), 2 (Minimum Transportation with Desegregation), and 5 (Extensive Desegregation). All of the principal transportation parameters were minimized: numbers transported, minutes transported, and miles walked. The results are of more than routine interest.

Much of the area of interest is a spread out suburban region, and a substantial number of students must be transported in any case (26 percent, 70 percent, and 73 percent for the three grade groups, based on a 1.0 mile maximum walking distance). The interesting point is that the upper two grade groups may be completely desegregated with small overall increases in numbers of students bused. Elementary grades can be desegregated with an increase from 26 percent as a minimum to only 32 percent of students transported. Even using only the 26 percent minimum busing and changing the schools to which the buses go (as in case 2), elementary schools can be desegregated to 80 percent of the level achieved at proportional racial balance. Significantly, in none of the grade levels does this reassignment produce very much longer average bus trips.



Graph of Achievable Desegregation

Northern Virginia

Oklahoma City, Oklahoma

The three counties of Cleveland, Canadian, and Oklahoma comprise the Oklahoma City SMSA, and the metropolitan case was chosen to include this whole area, including 30 different school districts. The city itself extends into all three counties, with the most heavily urbanized portion in the Oklahoma City Division of Oklahoma County (this division includes nearly the entire black population). The center school district includes nearly all of this division but also includes six schools outside the division, while three other school districts serve a small fraction of Oklahoma City Division. This confusing array of non-coterminous school districts has dictated a rather simpler definition of the center city: those schools and population residing in Oklahoma City Division.

The OCR directory of schools lists the majority group enrollment in the Oklahoma City District as 72.1 percent for the 1970-71 school year. The school population for Oklahoma City Division on the population files used in the study was 78.9 percent majority. The areas represented by these figures are not directly comparable, but the definitions are close enough to warrant labeling the demographic data as only fair.

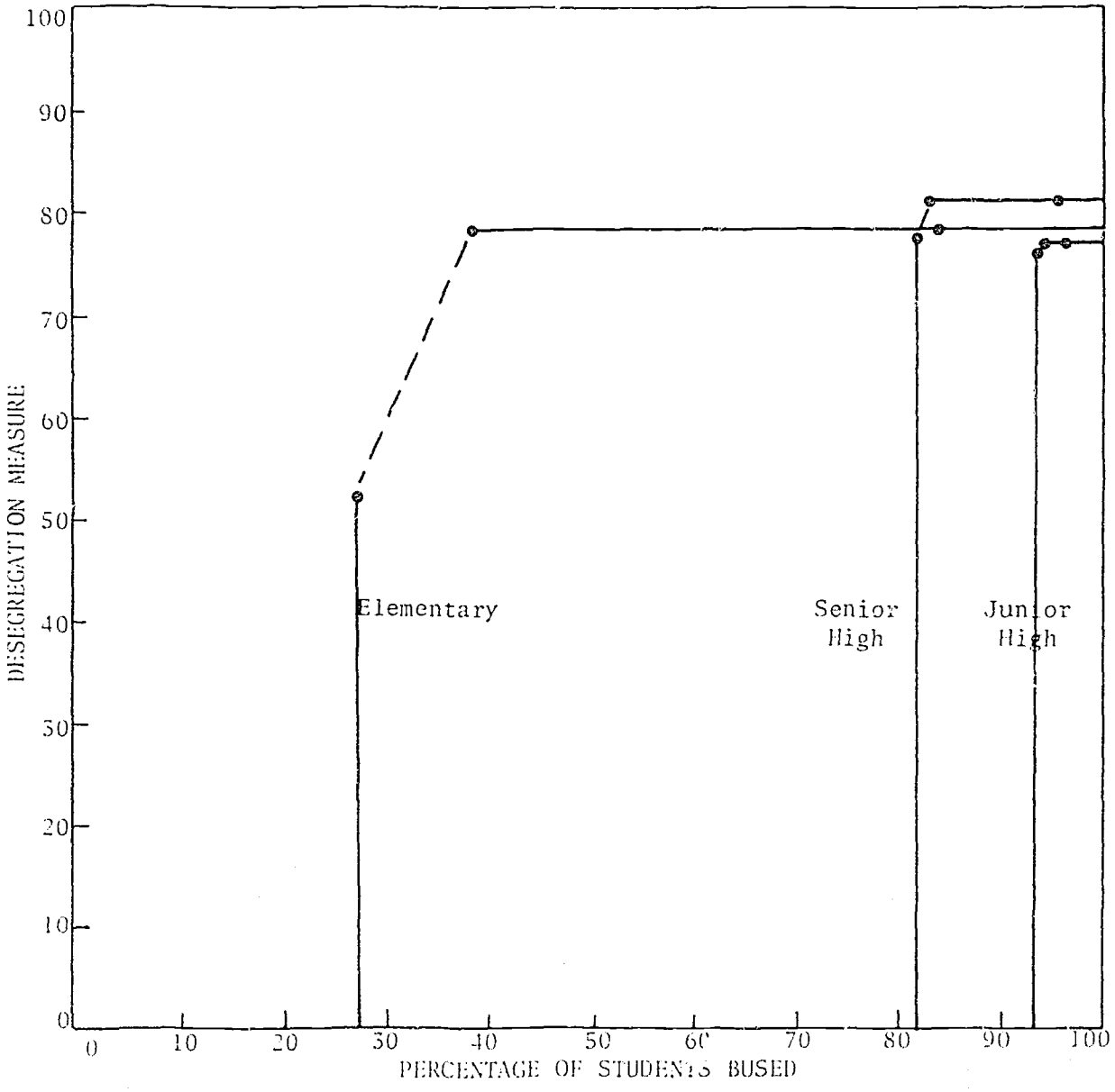
The transportation data, last revised in 1965, lists off-peak speeds. The coverage and density are good, but do not extend much beyond our definition of the central city. Route I-40, an important west-bound interstate highway, is not on the files but makes little difference for the central-city cases. For the

metropolitan case, only case 6 was run; travel times were not minimized for this case, so that the inadequacies of the file do not affect the results greatly.

For the central-city analysis, cases 2, 5, and 6 were run. The only transportation parameter minimized (in cases 2 and 5) was the number bused; thus the figures in computer outputs for travel times and distances are not meaningful and are not shown on the graph, since they are larger than could reasonably be expected if an explicit attempt were made to minimize the length of the ride.

Results for Oklahoma City are very typical of findings in many other districts studied in this survey. The junior and senior high schools can be desegregated almost completely with no increase in the number of students bused over what is required for students who live more than about one mile from school. (The level of transportation computed here as being required may be considerably higher than actual current busing levels if the current policy is to permit children to walk greater distances to school.) The elementary schools can be desegregated with a moderate increase in busing, again a typical result in the study.

The metropolitan area analysis is of technical interest only. Since in this analysis (case 6) the computer program does not attempt to minimize the numbers of students transported, it sheds no light on the relation between achievable desegregation and the minimum level of busing required to attain it.



Graph of Achievable Desegregation

Oklahoma City, Oklahoma

Oakland, California

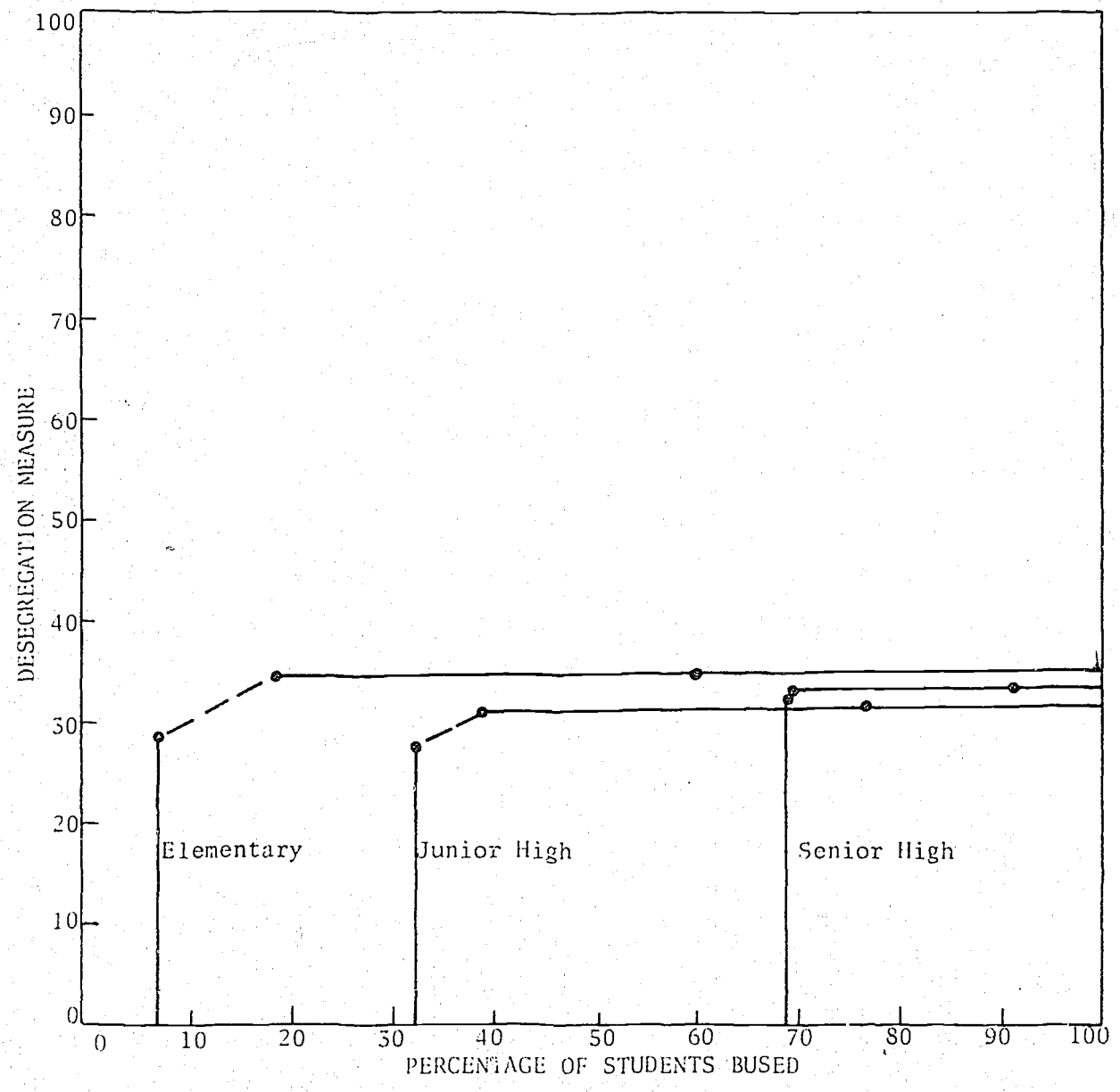
The central city was defined as Oakland City itself, which is served by the Oakland City School District. No metropolitan area cases were run, largely because of the difficulties in defining such an area, especially in such proximity to San Francisco, another one of the study cities.

The OCR register lists the school enrollment as 28.3 percent majority in the fall of 1970, while the school population file derived from census data listed a majority of 33.8 percent, for a difference of about 5.5 percent. Part of the discrepancy may be due to under-correction for the 8.8 percent Spanish-surnamed school population; in any event the error is fairly typical for a large city with a large minority group population.

The transportation file includes Oakland, San Francisco, and the Bay area. It was last revised in 1965, contains peak hour speeds, and is rather sparse in density. However, the file is adequate for the purposes of a survey analysis of this kind.

Cases 2, 5, and 6 were run for Oakland. The only transportation parameter minimized in cases 2 and 5 is the number of students transported; figures in the computer outputs on travel time and distance should therefore be disregarded, and are not shown on the graph. The results are quite typical except for the exceptionally small majority group population: Complete desegregation of the schools would require busing some 18 percent of the elementary students, compared with 7 percent in the minimum-transportation case, and some 38

percent of the junior high students, compared with the minimum of 32 percent; but the senior high schools could be desegregated with almost no increase in busing. Of course, even complete desegregation of Oakland itself results in quite a low Desegregation Measure, because of the large minority population.



Graph of Achievable Desegregation

Oakland, California

Omaha, Nebraska

The metropolitan area was selected as the entire urban area. This constitutes the following precincts in addition to Omaha City:

Douglas County	10	Beechwood Precinct
Douglas	15	Benson Precinct
Douglas County	27	Douglas Precinct
Douglas County	35	Florence Precinct
Douglas County	40	Jefferson Precinct
Douglas County	45	McArdle Precinct
Douglas County	55	Millard Precinct
Sarpy County	4	Bellevue Precinct
Sarpy County	5	Bellevue Precinct#2
Sarpy County	25	Gillmore Precinct #2
Sarpy County	26	Gillmore Precinct #3
Sarpy County	27	Good Luck Precinct
Sarpy County	28	Highland Precinct
Sarpy County	40	Highland Precinct #2
Sarpy County	45	La Platte Precinct
Sarpy County	47	La Vista Precinct
Sarpy County	54	Papillion Precinct
Sarpy County	55	Papillion Precinct #2
Sarpy County	57	Pawnee Precinct
Sarpy County	65	Richland Precinct

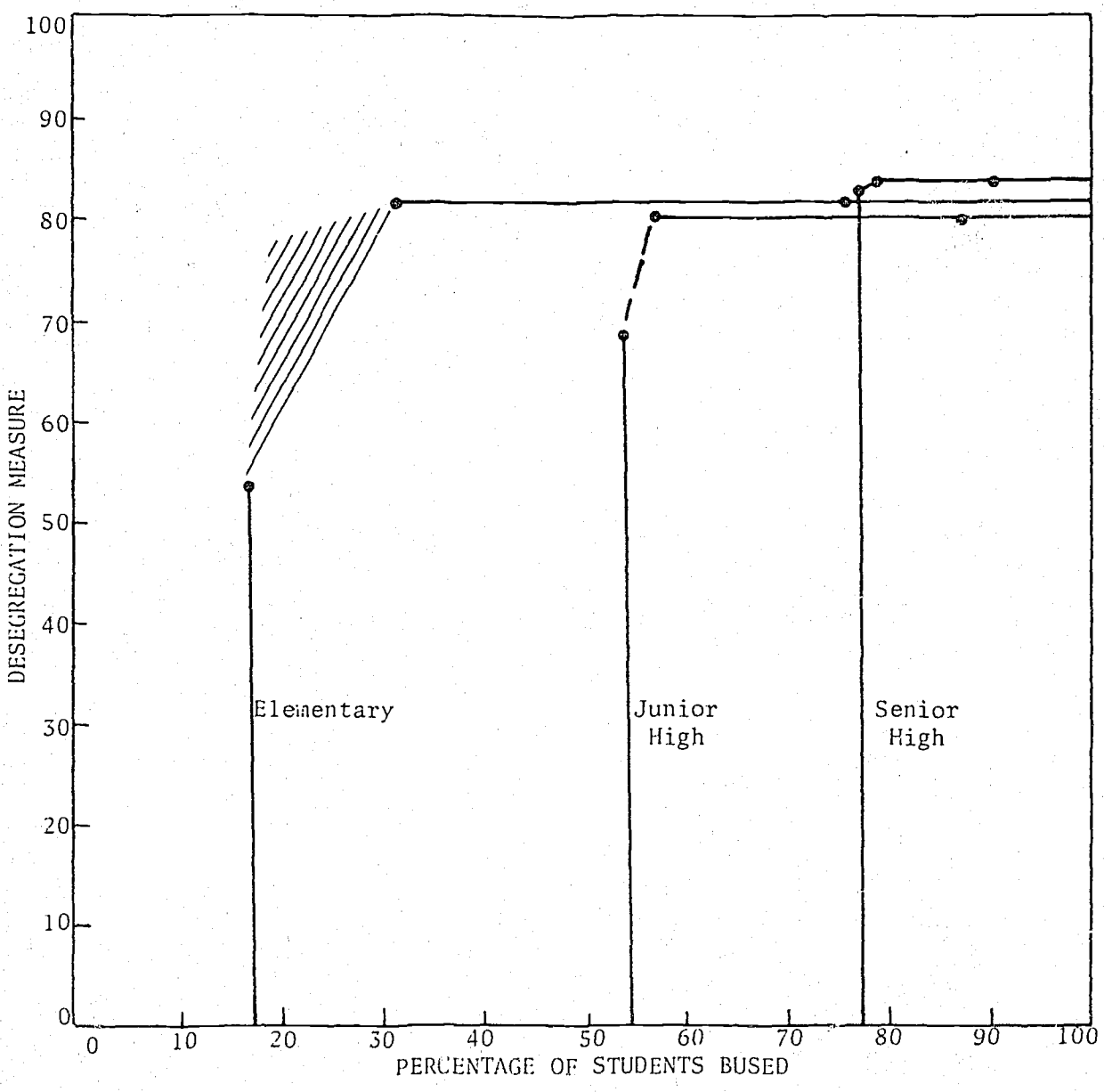
The central district consists precisely of Omaha City, which is served by the Omaha School District and a district labelled in the OCR Directory as "Westside via Omaha", also with superintendents' offices in Omaha. The

majority group in these districts is 82.0 percent according to the OCR Directory, while the school population files used in this study show 82.3 percent, for uncommonly close agreement.

The transportation file was last revised in 1966 and contains calibration speeds (assigned on the basis of roadway type). The file has only 1,439 intersections, but is probably adequate for a city of this size.

Cases 2 and 5 were run with minimization of numbers of students bused, but not the overall busing time; the figures in the computer outputs are therefore not shown on the graph since they represent overestimates of what could be achieved if the length of the bus ride were explicitly minimized. Case 6, a bounding case with no minimization of transportation, was run for the center city and the metropolitan area; it is of technical interest only.

The results show that the city's senior high schools can be desegregated with almost no increase in the number of students bused over what is required simply to get all students to school, and the junior high schools can be desegregated with only a slight increase in busing. An increase to 32 percent -- compared with 17 percent in the minimum transportation assignment -- is necessary to achieve full desegregation in the elementary schools. In this kind of situation, it is interesting to consider assignments for the elementary schools that would substantially reduce the level of transportation with only a relatively slight reduction in the level of desegregation achieved. The range of results of such possible assignments is shown by the shaded area in the graph.



Graph of Achievable Desegregation

Omaha, Nebraska

Center-City Analysis

Pasadena, California

Pasadena is a portion of Pasadena Division of Los Angeles County. It is the smallest minor civil division (MCD) that includes Pasadena, and the method used in the study required analyzing the MCD as a whole. Thus the central city definition includes not only Pasadena but also Altadena, La Canada-Flintridge, San Marino, and South Pasadena. This includes the Pasadena, La Canada, San Marino, and South Pasadena School Districts. A metropolitan case was not defined, since the area of analysis already extends well beyond central district boundaries.

The school population file for Pasadena Division contains 70.4 percent majority students, compared to 66.7 percent listed in the OCR Directory for the school districts listed above. The Oriental population is treated as minority, as well as those students of Spanish origin. The agreement is good, considering the difficulties inherent in the use of census files on Spanish-surnamed population.

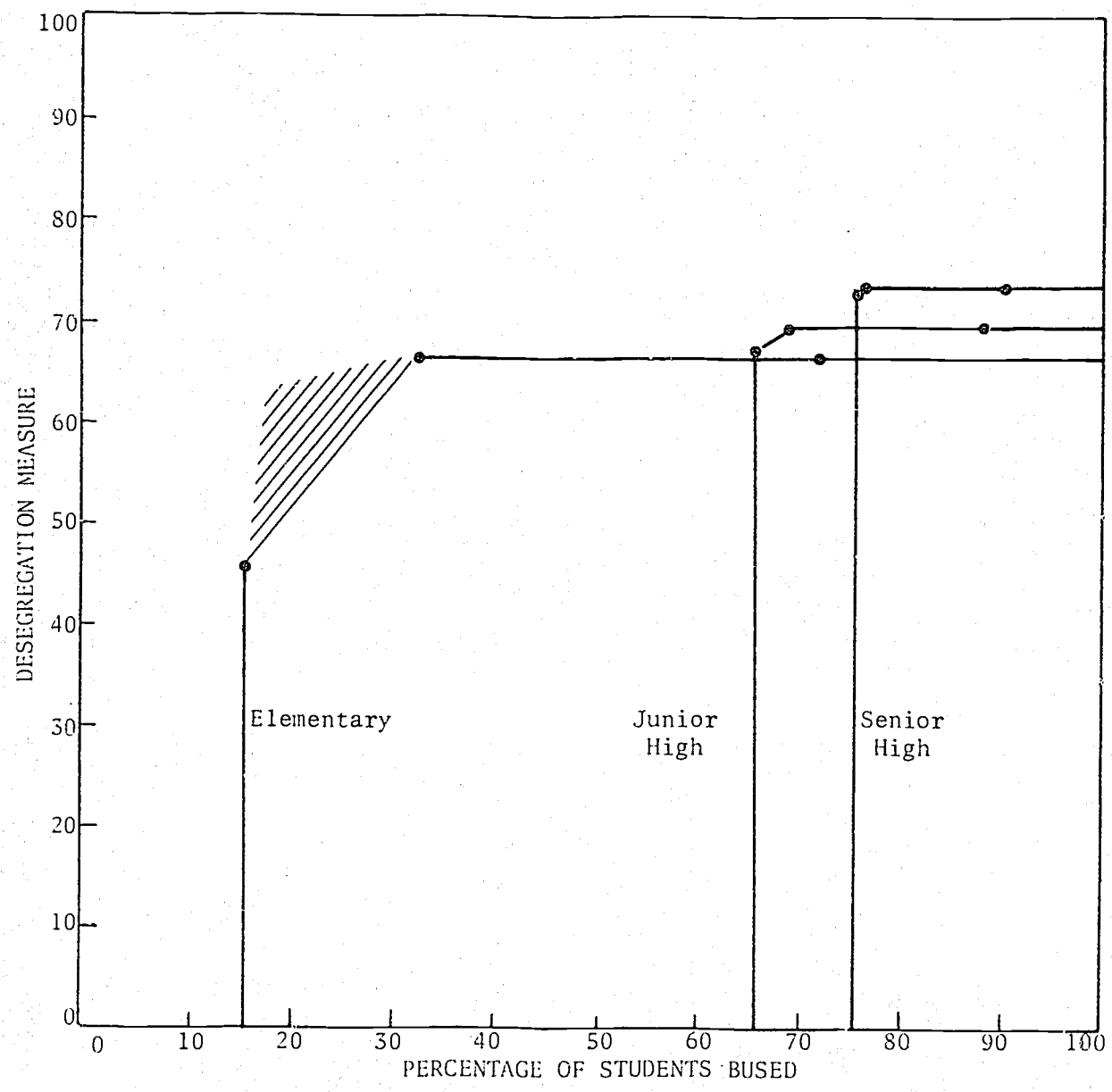
The transportation file used was for the entire Los Angeles area. The file is of gigantic proportions, covering nearly 1,000 square miles, but the density of intersections is very low at only about 5 per square mile. Thus the study area included about 100-200 intersections. The file was last revised in 1967 and lists peak hour travel times.

Pasadena was analyzed quite early in the study; its case schedule was the standard one for that period -- cases 2, 5, and 6 without explicit

minimization of transportation parameters except (in cases 2 and 5) for the number of children bused. In addition, a grade-reorganization assignment was developed; as explained in the preceding sections, this case is of little interest, and the results are not displayed on the graph.

The calculated results for the standard cases are similar to those in other cities examined in this study. Pasadena high schools can be desegregated with no increase in busing beyond the level required for those who do not live within about one mile of school. The junior high schools can be desegregated with a modest increase in busing -- 68 percent compared with the minimum of 65 percent. Full desegregation of the elementary schools, in contrast, requires a substantial increase in transportation -- to 33 percent compared with the minimum of 15 percent. Additional assignments could be produced that would call for much smaller increases in transportation, while reducing only slightly the level of desegregation achieved. The shaded area on the graph shows where the results of such intermediate assignments would fall.

Pasadena is unusual in that a really effective desegregation plan, bringing all schools close to the racial composition of the school district as a whole, is already in operation. The results shown here may therefore be largely of academic interest, especially the case 2 analysis which shows only partial desegregation.



Graph of Achievable Desegregation

Pasadena, California

Philadelphia, Pennsylvania

The metropolitan area of Philadelphia was chosen as the City of Philadelphia, plus all of Delaware County, plus the urbanized portions of Bucks and Montgomery Counties. An accompanying table lists the areas selected by minor civil divisions. Philadelphia is served by its own school system, while the metropolitan area is also served by a total of 46 suburban school districts. The city of Philadelphia and the Philadelphia school district have the same boundaries, so the center city for the purposes of this study is the city itself.

The schools are mixed in grade structure, as one would expect from the great number of districts, but the predominant structure is K-6/7-9/10-12, that is, the junior high school system.

The racial isolation in housing is severe; according to our population files, the city is 44.8 percent majority and the suburbs 93.2 percent majority, for an overall majority representation of 67.9 percent. Figures obtained from the Office for Civil Rights indicate, on the other hand, that the Philadelphia city school district is 36.4 percent minority. Thus the population data must be considered to be of poor quality. It is so poor for the high school population that we do not feel that the results for these grades are sufficiently valid to be reported. Thus they are not included in the graphs.

It should be noted that Fourth-Count census tapes have become available since the completion of this study; their use in determining true public school populations would prevent such bad matches between the actual school attendance

Cities, Townships and Boroughs in the Philadelphia Metropolitan Area

Philadelphia City

Bucks County
- Bedminister Twp.
- Bensalem Twp.
- Bristol Borough
- Bristol Twp.
- Falls Twp.
- Hulmeville Borough
- Ivyland Borough
- Langhorne Borough
- Langhorne Manor Borough
- Lower Southampton Twp.
- Middletown Twp.
- Penndel Twp.
- Tulleytown Borough
- Upper Southampton Twp.
- Warrington Twp.

Delaware County
- All

Montgomery County
- Abington Twp.
- Ambler Borough
- Bridgeport Borough
- Bryn Athyn Borough
- Cheltenham Twp.
- Conshohocken Borough
- East Norriton Twp.
- Hatboro Borough
- Horsham Twp.
- Jenkintown Borough
- Lansdale Borough
- Lower Bwynedd Twp.
- Lower Merion Twp.
- Lower Moreland Twp.
- Lower Providence Twp.
- Narbeth Borough
- Norristown Borough
- North Wales Borough
- Plymouth Twp.
- Rockledge Borough
- Springfield Twp.
- Upper Dublin Twp.
- Upper Gwynedd Twp.
- Upper Merion Twp.
- Upper Moreland Twp.
- Upper Providence Twp.
- West Conshohocken Borough
- West Norriton Twp.
- Whitemarsh Twp.
- Whitpain Twp.

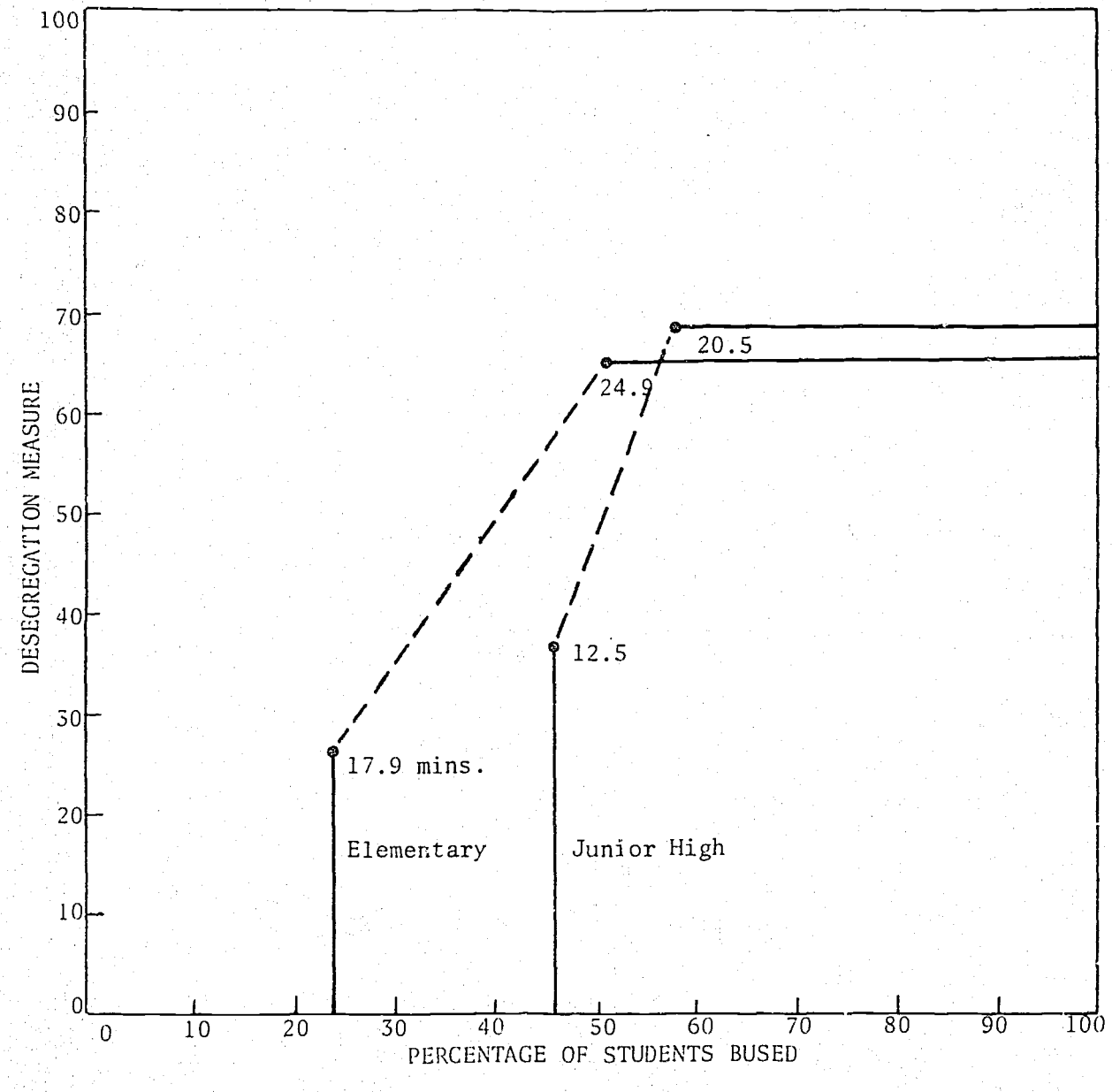
population and the school population as prepared from First-Count census data and other sources.

The transportation file was last revised in 1960 and lists peak, i.e. rush hour speeds, so that our speed estimates are conservative. The file is of very low density and includes only 273 square miles, so that much of the metropolitan area was not covered. There were, in fact, over 9,000 students in that area who were unassigned because of time limitations (computed at 15 mph outside the transportation grid). Overall, the file ranks as the worst one used in the study.

The analysis in the center-city cases shows that the junior high schools can be completely desegregated at a cost of a moderate increase in busing, to 45 percent, compared with 35 percent that is the minimum required to transport those children who live more than one mile from an appropriate school. Average travel time for these students increases to 18 minutes from 13 in the minimum-transportation cases. In the elementary schools, complete desegregation would require busing some 34 percent of these students, compared with 8 percent in the minimum-transportation assignment. Average travel time for elementary school students almost doubles. In this situation, it would be appropriate to investigate assignments that might substantially decrease the transportation burden -- both numbers bused and average times -- at relatively smaller decreases in the level of desegregation achieved. The shaded area in the graph shows where the results of such assignments would fall.

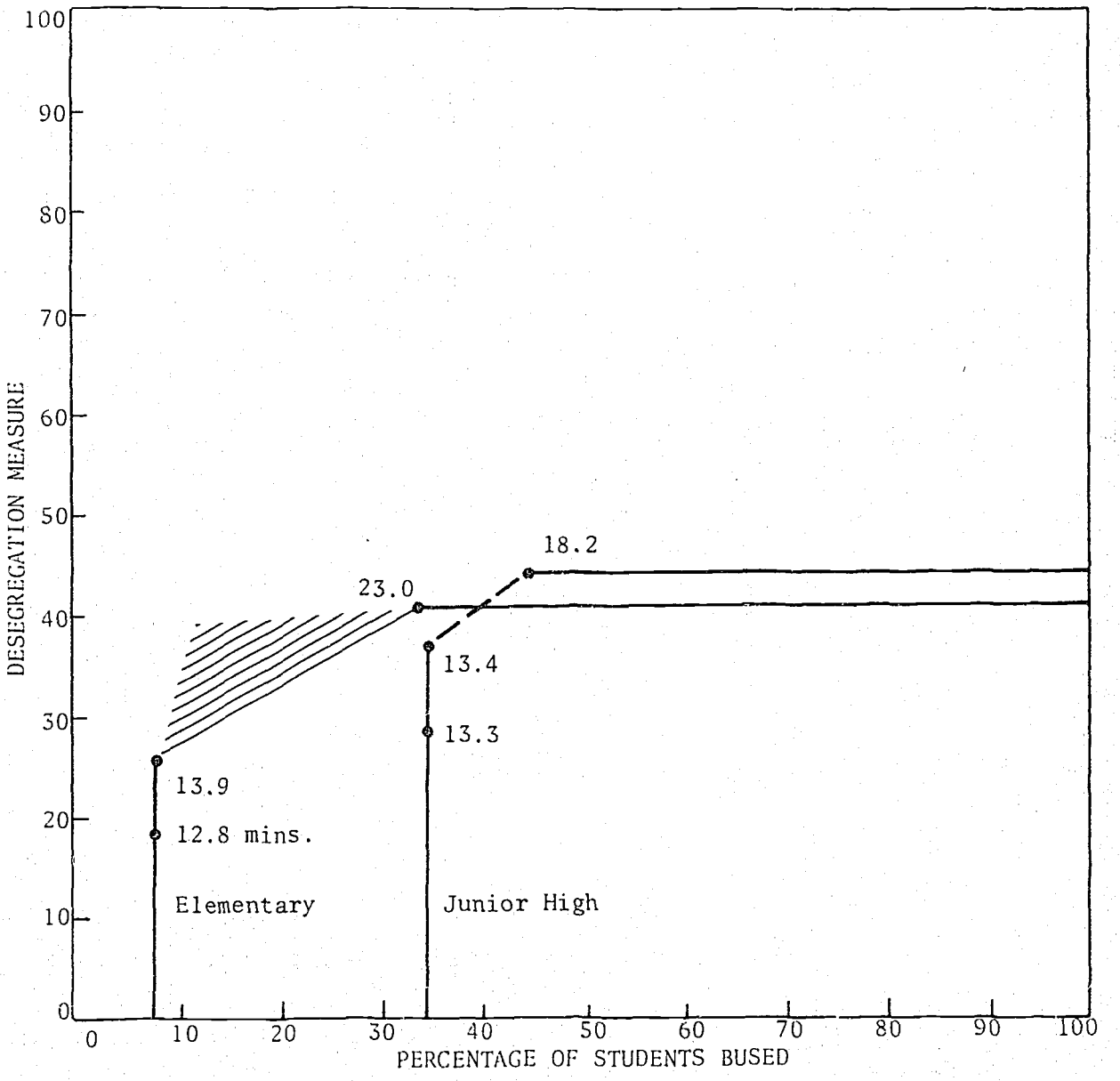
In the metropolitan area, desegregation is attainable at a somewhat lower burden in terms of busing for desegregation purposes, compared with the center-city cases, although the burden is still significant in the elementary schools. Again, it would be appropriate to investigate assignments intermediate between cases 1 and 5 for these schools.

We feel that these general conclusions, as distinguished from the specific numbers calculated in these cases, are not invalidated by the data problems described above. The conclusions derive primarily from racial concentrations in residence and from the distances involved. The data problems merely mean that the exact figures calculated are of limited use.



Graph of Achievable Desegregation

Philadelphia, Pennsylvania
Metropolitan Area



Graph of Achievable Desegregation

Philadelphia, Pennsylvania
Center City Analysis

Pomona, California

Because Pomona is itself a suburb of Los Angeles, no distinction was made between central and metropolitan Pomona. Pomona itself consists of a portion of East San Gabriel Valley Division of Los Angeles County. Along with Pomona, the following communities are located in the division:

Avocado Heights	La Puente
Azusa	La Verne
Baldwin Park	Rowland Heights
Claremont	San Dimas
Covina	S. San Jose Hills
Diamond Bar	Valinda
Glendora	Walnut
Hacienda Heights	West Covina
Industry	West Puente Valley
Irwindale	

Because the census joins these into a single MCD (Minor Civil Division), the Pomona district was defined as the entirety of the Division, although this is not ideal for the purposes of the study. The major school districts in this area are as follows:

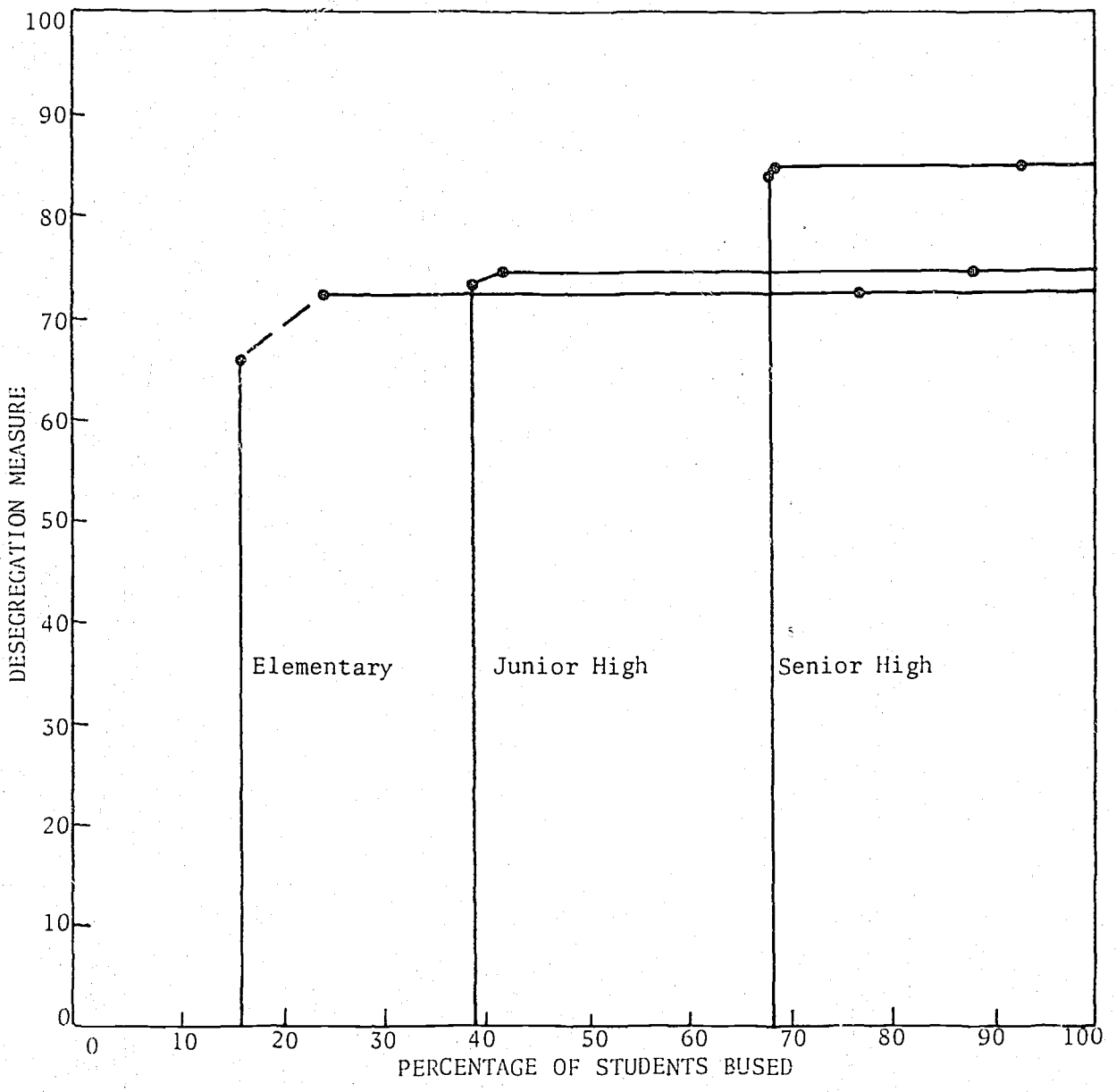
	Enrollment	Percent Majority	Percent Negro
Pomona	22,801	62.9	19.1
Azusa	12,814	72.7	.2
Baldwin Park	13,102	63.5	.6
Claremont	7,175	93.2	1.8
Covina Valley	17,030	90.6	.3
Glendora	9,245	96.0	.2
Hacienda La Puente	35,588	67.5	2.2
Rowland	14,070	70.9	2.3
Walnut Valley	4,746	89.3	.4
West Covina	13,490	87.7	2.1
Totals	150,061	75.3	4.0

The agreement with the population file used in the study was almost exact. The reader will note that, with the exception of Pomona itself, there are very few Negroes; the minority group is composed principally of Spanish-surnamed students.

The transportation file used was for the entire Los Angeles area and is very large, covering nearly 1,000 square miles. The file is more than adequate for the purposes of this study, even though it reflects only about five intersections per square mile. The file was last revised in 1967 and lists peak hour times.

Cases 2, 5, and 6 were run; in cases 2 and 5 only the number of students bused was minimized and the figures on travel time and distance in the computer tabulations are therefore overestimates of what could be achieved. In case 6 no limit was placed on number of students bused, and its results are accordingly of limited practical value.

The results are very striking in that they show that, in the junior and senior high schools, almost no increase is required in the number of students bused over what is needed for children who live more than one mile from school. In the elementary schools, complete desegregation would require busing 24 percent, compared with 15 percent as a minimum. The reader must keep in mind, however, that since the program does not distinguish between Negro, Oriental, and Spanish-surnamed students, the resultant plan might well leave one of the minorities still segregated from the other minorities despite integration into majority schools.



Graph of Achievable Desegregation

Pomona, California

Pontiac, Michigan

Pontiac, a small industrial city to the north of Detroit, is served by the Pontiac City School District, which also serves parts of Sylvan Lake City Pontiac Township, Bloomfield, West Bloomfield, Waterford, Orient, and Avon. For the purposes of the study, the central city is selected as the city of Pontiac itself. A metropolitan area was not defined.

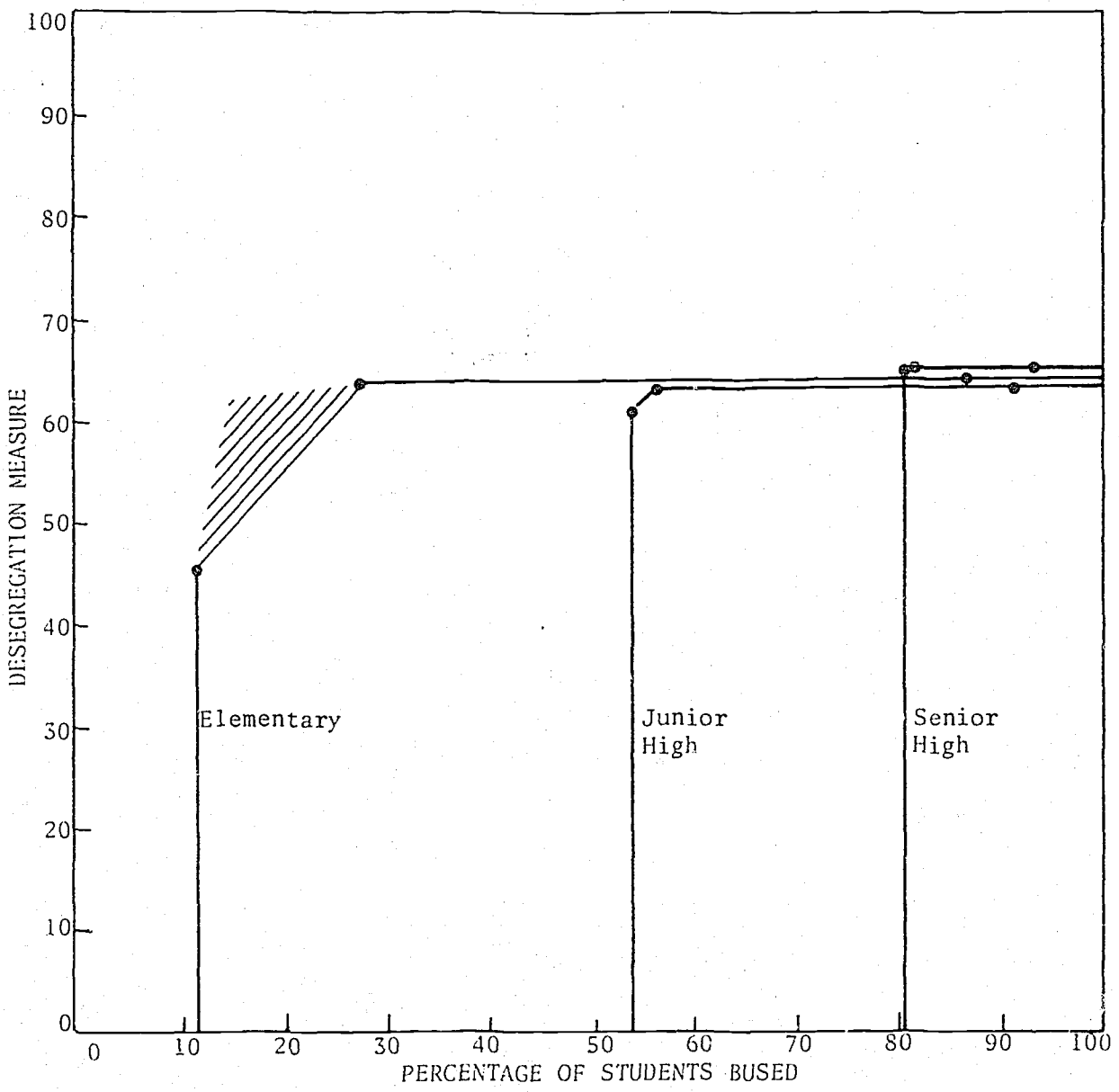
Some distortion of school population and capacity results from the fact that the actual school district and the city do not coincide. The capacity of schools in Pontiac is greater than the number of students in the city, because in reality, some students from outside the city are educated there. The program automatically increases the assigned school population to match indicated enrollments, so that the assigned population is greater than the actual number of school children in Pontiac.

The OCR Directory lists the percentage majority group enrolled in the schools as 62.2 percent. The minority includes, in addition to Negroes, 4.4 percent Spanish Americans and a scattering of other races. The population file used for the study lists 63.3 percent majority, for very close agreement with actual enrollments.

The transportation file used was the metropolitan Detroit road network. The file was last revised in 1967 and contains average daily travel (ADT) speeds. The file covers an enormous area, about 680 square miles, with a density quite adequate for the purposes of this study.

Cases 2, 5, and 6 were run for Pontiac. For cases 2 and 5 the program minimized only the numbers of students bused, so that the travel times and distances in the computer outputs are overestimates of what could be achieved. In case 6 no limit was placed on the number of students bused, and the only constraint was the standard 35-minute limit on student travel time.

The results show that the junior and senior high schools can be completely desegregated with almost no increase in the number of students bused over that required in the minimum transportation case. Desegregation of the elementary schools would require transporting 28 percent of students, compared with 11 percent bused in the minimum transportation desegregation case. The large difference in busing requirements in these two cases indicates that it might be desirable to produce assignments between cases 2 and 5; the area in which the results of such intermediate cases would lie is indicated by the shaded area on the graph.



Graph of Achievable Desegregation

Pontiac, Michigan

Prince George's County, Maryland

Prince George's County has been the subject of much more comprehensive study than any other of the 44 urban areas in the survey. The first analysis included cases like those used for all other areas, as well as cases in which the results were tested for sensitivity to a number of factors. The results served as the basis of the Lambda report School Desegregation with Minimum Busing, December 10, 1971. A further major analysis was conducted in which the data were first subjected to considerably more refinement and validation than was possible for other areas, and in which a comparison was made to current practices in the County. The results are available in the report School Desegregation Alternatives in Prince George's County, April 28, 1972.

These reports are not repeated in this volume.

Richmond, Virginia

Richmond, Virginia, is an independent city bordered by Hanover County to the north, Chesterfield County to the southwest, and Henrico County to the southeast. The urbanized area extends into those three counties and includes the following governmental units:

Richmond City
Bermuda District, Chesterfield County
Dale District
Manchester District
Matoaca District
Midlothian District
Mechanicsville District, Hanover County
Brookland District, Henrico County
Fairfield District
Varina District

The central school district, that is Richmond City, was used for the center-city analysis, and the urbanized area, as defined above, was used for the metropolitan analysis.

The school population file was 44.8 percent majority for the center city and 64.2 percent for the urbanized area. The OCR register lists the following constituencies for the school districts which are involved:

	Total	Percent Majority
Richmond City Schools	47,988	35.5
Chesterfield County Schools	24,063	90.2
Hanover County Schools	9,285	76.3
Henrico County Schools	34,274	91.4
Total	115,610	66.7

The totals are not directly comparable to our metropolitan area case, which does not include the entirety of the suburban counties; we may compare, however, in the central district, where we find whites over-represented on the population file by about 9.3 percent. This discrepancy is almost certainly due to an underestimate of the number of whites attending private schools. At any rate the quality of the demographics must be regarded as only fair.

The road network was last revised in 1963 and lists ADT travel times. The file is exceptionally dense, but it does not extend very much beyond city limits. Thus travel times and distances for the metropolitan cases must be regarded as approximate. All in all the quality of this data must be regarded as only fair.

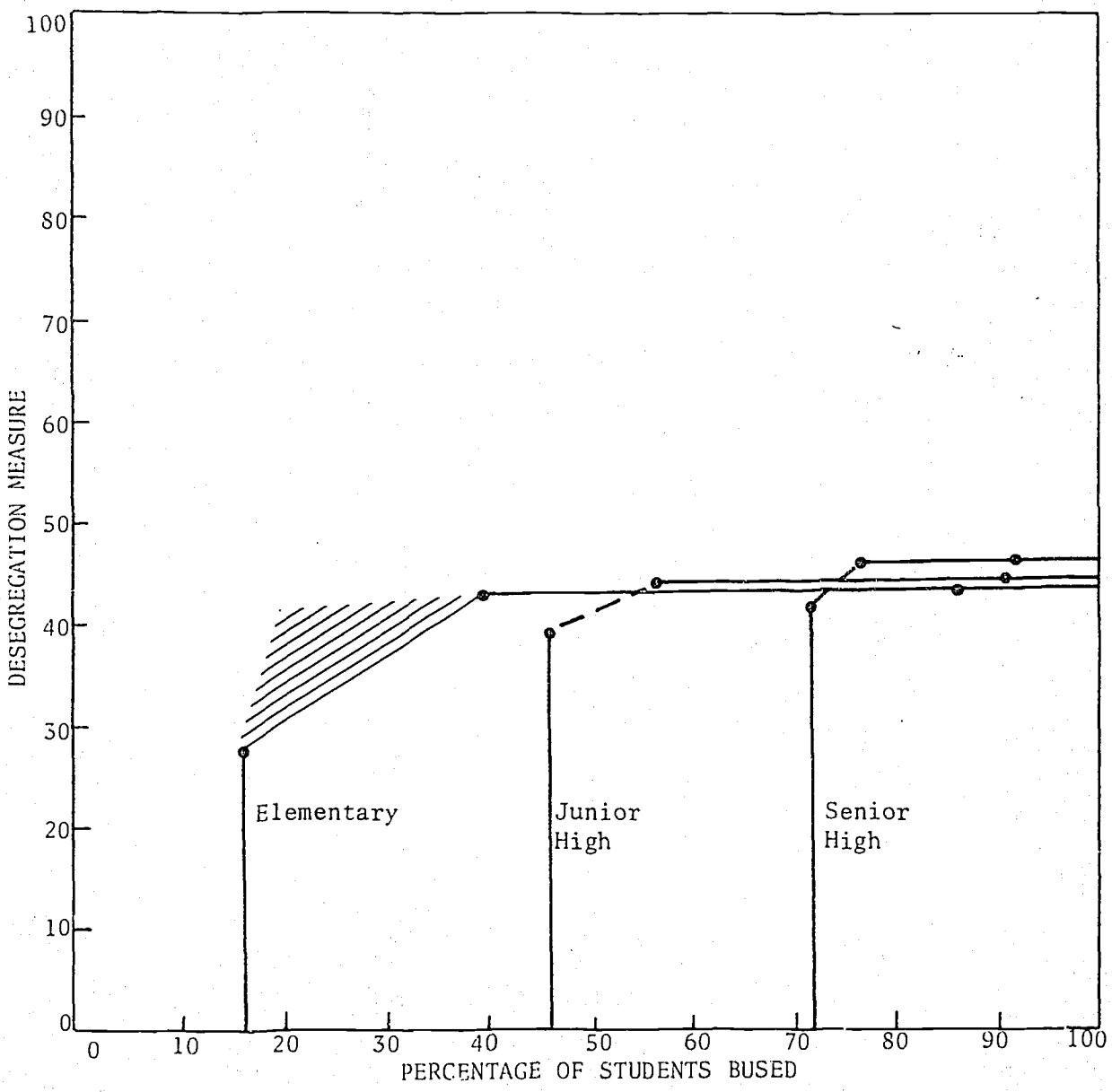
The school organization into grades is mixed; in the study it is reported as 1-6/7-9/10-12.

Cases 2, 5, and 6 were run for the central district. None of the center-city cases minimized travel distance; cases 2 and 5 minimized only the numbers of children bused for the levels of desegregation attained. Thus busing times and distances calculated are not meaningful and are not shown on the graph since they are overestimates of what is actually required.

Results for the center-city analysis show that a large increase in numbers of students bused (compared with other cities) is required for full desegregation. Thus, for example, 39 percent of elementary students are bused in case 5 -- extensive desegregation -- but only 15 percent when students walk to school

when this is possible. In developing an actual plan it might be valuable to consider accepting some decrease in desegregation levels in order to hold down the increase in busing. The results of such cases -- intermediate between cases 2 and 5 -- would fall somewhere in the shaded area in the graph.

For an assignment limited to Richmond itself, even full desegregation leaves all schools predominantly black. This naturally places more than the usual importance on an analysis of the wider metropolitan area. Unfortunately, the metropolitan area analysis was conducted according to the ground rules that applied to districts examined early in the study: Only one case was run, case 6, in which no attempt is made to limit either number of students bused or the length of the ride, subject to a 35-minute limit on travel time. Thus, this analysis is of technical interest only. An analysis could be made of the metropolitan area that would have more practicable application, by minimizing all transportation parameters and exploring more fully the alternative combinations of busing and achievable desegregation.



Graph of Achievable Desegregation

Richmond, Virginia

Center-City Analysis

St. Louis, Missouri

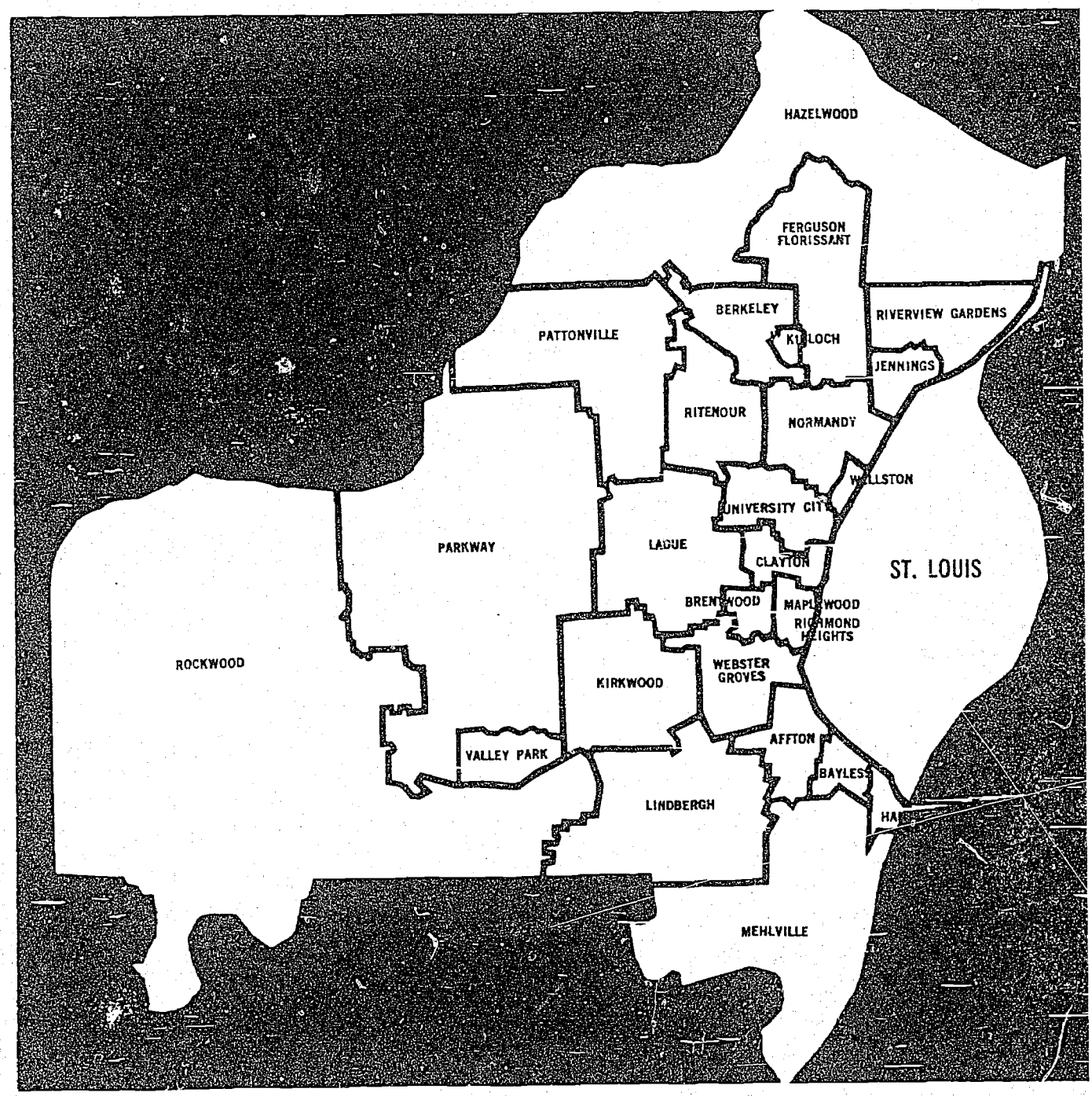
The central district comprises the city of St. Louis, which is a single coterminous school district. The metropolitan area was chosen as the entirety of surrounding St. Louis County. This area is at present served by 27 school districts, each of which typically has its own school district. St. Louis County includes several suburbs with substantial minority population (particularly Kenlock, Wellston, and University City). The present division of the County into districts is depicted in the accompanying map.

According to files from the Office for Civil Rights, the percentage of majority students in the center city was 34.1 percent as of September 1970; the minority is virtually totally Negro. The school population file used in this study lists the majority population as 36.2 percent, for quite good agreement.

The road data was last revised in 1966 and lists speed limits rather than actual speeds. The network is rather sparse. Thus, while the file is certainly adequate, it is not among the best.

The central district was analyzed through cases 2, 5, and 6. Only the numbers of students bused were minimized (except in case 6) but not their busing times; thus the travel times and distances in the computer outputs are overestimates of what could be achieved. These travel times are not shown on the graph since differences in the calculated times are not meaningful.

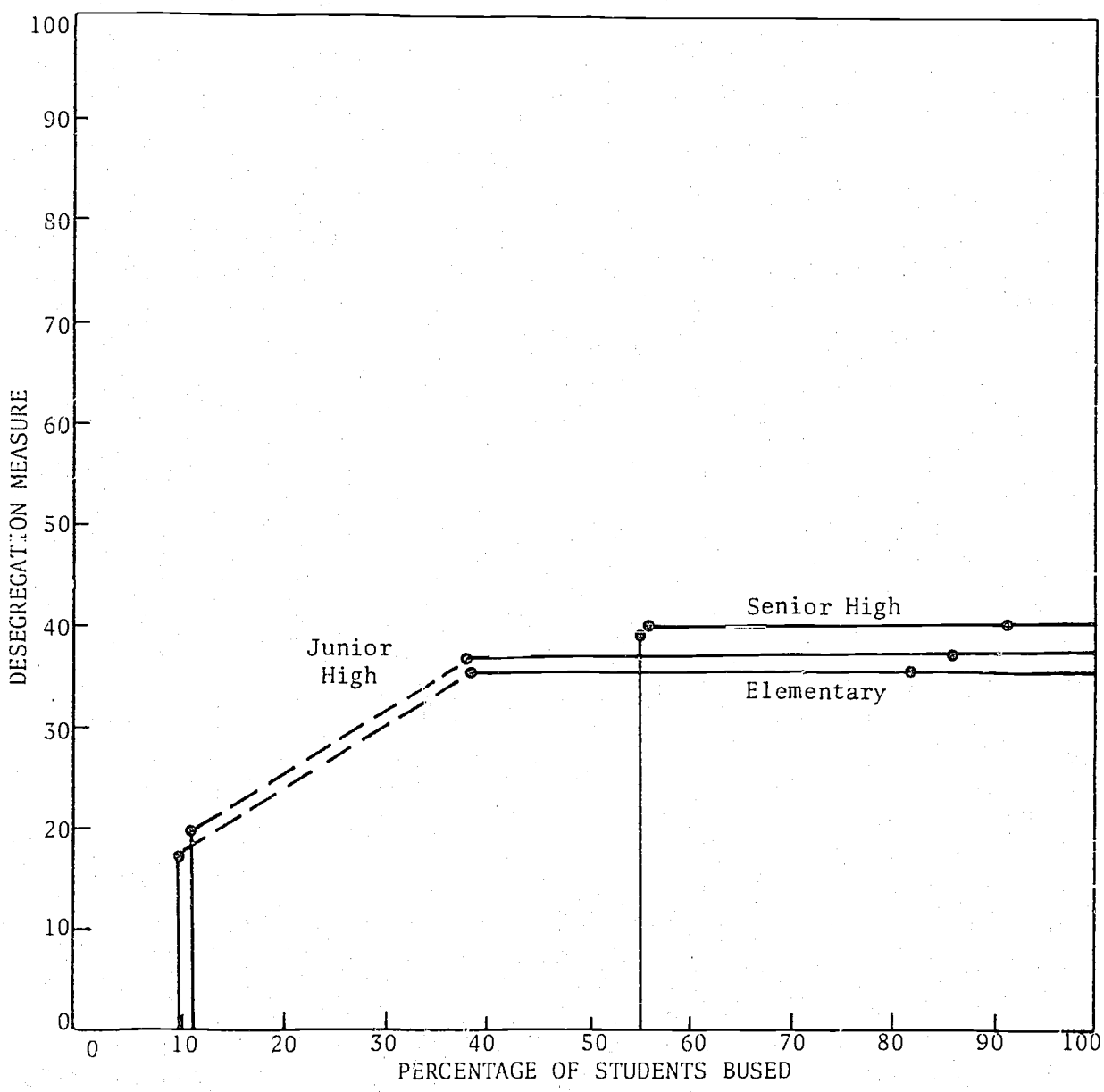
Results for the center city are rather typical for areas in which housing segregation is severe: A considerable amount of extra busing is required for



SCHOOL DISTRICTS IN ST. LOUIS AND ST. LOUIS COUNTY

elementary and junior high school levels in the city case, but very little increase in the number of students bused is necessary for the high schools (with their larger capacity and larger attendance zones).

Because of the city's racial composition, complete desegregation produces schools that are 60 to 65 percent minority. To change this situation would require including the metropolitan area in a desegregation assignment. For the metropolitan area analysis, case 6 was run. In this case, the program seeks an assignment in which the closest possible approach to proportional racial balance is attained with the only constraint being a 35-minute limit on travel time. Since this case places no limits on the number of students bused, it serves to prove only that desegregation in the metropolitan area is feasible but does not shed light on the overall transportation penalties that would be incurred in such a plan.



Graph of Achievable Desegregation

St. Louis, Missouri
Center-City Analysis

San Antonio, Texas

The San Antonio urbanized area is served by 16 school districts of which 11 have superintendents' offices in San Antonio itself and operate schools within the city. The major districts in the center city are as follows:

	Enrollment	Percent Majority	Percent Spanish
E. Central	3,207	71.1	22.4
Edgewood	22,689	3.7	89.8
Ft.Sam Houston	1,642	80.5	7.2
Harlandale	17,955	32.7	67.0
North East	28,035	90.2	8.9
Northside	21,250	75.8	20.9
San Antonio	77,253	22.9	61.5
S.San Antonio	9,223	35.8	64.2
Southside	2,231	26.5	72.7
Southwest	3,196	63.0	35.3
Total	186,681	40.3	51.6

These districts do not limit themselves to San Antonio Division, however, but also serve parts of neighboring divisions of the county. The school districts are so intertwined that it was not possible to determine a good definition for the center city, and thus none was defined. The metropolitan area was taken as those divisions of Bexar County which are at least in part in the urbanized area. These include the following:

E. Bexar Division
N. E. Bexar Division
N. W. Bexar Division
San Antonio Division
S. Bexar Division
S. W. Bexar Division

The school population file lists 47.5 percent majority students, considerably higher than the 40.3 percent majority in the listed school districts. However, the two areas are not directly comparable; the collection of school districts includes only those districts which have some schools in San Antonio City, while the set of County Divisions includes all of the urbanized area. Thus, we expect that the suburban areas have a higher percentage of majority students. The two figures do not in themselves suggest any substantial error in demographics.

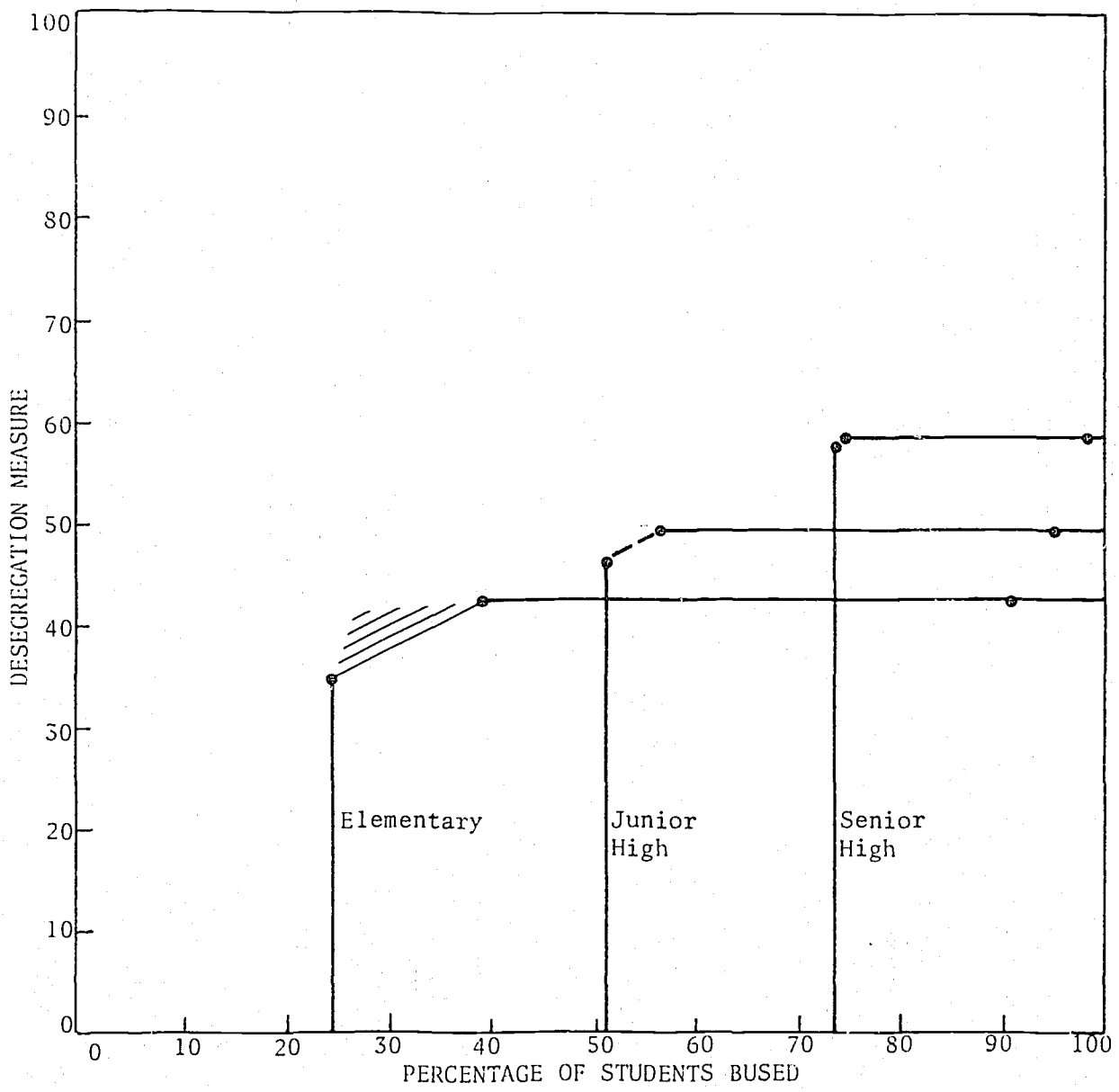
We should note that the bulk of the minority population is Mexican-American rather than Negro. Spanish-surnamed students were not identified as such in the prime data source, the First Count of the U. S. Census, and were identified rather from files on school attendance provided by the Office for Civil Rights. The methods used are inexact as to geographical location of students, so that the distribution of Spanish-surnamed students in the file is probably less accurate than the total number of those students. For this reason we rate the demographic data as only fair. It should be noted that, with the recent availability of Fourth-Count census tapes, it is now possible to construct a population file that reflects much more accurately the minority population especially for areas in which there is significant Spanish-surnamed minority.

The transportation data files were last revised in 1970 and contain Average Daily Travel Times. The density is quite high and the coverage is adequate.

The city was analyzed with cases 2, 5, and 6, minimizing only the numbers of students bused (except in case 6); travel times are not shown on the graph since the calculated numbers are longer than those that could be achieved if travel time (and distance) were minimized.

The analysis shows that the senior high schools in San Antonio could be desegregated with practically no increase in the number of students bused above the level that is required to get all children to school. Desegregation of the junior high schools could be achieved from a modest increase over the minimum required. In the elementary schools, some 39 percent of the students would have to be bused to achieve complete desegregation -- a considerable increase over the minimum required level of 24 percent. In such a situation, other assignments could be considered for the elementary schools, assignments that might relax slightly the desegregation goal while effecting a relatively more substantial reduction in busing levels. Such assignments would produce results that would fall somewhere in the shaded area in the graph.

These results are typical of findings in other districts. What is of equal interest is the dramatic decrease in minority enrollment from elementary to junior high and to senior high levels, which is almost certainly attributable to the very high drop-out rate of Mexican-Americans.



Graph of Achievable Desegregation

San Antonio, Texas

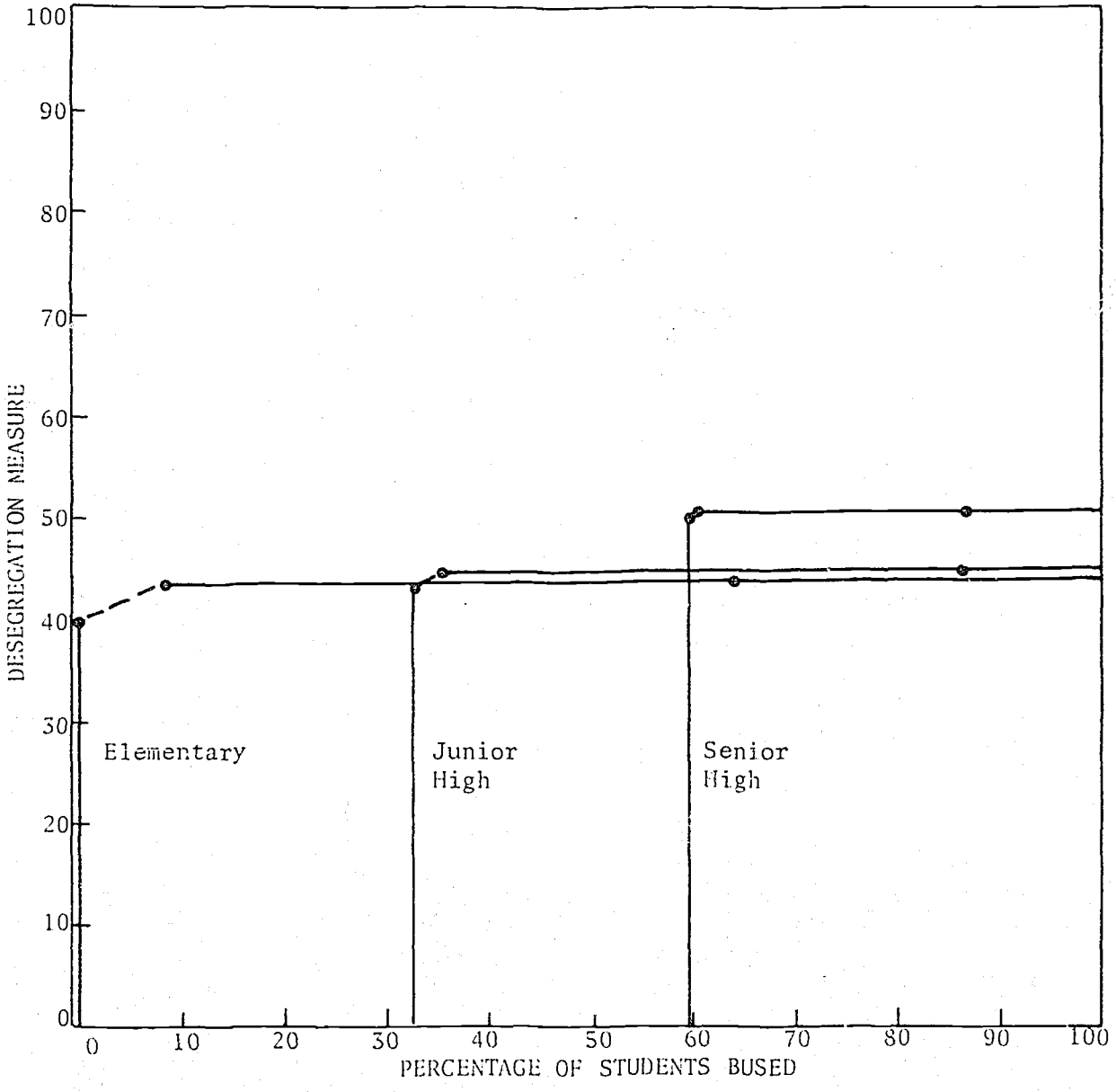
San Francisco, California

Because the San Francisco SMSA is shared with Oakland, another study city, and because of the travel problems inherent in combining the Bay Area, a metropolitan area was not defined for San Francisco. All cases were run for San Francisco City, which is identical with San Francisco County and is served by the San Francisco Unified School District.

The Directory of the Office for Civil Rights lists the district enrollment at 36.9 percent majority, 13.6 percent Spanish Origin, 20.8 percent Oriental, and 28.5 percent Negro. Thus there are three very substantial minorities. The assignment program used in the study does not differentiate between different minority races, so that there is no guarantee that these races are integrated among themselves in the assignments produced. The school population file lists 45.5 percent majority enrollment, substantially greater than reported to OCR by local authorities. The high fraction of Spanish-surnamed students is in part responsible for the error, because of the difficulties in treating this minority with First-Count census data; Fourth-Count census data now available makes it possible to produce much more accurate population files.

The transportation file, last revised in 1965, contains peak hour speeds. The file is rather sparse, partly because of the large area involved, including Oakland and the entire Bay Area. However, the data seems adequate for the purposes of a survey of this kind.

Cases run included case 2 (minimal transportation with desegregation of transported students), case 5 (extensive desegregation), and case 6 (maximum feasible transportation). In cases 2 and 5, only the numbers of students bused were minimized, so that once on the bus a student might be carried a considerable distance for the sake of desegregation. Thus even case 2 results show very substantial desegregation, close to racial balance. The calculated average busing times, even though they were not minimized, are not excessive so that we may conclude that San Francisco can be very nearly balanced between minority and majority groups without very much more busing than is required simply to get all children to school. Even if an assignment were constrained to further reduce travel time, it is probable that only a small increase in the number of students bused would result.



Graph of Achievable Desegregation

San Francisco, California

Seattle, Washington

The Seattle metropolitan area was defined as the entire SMSA, including King and Snohomish Counties. The city of Seattle is coterminous with the Seattle school district, and this district was chosen as the central city.

No minority is very substantial in numbers except in Seattle itself, where the minority of 20.3 percent is divided among Indians (1.0 percent), Negroes (12.8 percent), Orientals (5.3 percent), and Spanish Origin (1.2 percent).

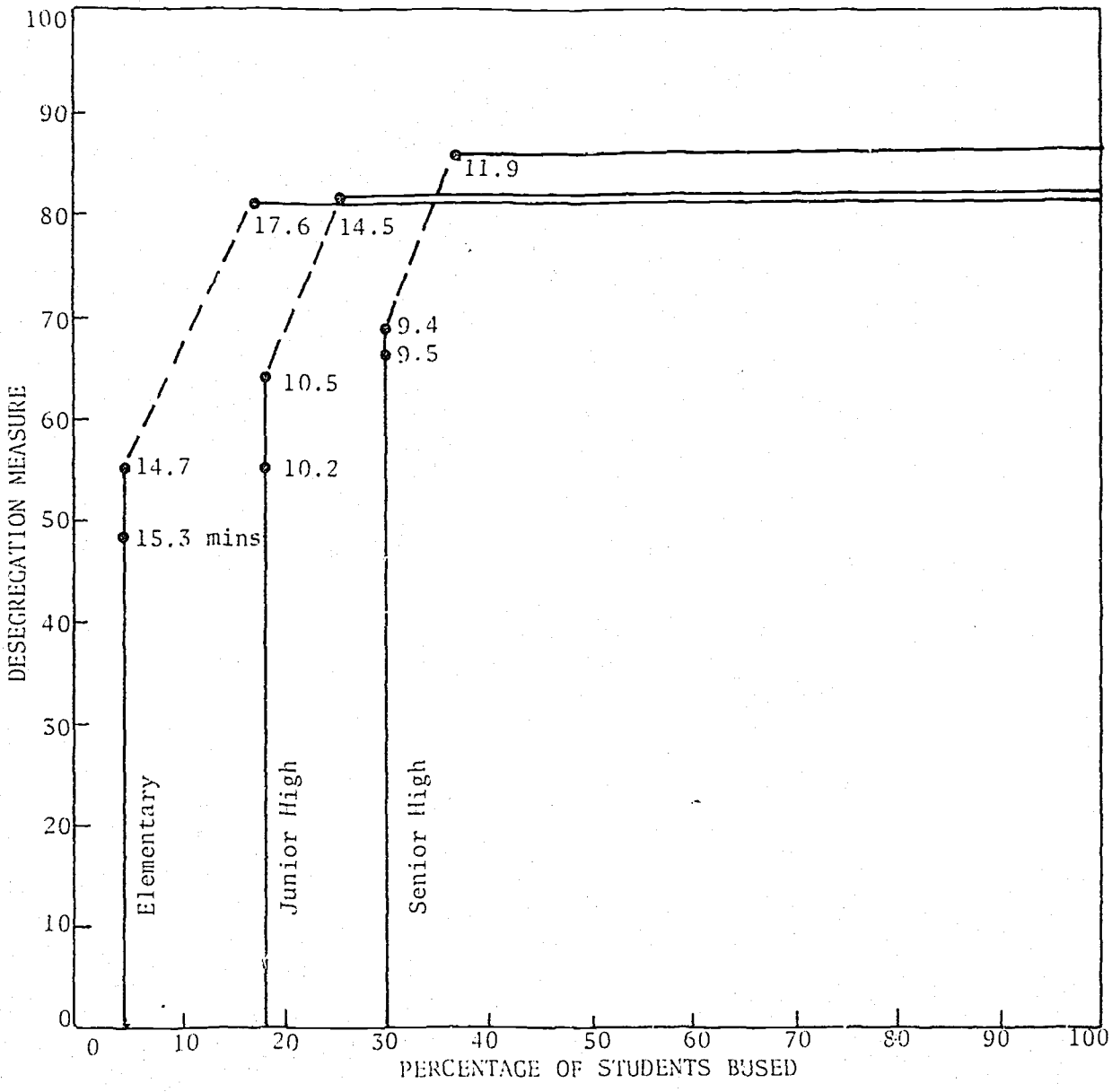
The analysis was made assuming that students walked no more than about one mile to school, and were transported if the distance was greater. However, Seattle follows the State of Washington guideline of two miles, so that it could be expected that busing levels would be reduced; this expectation is borne out by information that there is in fact very little actual busing within the City of Seattle. The results must be read with this discrepancy in mind.

The transportation file was last revised in 1970, and lists ADT times. Coverage and density are very good so that the general quality level is excellent.

Cases 1, 2, and 5 were run for the center-city analysis, and cases 1 and 5 were run for the metropolitan area analysis. All three transportation parameters--numbers transported, travel time (and distance), and total walking distance--were minimized; thus, in contrast to some of the cities studied early in the survey, the figures in the computer outputs can be regarded as fair estimates of what could actually be achieved, assuming a one-mile walking distance.

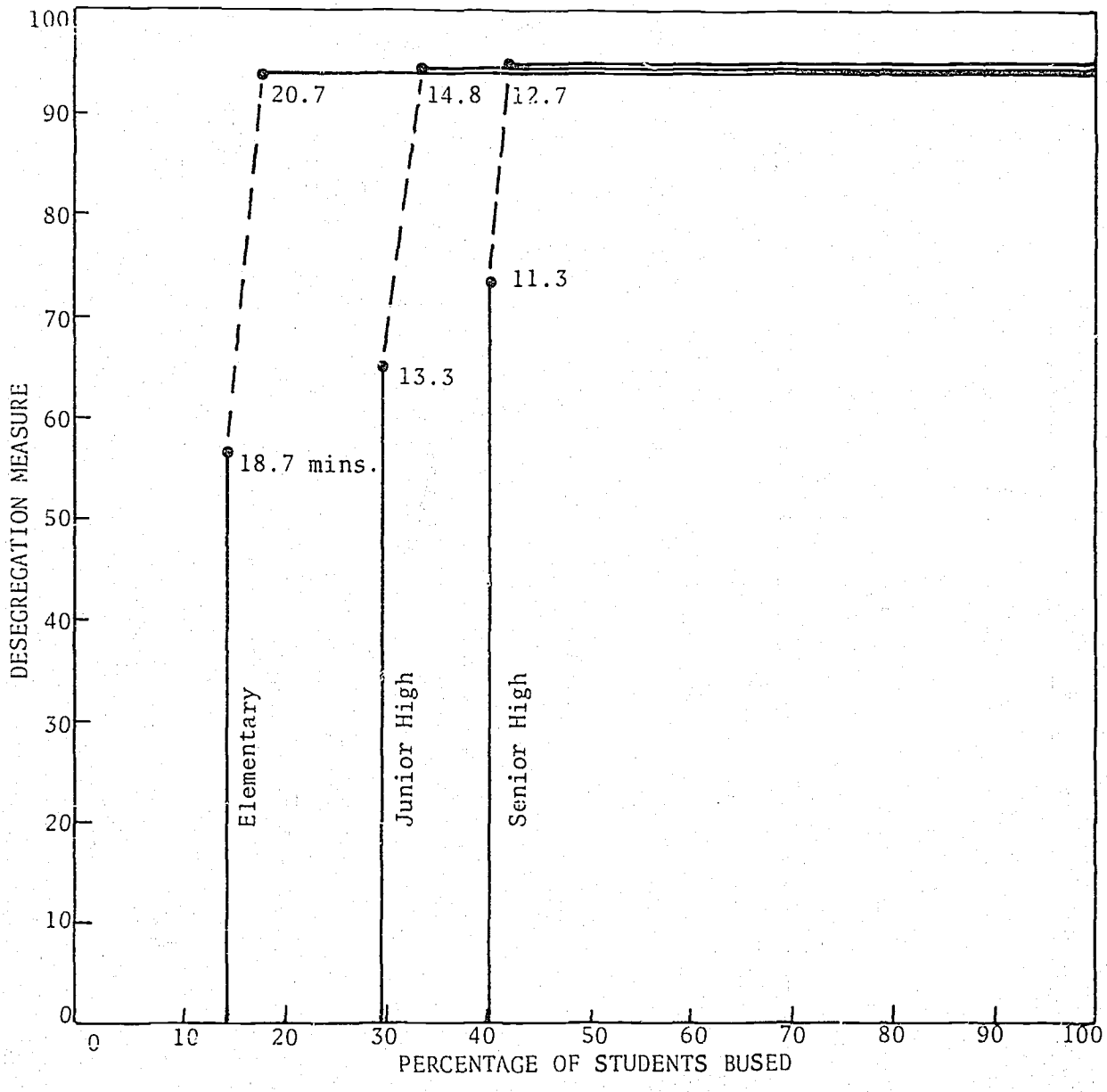
The center-city results are typical of districts surveyed, except for the fact that case 2 does not provide--as it does for many other districts--almost complete desegregation of the senior high schools. Also typical is the increase in travel time from case 2 to case 5.

The metropolitan area results are like those of the center city in the sense that case 2 does not provide complete or nearly complete desegregation at any grade level. In contrast to the center-city results, however, it can be seen from the graph that the percentage increase in busing required to achieve full desegregation is extremely small.



Graph of Achievable Desegregation

Seattle, Washington
Center-City Analysis



Graph of Achievable Desegregation

Seattle, Washington
Metropolitan Area Analysis

Toledo, Ohio

The center-city analysis for Toledo was the city itself. The metropolitan area of Toledo was defined as the part of the SMSA which lies in Ohio, thus excluding a portion of Michigan. Toledo is located in Lucas County which, together with Wood County, makes up the metropolitan area. School districts for this area are listed in an accompanying table.

	Enrollment	Percent Majority
Bowling Green	3,789	97.2
Eastwood	2,042	94.3
Elmwood	1,760	97.3
Maumee	4,517	98.2
Millbury	2,471	--
North Baltimore	11,113	98.5
Northwood	1,057	--
Oregon	5,166	95.8
Otsego	1,999	--
Ohawa Hills	1,121	--
Perrysburg	2,645	96.2
Rossford	1,675	97.9
Springfield	2,717	96.2
Sylvania	8,397	98.6
Toledo	61,906	70.5
Washington	11,518	99.5
Total	113,893	83.1

The school population files used list 81.5 percent and 88.0 percent, respectively, for percent majority in center city and metropolitan area, compared to 70.5 percent and 83.1 percent on the OCR files for 1970-71. Thus there was a quite severe error in Toledo City (but of course no great error in the

virtually all-white suburban area). The error is severe enough to make results questionable in interpretation.

The road network is extremely small in total area, just large enough to cover the city of Toledo, but not the metropolitan area as we have defined it. The density is extremely great, at about 203 intersections per square mile. The fact that it does not cover the metropolitan area is of no concern since, in the only case analyzed for this area, travel times and distances were not minimized and thus are not meaningful in any event. The data were last revised in 1971 and contain average daily travel (ADT) speeds.

A great number of cases were analyzed for Toledo, since it was one of the first cities analyzed, and served somewhat as a shakedown for analytical methods to be employed. For the center-city analysis, standard cases 1, 2, 3, 4, 5, and 6 were run. Only in case 1 were travel times minimized in addition to the minimization of numbers of students bused. All these cases are plotted in the graph. In addition, several exploratory cases (not shown on the graph) were defined, not so much to analyze Toledo further but rather to determine the possible value of using such cases in the survey as a whole:

- As explained in preceding sections of this report, the standard procedure in the survey was to permit assignment of students up to 105 percent of stated enrollment if this would aid in desegregation. A special case 1 was run for Toledo in which no excess was permitted. The results between the standard case 1 and the no-excess case 1 were negligible, and accordingly the standard was used for the remainder of the cities surveyed.

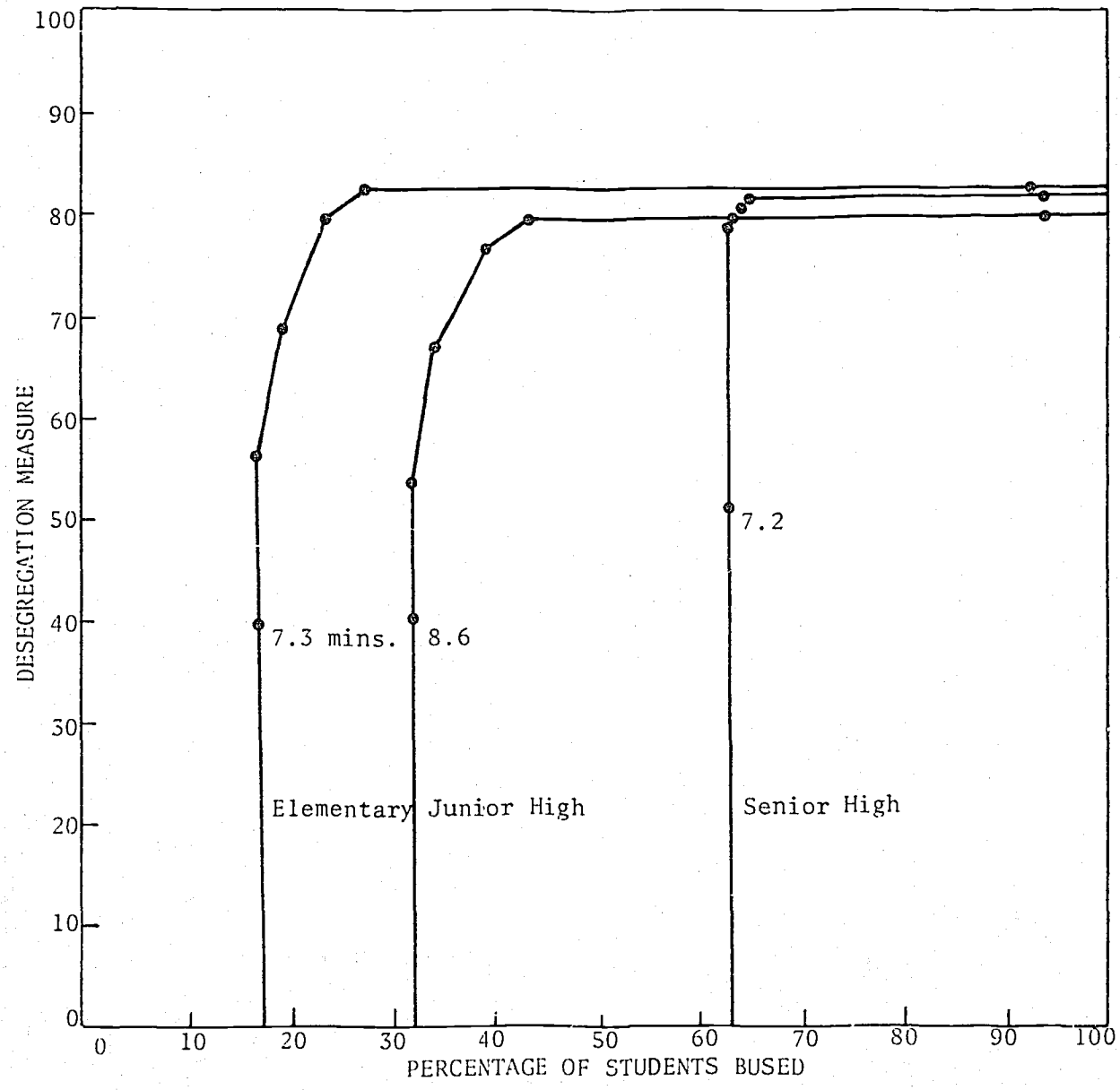
- Another version of case 1 was run in which assignments minimized only the numbers of students bused rather than both the numbers of students and the distances traveled. Travel times in this special case are much higher than in the standard case -- in other words, much higher than is absolutely necessary -- which is not consonant with our informal definition of this case as a "neighborhood" assignment, and accordingly the case was not run for other cities. It is of interest that the extra travel time has very little effect on the desegregation achieved in the elementary and junior high schools but significantly increases the desegregation level in senior high schools. Aside from this phenomenon, this special case proves primarily that a computer will not minimize travel times unless you so instruct it!

In the metropolitan area the standard case 6 was run. It shows that it is feasible to desegregate the area, but since the assignment does not minimize even the numbers of students bused (let alone travel times) it is of merely technical interest and is not graphed. Finally, an additional case 6 was run for the metropolitan area, in which we explored whether or not there was any advantage in reorganizing grades in the fashion defined in the introductory section of this report. There appeared to be no advantage to such a grade reorganization and, after further trials in a few other areas, this case was dropped from the survey procedure.

The analysis of so many cases serves to explore more fully in Toledo than was economically feasible for the other areas the balance between desegregation goals and transportation burden. Among other things, it makes possible

an understanding of how a curve that is based on only two or three cases would appear if it is filled out by additional intermediate cases.

The results are quite similar to those for other areas similar to Toledo. Desegregation of senior high schools requires almost no busing other than what would be required for students who live more than one mile from an appropriate school that has the needed capacity. This stems, of course, from the large capacity and consequently large attendance zones of the senior high schools. The desegregation of junior high and elementary schools would require more busing, but there are many options between the minimum-transportation assignments (cases 1 and 2) and the extensive desegregation assignment (case 5) that require more modest busing and that provide substantial although not complete desegregation.



Graph of Achievable Desegregation

Toledo, Ohio

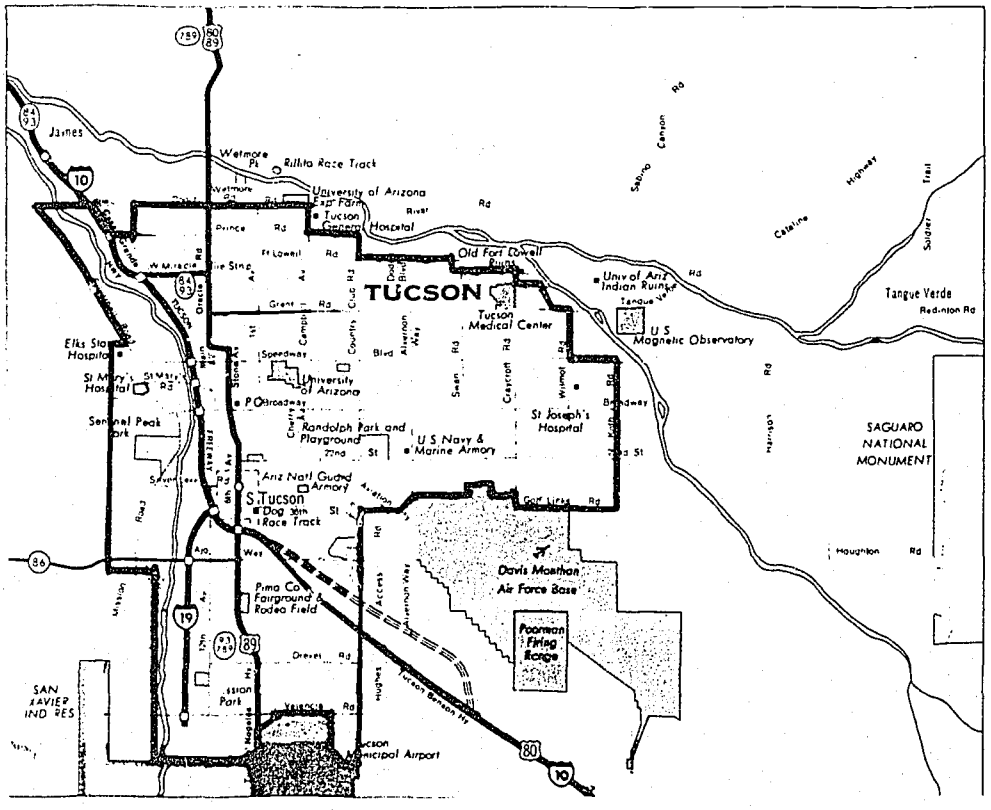
Center-City Analysis

Tucson, Arizona

The metropolitan area of Tucson was defined as the entire Standard Metropolitan Statistical Area (SMSA), consisting of Pima County. The center city and the central school district have essentially no common boundaries; Tucson is served by a host of school districts, and the central district extends outside of Tucson. An accompanying map shows the boundaries of the City of Tucson. The situation was resolved by defining the central area as the City of Tucson, so that eight districts are actually involved in the center city case. Of the approximately 60 schools in these eight districts, only three lie outside Tucson, so that in fact they are, as a group, essentially coterminous with Tucson.

However, we may not conclude that the definition of the central city is adequate, because there is a net overcapacity in Tucson, with many students crossing city boundaries from outside. Thus we have a relatively poor match between population area and school area.

Because of these problems it is difficult to make judgments concerning the data on racial composition of the school population. The table shows all districts in Pima County and the racial composition of larger districts as reported in the Directory of the Office for Civil Rights; the school population file used in this study is 72.0 percent majority, which shows reasonable agreement. The minority group in the Tucson area is nearly totally Mexican-American.



Boundaries of Tucson, Arizona

School Districts in Pima County, Arizona

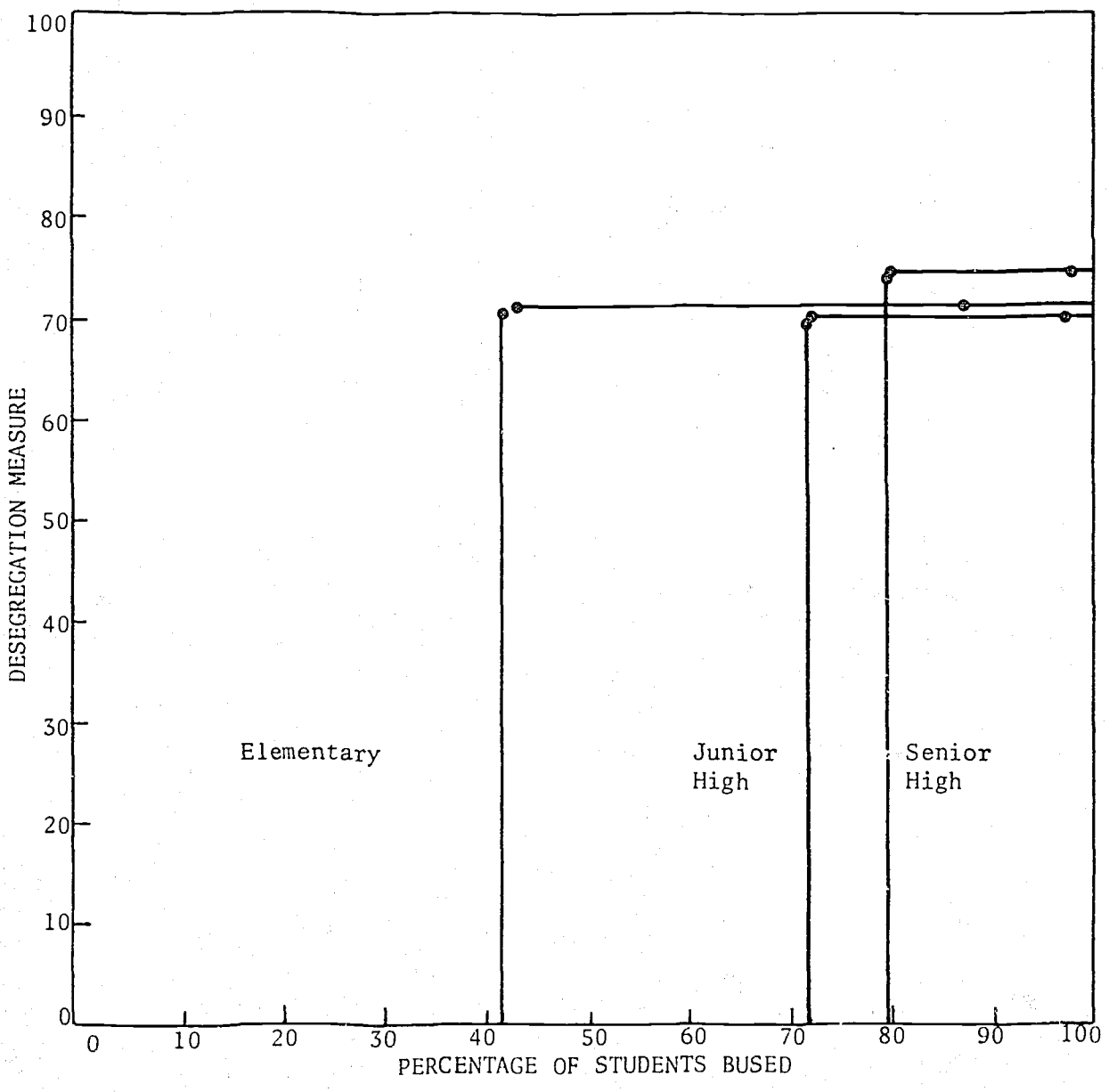
	Enrollment	Percent Majority
Ajo Elementary	1,143	--
Ajo High	576	--
Amphitheater Elementary	4,763	85.5
Amphitheater High	2,351	87.8
Catalina, Foothills Elementary	519	--
Continental Elementary	104	--
Flowing Wells Elementary	2,766	--
Flowing Wells High	1,016	
Marana Elementary	1,037	62.2
Marana High	396	--
Suhuarita Elementary	549	--
Suhuarita High	279	--
Sunnyside Elementary	4,973	53.6
Sunnyside High	1,739	55.1
Tangue Verde Elementary	265	--
Tucson Elementary	38,441	64.9
Tucson High	16,624	71.6
Vail Elementary	103	--
Empire Elementary	--	--
Redington Elementary	--	--

Transportation data were last revised in 1960 and contain ADT travel times. Density and coverage are adequate, but the file is rather old.

Cases 2, 5, and 6 were run for Tucson. The metropolitan area case was also run; it is not plotted on the graph, for reasons explained in the preceding sections. It is remarkable that the racial composition of the metropolitan area is

about the same as that of Tucson, so that there is no strong reason to merge suburban and urban areas more than is already the case. The results of the center-city analysis are striking in that complete desegregation of schools can be achieved with essentially no busing other than the minimum required to get all students to school; such results are characteristic of districts in which the racial residential pattern is a "pepper and salt" distribution, rather than a minority center surrounded by majority suburbs. Presumably because of this distribution phenomenon, the burden of busing is very nearly the same for majority and minority students.

Tucson was examined relatively early in the study, and only the number of children bused is minimized in the cases shown. Figures for average travel time and distance should therefore be disregarded, since assignments could be produced in which these parameters would be significantly lower.



Graph of Achievable Desegregation

Tucson, Arizona
Center-City Analysis

Wichita, Kansas

The metropolitan area was selected as that part of Sedgwick County which is listed as an urbanized area by the U. S. Census Bureau. This area includes Wichita City as well as the following townships:

Deland	Riverside
Gypsum	Rockford
Kechi	Salem
Minneha	Waco
Ohio	Wichita
Park	

This area includes McConnell, Kechi, Park City, Eastborough, Maysville, Maize, Haysville, Oaklawn, Derby, and Mulvane. Sedgwick County is served by nine school districts, of which Derby, Haysville, Maize, Mulvane, and Wichita serve the urbanized area. The central district serves a 152 square mile area and about 60,000 students. The center city was selected as Wichita City itself, although it is not exactly coterminous with the central school district.

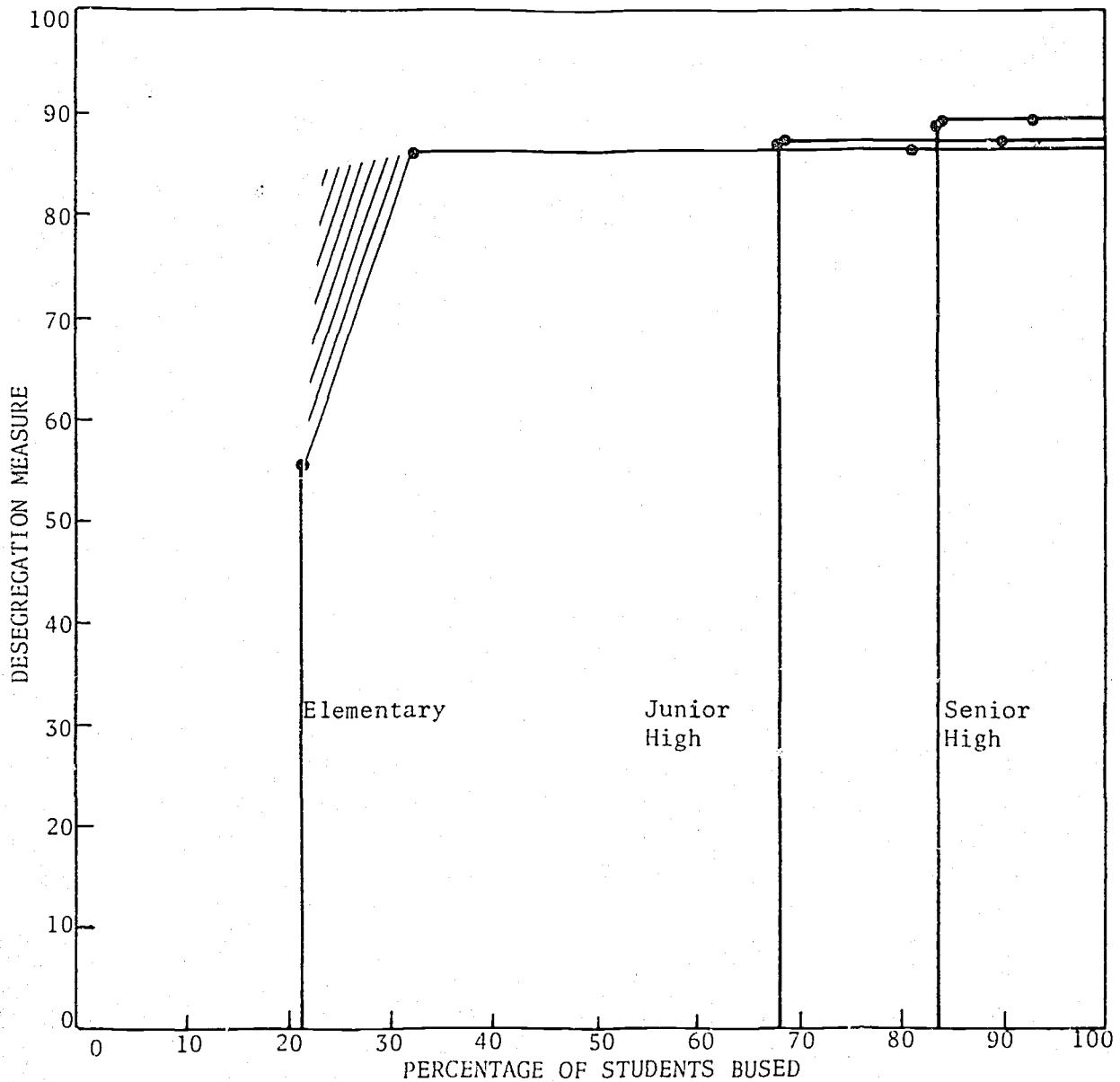
The Directory of the Office for Civil Rights lists the majority population enrolled in Wichita school district as 82.9 percent, and the minority is predominantly black. The population file used in this study lists 87.5 percent majority, so that there is a moderate error in racial composition of the population file.

The transportation data was last revised in 1960. Speeds were derived from highway class data and a mathematical model which shows traffic by capacity and loading data. Two new highways, I-35 and I-235, are not in the file; I-235 is a semicircular superhighway on the western border of the city and its

absence is a serious deficiency of the file. The area covered is about 71 square miles, so that its use beyond city limits would be questionable; in fact it was not so used, so that the lack of coverage was not a serious defect.

The analysis of Wichita is based on cases 2, 5, and 6, run only for the center city, which in fact covers the overwhelming bulk of the population. The only transportation penalty applied in cases 2 and 5 was the number of students bused (as well as the standard outer limit on travel time of 35 minutes). Thus the computer outputs reflect longer travel times and distances than would result from an assignment in which these parameters were explicitly minimized.

The results indicate that complete desegregation of the junior and senior high schools can be achieved without transporting any more students than those who live more than about one mile from a school of the appropriate grade level. In the elementary schools, however, complete desegregation would require transporting 34 percent of the students, compared with 21 percent who would have to be transported in any event. It would be possible to develop assignments intermediate between cases 2 and 5, in which the level of busing could be substantially reduced with only a relatively slight relaxation of desegregation goals. Such assignments would produce results -- in terms of desegregation level and busing level -- that would fall somewhere in the shaded area in the graph.



Graph of Achievable Desegregation

Wichita, Kansas