Merton Bus Network

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Abstract

The purpose of this project was to recommend improvements to the bus network in the London Borough of Merton that would increase bus ridership, and decrease traffic congestion. We arrived at these conclusions after reviewing the literature on different international bus systems, examining the existing bus network in Merton, and interviewing traffic experts. Our report identifies several changes to the existing bus network that will improve the bus service and increase ridership.

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Executive Summary

The goal of our project was to recommend improvements to the bus network to meet the changing transportation needs of the London Borough of Merton. Many factors were taken into account in the formulation of our final proposal. Information obtained through the research of demographics and the current transportation system in Merton, as well as interviews, a focus group, and surveys were all important in determining our proposal.

Through our evaluation of Merton's demographics and current transportation system, areas were located in which potential improvements could be made. These included inadequate or unserviced areas, congested areas, and new industrial areas. Once these locations were identified, potential solutions were proposed for these problems.

Following the evaluation of the transportation system in Merton, a set of interviews was conducted with transportation officials and engineers working for the London Borough of Merton and London Transport. The purpose of these interviews was to gain insight into the transportation systems of both Merton and London from experienced professionals. Additionally, these experts reviewed some of our potential recommendations to determine their feasibility. It was very important to obtain opinions from professionals in the field who either supported our ideas or had constructive criticisms.

In addition to the interviews, surveys and a focus group were conducted to obtain the general opinion of the public concerning the current transportation system and our proposed ideas. These were helpful in providing a view from first hand users of the system, and in identifying problem areas that our team missed. Additionally, surveys

were conducted of private transportation users, to determine the reasons for their choice of transportation mode.

Once this data was compiled, we formulated a final proposal, which relied heavily on the information obtained from the interviews with the professional transportation engineers and officials. This proposal includes express routes connecting major town centres, additional routes into unserviced areas, and modifications to the existing routes. Also included in our proposal were the addition of park and ride services and a restricted access lane. The addition of the express routes could increase bus use by ten percent. Our final proposal was presented to the London Borough of Merton.

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1.0 Introduction

Merton contains 170,000 people and encompasses 9,380 acres of land. The influx of money from its 3,500 small to medium sized businesses has resulted in an increased prosperity of the area. However, with the new prosperity, have come problems. If present trends continue, the increase in car ownership in Merton by 2010 will be between 83 percent and 142 percent, far beyond the road capacity. To reduce the rate of growth in car ownership and to accommodate existing businesses, Merton has implemented ideas from the Alternative Movement Strategy (AMS). The AMS is a document indicating problem areas in public transportation and their possible solutions in the borough of Merton.

The goal of the AMS is to encourage a greater use of bus services by creating a higher quality bus system better designed for local needs. Part of the AMS's answer to the road congestion problem has been the construction of the Croydon Tramlink. The Croydon Tramlink is a 28-km light rail system that services Merton and Croydon. However, other sources of public transportation such as buses will have to be used with the Tramlink to increase public transit usage. The result will be a more comprehensive and efficient public transportation system.

The goal of our project was to recommend improvements to the bus network that helped accommodate the changes that have taken place in the London Borough of Merton. Our aim was to design a higher quality bus system with more frequent, reliable service, and vehicles that are environmentally friendly and accessible for all patrons. The new system will make appropriate use of innovative measures to achieve efficiency, and overall satisfaction. The proposed bus system is integrated with the new Tramlink, in

order to make public transportation more efficient. It was necessary to examine private and public transportation patterns to accomplish this goal. The analysis of the major activity centers, the proposed Tramlink routes, road space, and public opinion were also important in the recommendation of improvements to the bus network. Research of the South and West London Transport Conference (SWELTRAC) proceedings, international bus systems, innovations in bus transportation, space availability, and the current public transportation strategies and polices in the London area also were taken into consideration.

We believe that our project will be helpful to residents of Merton and surrounding London Boroughs, as well as to London Transport. Passengers will benefit through a simplified and economical transportation network that will better meet their transport needs at lower costs than private automobile transportation. London Transport will benefit through increased ridership, a decrease in road congestion, and an increase in revenue.

The proposed bus network was presented to SWELTRAC, and the London Borough of Merton. An oral presentation as well as a written report was submitted at the conclusion of the project to both of these organizations. The results were used to make a recommendation for an improved bus network in Merton and the surrounding areas.

2.0 Literature Review

In Merton today, transportation is encountering many difficulties that must be addressed. The Bus System Enhancement section of the Alternate Movement Strategy has been developed to address these problems with plans to renovate the transportation system. The aim of the proposed strategy is to encourage people to use public transportation instead of cars due to insufficient road space. The Bus System Enhancement plan states that the Borough would like to see the addition of services to their existing bus system (Alternate Movement Strategy, 1991). In order to propose suitable bus service changes it was necessary to complete a literature review.

This literature review looks at the history of bus transportation, different bus systems, and different routes. Bus system designing, planning and quality standards are discussed in this chapter. Since it is imperative to look at examples of where certain types of systems have succeeded and failed, case studies have been included.

2.1 History

The first passenger bus was "a single twenty four passenger, double deck motor bus," that was introduced to the United States in 1905 (Miller, 1960, p. 153). The success of this type of transportation led to the addition of thirty-four more buses over the next three years on that particular route in New York. Despite its popularity and usefulness in New York, a weak power generator and lack of structural safety prevented other cities from using the vehicle. Even fifteen years later, only sixty motorbuses operated in the entire United States (Miller, 1960). Changes had to be made in the construction and design of buses or they would not be universally accepted as a form of public transportation. Between 1920 and 1922, some major changes were made in bus design.

The chassis were made specifically for the bus instead of mounted on truck bodies, and the entrance step was lowered. Other improvements were to the buses' structural integrity, a lower center of gravity, an extra long wheel base, and wider tire treads to improve handling characteristics. Additionally, springs were added for a smoother ride, engine power was increased, and the interior was made more attractive (Encyclopedia Britannica, 1973).

The next major innovation in buses occurred in 1926, when the engine was moved to a location under the body of the bus. Gas electric or diesel electric engines were also added to replace the existing out of date engines. These gas or diesel engines drove a generator, which powered electric motors over the rear wheels. The main advantage to these engines was the elimination of manual gear shifting, resulting in reduced wear and tear on the engines and a smoother ride. Air suspension was also added to improve the quality of the ride (Encyclopedia Britannica, 1973). These improvements played a key role in motor transportation's increased popularity. By 1930, the number of buses in operation had risen to over 13,000. That number continued to rise steadily to 64,000 in 1993 (Edwards, 1996).

2.2 Design

In order to operate effectively, public transportation must usually confront two problems. The first is the ability to provide transportation for those who are not able to provide their own. The second is how to move a large number of people between a small number of locations. Unfortunately, the situation in suburban areas is just the opposite. There is a demand for a small number of trips, between a diverse number of locations.

These two perplexing problems must be accounted for when planning for effective and cost efficient bus routes.

2.21 Profile

The goal of public transportation is to provide a transport system that will cover the present and projected travel needs of its consumers, and be able to adjust, to satisfy transport needs not originally addressed (Steel, 1969). Before determining what type of bus network to establish in an area, a comprehensive profile of the area must be compiled. The profile determines some basic objectives that should be satisfied by the system along with considering residential and commercial needs.

One aspect of an area profile is demographics. Demographics include the residential and employment concentrations of the immediate area containing the transport system, as well as nearby areas whose citizens will use the system. The residential and employment concentrations identify where people, live and work. This allows a transportation system to be specifically adapted to the primary users.

The area profile must also include a study of the laws in the area that governs transportation. The policies that govern the area could either help or hinder certain public transportation methods. These policies affect the decisions made by companies in charge of the planning and constructing of the system and sometimes result in higher costs and delays (Steel, 1969).

2.22 Planning

To begin the planning of a bus route it is first necessary to understand a number of definitions and classifications which are used to characterize and evaluate a given situation. The first of these is the right of way, (R/W), which is defined as a strip of land

on which the bus operates. The right of way is broken into three distinct categories, called category 1, 2, and 3. Category 1 is a fully isolated route with no grade crossings or access by other vehicles. Category 2 is not fully isolated, but rather consists of routes that are separated longitudinally from other traffic, with no regular intersections or grade crossings for vehicles or pedestrians. An example of a category 1 would be a rail track, which has no crossing, or access by other vehicles. An example of a category 2 however, would be a street running tram, which would have separation from other traffic, but would run on the road with other traffic. The street running tram is separated but not isolated. Category 3 consists of regular streets with mixed traffic. Most bus systems fall into category 3 (Khisty, 1990).

Once it has been decided that a system should be designed or modified, there are many methods that can be used. The method used must be specifically designed to meet the needs of that particular area. The following is one possible method of organizing or modifying a system.

In the Khisty method, it is important to determine the passenger-carrying capacity of the various roads that are under consideration as possible routes. The passenger-carrying capacity is defined as "the maximum number of people that can be carried past a given location during a given period of time, under specified operating conditions" (Khisty, 1990, p.380). The passenger capacity of a route is dependent on four main factors. These factors are the maximum number of vehicles per transit area, the passenger capacity per vehicle, the minimum possible time spacing between individual vehicles, and the number of lanes in the roads. Knowledge of these factors is an important consideration when evaluating or planning a transportation system (Khisty 1990).

2.3 Systems

The next step in the planning process is the selection of a specific bus system. There are three main types of bus systems used to satisfy the different needs of transit passengers. These systems consist of demand responsive, fixed schedule, and express mode bus systems. Each of these systems has individual strengths and weakness that must be evaluated in order to apply them effectively to a given environment.

2.31 Demand Responsive

Demand responsive bus systems are the most common bus systems used. They are a "transportation service characterized by flexible routing and scheduling of... vehicles to provide door to door or point to point transportation at the user's demand," (Stanley, 1983, p. 73). The basic idea is to respond to the consumers needs which fall into four distinct categories. They are multiple home origins to one destination, multiple home origins to a few destinations, multiple home origins to multiple destinations, and multiple home origins to multiple destinations via a central interchange point (Hutchinson, 1960).

The purpose of multiple home origins to one destination system is to take passengers from different places to one central location. From there, they have access to other modes of transportation to assist them in either arriving at their final destination, or other major activity centers. The multiple home origins to few destinations system is similar to the previously mentioned system, except with a wider range of destinations. Areas with a variety of activity centers would be more apt to subscribe to this method. The multiple home origins to multiple destinations system is a "modified version of a taxi," which allows the passengers to decide their places of arrival and departure. This

method is mainly employed by charter bus services (Hutchinson, 1960, p. 223). Multiple home origins to many destinations via a central interchange point is closely related to the first method described. Except in the latter, the central interchange point is meant to transfer passengers to different service centers, not to different areas of the town (Hutchinson, 1960).

With every system, certain disadvantages also must be taken into consideration when evaluating effectiveness. One of the major disadvantages with the demand-responsive bus system is a very high maintenance cost. These high costs are the result of the large distances traveled by individual vehicles to meet the passengers needs.

2.32 Fixed Schedule

The fixed schedule system is a method used in cities such as Atlanta, Boston, and San Francisco. Its purpose is to pick up and drop off passengers as close to their destinations as possible (Stanley, 1983). This system has preset stops at preset times, short travel distances, and low speeds. To make the system more effective lanes mainly for buses, called bus lanes, have been added in many cities (Edwards, 1992). These lanes are meant to decrease the effect that local traffic congestion has on the operating times of the buses. A problem with this system is that its routes are fixed. Consequently, the routes must be periodically updated to meet the changing needs and locations of businesses and communities.

2.33 Express

Express bus systems can also be called limited-stop bus service because the stops are infrequent and specified. The distances covered by the buses can be greater than three miles and travel speeds can exceed fifty miles per hour. Express systems are

usually used to provide service for three types of facilities, fringe parking areas, bus stations, and terminals. At fringe, parking areas travelers can park their cars and transfer to an express bus. Bus stations are used for loading, unloading, and transfer areas for local buses and private cars, and have short travel distances. Terminals are facilities meant for quick loading, unloading and distributions of passengers and goods (Hutchinson, 1974). Cities such as Chicago, Cleveland, and Houston are known to use these types of express bus systems. Like every method there are problems associated with the express bus system. These include long waits and fewer destinations for riders to choose from (Edwards, 1992).

2.4 Routes

Once the proper system has been determined for an area, it is necessary to define its travel routes. These routes are the paths taken by transportation vehicles to get passengers from one point to another. They are set up to meet the transport needs of a variety of people and situations. The five major routes in use are radial routes, circumferential routes, cross-town routes, feeder routes, and shuttle routes. Each route has its own separate function.

Radial routes bring people from outlying cities and towns into the area's major activity centers. These routes can best be described as spokes on a wheel, where the center of the wheel is the destination of the majority of the traffic. Radial routes usually represent the quickest way to get into the city, and allow people to accomplish a variety of tasks including work, shopping, and entertainment (Hutchinson, 1974). However, since major activity centers change as an area develops, the routes can become outdated quickly and must be updated regularly (Rosenbloom, 1990).

The need for travel between suburbs led to the advent of circumferential routes. Circumferential routes provide a mode of travel for passengers who want to go from one outlying area to another, without passing through a major business district. These routes sometimes form circles around large cities and can serve as connectors to radial routes. The resulting combinations of circumferential and radial routes are referred to as a Spoke and Wheel network. The circumferential routes are used to transport people around the outskirts of the city and to radial routes (Edwards, 1992).

The need to travel relatively short distances, such as across town, led to cross-town bus routes. They are meant for intra-city travel. Cross-town routes are relatively short and straight, and are adjacent to the major activity centers (Edwards, 1992).

Feeder systems connect less populated areas to radial routes in order to facilitate travel to and within the central business district. Feeder systems encompass the areas not covered by radial routes and greatly decrease the amount of time needed to travel to work, retail shops, restaurants, or recreational sites within the city (Hutchinson, 1974).

Shuttle routes are traveled by shuttle buses that go back and forth over a particular route (Stanley, 1983). They can either connect to "non-central activity centers," or provide transportation from the central area of activity to major venues (Edwards, 1992; Hutchinson, 1974, pp.192).

2.5 Efficiency

Once a specific system has been chosen for a particular route, it is necessary to implement an efficient operating plan for the buses. Many strategies and controls can be implemented to accomplish this. For instance, Headway-Based Control is one strategy in which the goal is to maintain proper separation between each bus along the route. This is

accomplished by having the operator set the frequency of the buses to a certain interval to maintain spacing. The result is less congestion at bus terminals, since no two buses will be arriving at the same time, which translates into a decreased wait time for passengers (U.S.D.O.T. 98).

Schedule-Based Control is another strategy that can be implemented to increase the efficiency of a bus transportation system (U.S.D.O.T. 98). The idea behind the system is that each bus maintains its own schedule, instead of maintaining a constant headway with other buses. This means that the buses arrive and leave a stop at designated times, rather than changing times to accommodate the movements of other buses. Each bus maintains its own specified schedule no matter how much congestion or bus bunching occurs. However, if each bus maintains its schedule, congestion and bunching should be minimized.

Binary Schedule-Based Control is a slight modification of the Schedule-Based Control method that can be implemented to increase its effectiveness. Binary Schedule-Based Control requires the buses to be either under the full control of the center of operations or under no central control at all. This means that if a bus maintains its preset schedule it is not controlled, but if it deviates either ahead or behind schedule, the center of operations will intervene. If a bus was running late it would be instructed to skip a stop, but if it was well ahead of schedule it would be held at the stop until it was back on the original schedule (U.S.D.O.T. 98).

The efficiency of bus services is important to the development of any transportation system, especially if the system is integrated with another one. The efficiency is an especially relevant factor in Merton, where the bus system will be linked

with the tram. If the buses were not to maintain set schedules it would be impossible for a commuter to rely on them to transport him to the tram station to catch a tram. This is another important factor to consider when examining the bus network in a particular area. This will be important in determining which control system will suit the needs best.

2.6 Standards

Once a new transportation system has been developed, a set of standards is necessary to evaluate its performance. The Bus Goals Task Force, a group from the American Public Transit Authority, has developed standards to assist in evaluating a transportation system. These standards consider many aspects of the bus system. One important characteristic is the reliability of the system, which is the percentage of vehicles that arrive within a set time deviation from schedule. In most cases, this deviation standard is four minutes. However, this may vary from case to case, and depends on the specifications of the transit system operators (Khisty, 1990). Other important characteristics include the cost effectiveness of the system, quality of service, and service to a high percentage of the mobility market (APTA, 1997). Cost effectiveness is also an important factor, since the funding available should be used in an effective manner to better the transport for more people. High quality service consists of service to a high percentage of the mobile market, which is reliable, safe, and clean.

These are not the only guidelines that can be used to evaluate and improve a transportation system. In Philadelphia, Pennsylvania, as well as fourteen of the thirty busiest bus systems in the United States, guidelines were implemented to evaluate a transportation system. These guidelines suggest that a heavy investment in station tracks, service areas, the latest technology, cleaner stops and cleaner cars are indicative of a

successful transportation system. In addition, these guidelines suggest that a successful transit system should have improvements in other areas. These would include investment in express trains and busways in conjunction with simplified fares and public-private programs that offer passes at bargain prices. Most importantly, a transit system should be involved in regional planning to develop new businesses and homes along existing routes (UT, 1997).

In suburban areas, improvements such as faster and more frequent service would be used to increase ridership. Efficiency will also be increased by the development of homes and business centers along the routes (UT, 1997). By following these guidelines, a significant increase in bus use in Philadelphia was noted.

When recommending bus service changes for Merton it will be beneficial for us to look at many of the same guidelines previously mentioned. The successful implementation of many transport systems in metropolitan areas indicates their usefulness in the design process.

2.7 Case Studies

By looking at the individual parts described earlier in this text, a general idea of what makes transportation systems successful becomes apparent. However, to fully understand the complexity of the public transportation needed for Merton, it is necessary to study successful transportation systems in their entirety.

2.71 Curitiba, Brazil

The transportation system in Curitiba, Brazil has received praise for the innovative design of its busway. There are many factors that make the Curitiba bus system successful. The first is the geometry of the bus network. There are five express

busways, which have streets running between them for the use of cars. The buses travel into and out of the city in conjunction with feeder buses to simplify transfers to local routes. Color coding of each service is also used to make transfers easier. The color coding system consists of different colors for express buses, suburban feeder buses, and inter-district buses, allowing riders to easily distinguish between services. Another way in which travel has been expedited in Curitiba is through the availability of one pass, which allows transfer to all buses in the city. This decreases the time spent paying fares on the buses so travelers can get to their destinations faster (APTA, 1999).

All of these improvements have had a significant impact on the city of Curitiba. Since this system has been implemented, three-quarters of all commuters or about 1.3 million passengers utilize the buses each year. Due to the increased revenues, the vehicles are new and well maintained. Environmentally, Curitiba has the lowest atmospheric pollution rate in Brazil because fewer cars are producing pollution. The combination of these factors is why the Curitiba bus network is successful (APTA, 1999).

2.72 PACE

PACE is the name of the suburban bus division of the Regional Transportation Authority (RTA) in Chicago. The PACE division was created in 1984 following the restructuring of the RTA into three distinct service boards, the Chicago Transit Authority (CTA), Metra, and PACE (TCRP, 1995). PACE provides all non-rail transit service in six suburban counties in Illinois. These services consist of fixed route, Dial-a-Ride/Paratransit, Vanpool Incentive Program, and Subscription Services.

The fixed route service, operated by PACE, consists of 140 regular routes, 79 feeder routes, 9 subscription routes, and 2 seasonal routes. These routes use 558 vehicles,

service 200 individual communities, and carry nearly three million riders per month (TCRP, 1995). The Dial-a-Ride program consists of 192 lift-equipped vehicles that provide door-to-door service to approximately 102,800 riders each month, the majority of whom are elderly and/or disabled.

The Vanpool Incentive Program (VIP) is another service established by PACE to serve the needs of small groups of people. The VIP service provides vans to groups of 5 to 15 people, allowing them to commute to and from work together. Currently there are 172 vans in use and PACE has plans to increase the number to 215 in the near future. Lastly, subscription service consists of nine routes operated for Sears' employees by private contractors and results in 200,000 additional annual riders (TCRP, 1995).

The services provided by PACE are a result of the unique needs of the operating environment. The environment consists of a suburban area that had a 1990 population of 4,454,317 and an employment of 2,163,600. Forty percent of the Chicago area office space is contained within this suburban area. Since 1975, more than 55 million square feet of office space has been built in the suburbs. These suburban areas usually have poor transit access. To correct this situation, PACE is working with interested municipalities and developers to incorporate transit planning into their designs. As a result of this cooperation PACE has been able to incorporate transit needs such as bus shelters, turn lanes, and signal modifications into bus service improvements to provide faster and more effective service (TCRP, 1995).

The combination of multiple services and its involvement with municipalities and developers in incorporating transit planning into their designs is the reason for the success of PACE. The multiple services they provide allow PACE to meet the many

changing needs of the community. Its involvement in community design allows it to adapt these multiple services to any new demands that might arise. These two ideas could be implemented in Merton to meet its changing needs.

2.73 New Jersey

Another example of a successful transportation system is the New Jersey Transit (NJ Transit), a public corporation and the third largest provider of bus, rail, and light rail transit service in the United States. In 1993 the transportation system consisted of 1,856 buses on 170 routes and 582 trains on 12 rail lines statewide, serving over 290,700 customers a day and 166 million passenger trips each year. However, there was still a great need for improvement in the NJ Transit. According to a 1993 Rutgers University study, nearly eight percent of the new jobs created in New Jersey were in the suburbs, one of the NJ Transit's least serviced areas. (TRCP, 1995)

As a result of the Rutgers University study, NJ Transit began to research expanding its reach into suburban areas through innovative transit services to better meet the needs of the suburban commuters (TCRP, 1995). One possible solution to this problem is the WHEELS service, which is a $7 million project supported by Federal Highway Program funds. The project consists of fixed route bus and rail service, which accommodates the new transportation demands caused by suburban employment.

The WHEELS program was designed to accommodate suburban employees', who were previously under served by NJ Transit. The system is served by minibuses rather than the full sized buses used on their fixed routes. The use of minibuses is the result of a smaller demand per area compared to city use. The service also offers four nontraditional methods of operation: transit connection, park-and-ride, flex routes, and circulator

services. Transit connections and park-and-ride operations are used to improve the convenience of public transport, making it easier for those commuters who do not have direct access to WHEELS service (Khisty, 1990). Flex routes, which are a new concept for NJ Transit, allow customers to reserve a ride in advance from any given location within a specified area. In other words, the location and destinations of individual riders define the routes. Circulator routes are set up to provide greater access to downtown retail areas. In this case, a circular route is set up around a major retail area to provide easy access for shoppers and employees (Khisty, 1990).

Since the implementation of WHEELS in November of 1993, with one route and 258 passengers per month, there has been a steady increase in ridership. By April of 1995, there were 19 routes operating with a ridership of 14,843 passengers per month (TCRP, 1995). This dramatic increase in ridership was due mainly to the distinct marketing strategies used to promote the WHEELS program. These marketing strategies consisted of individual brochures specifically tailored for each service. The brochures provided a description of the WHEELS program, as well as schedules, maps, and fare information. The brochure also detailed other promotions associated with the WHEELS program. One promotion to encourage ridership was a free fare period ranging from one to three months on all new services (TCRP, 1995).

Another service connected with the WHEELS program was the NJ Transit Business Pass and TransitChek programs. These two programs were designed to encourage businesses to promote public transportation to their employees. The Business Pass program allows companies to sell monthly bus and rail passes directly to their employees at a discounted rate. The TransitChek program was designed to be a fringe

benefit to workers, where employers could purchase a TransitChek and pass it on to their employee as an incentive to commute regularly by public transport. One possible benefit for companies is that TransitChek is a tax-deductible expense (TCRP, 1995).

The success of New Jersey Transit is due to the use of multiple services to meet the needs of the community. Some of New Jersey Transits more innovative ideas included the use of flex routes, minibuses, and incentive programs. All of these could be used in some form by Merton.

2.74 Michigan

Grand Rapids Area Transit Authority (GRATA) in Michigan is another example of a successful transportation program. Grand Rapids, Michigan is the state's second largest city, with a 1993 population of approximately 980,000 and growing. GRATA is currently expanding and improving its services to meet the needs of this growing community. Currently, GRATA operates 58 fixed route buses over a 150 square mile service area with an annual ridership of 3.5 million per year (TCRP, 1995).

To accommodate the areas ever changing needs, GRATA has redefined itself through its long term planning process entitled, *Mobile Metro 2020* (TCRP, 1995). Highway traffic congestion, the growth of businesses away from the downtown area, and increased air pollution are among the problems addressed in Mobile Metro 2020. In April of 1994, the initial goals of Phase I were outlined as follows, consistent bus headways of no more than 15 to 30 minutes, and suburban circulators in areas previously under-served. Other goals were longer hours of service, and revised schedules that are easier for riders to understand (TCRP, 1995). These early goals were established to lay a foundation for future expansion of the existing transportation system.

In March of 1995, GRATA's two new suburban circulators, Route 11 and Route 15, began operating using a 14-passenger minibus. These routes were designed to give shoppers, workers, and area residents convenient and comfortable transportation. These routes also connect to each other and to existing routes in the GRATA system, providing linkages to other parts of the region. Route 15 links areas that include an airport, hundreds of employers, a major department store, two malls, and Kentwood City Hall. Route 11 serves a mixture of residential and commercial locations including small manufacturers, service oriented businesses, and residential areas. Both of the routes have two shuttles, one moving clockwise and the other moving counter clockwise. Since the initiation of service on March 6 through early May, these two routes carried nearly 15,000 passengers (TCRP, 1995).

As part of the transit development plan, GRATA made substantial improvements to other areas of its transportation system. For example, the frequencies on five routes were improved to provide consistent thirty-minute headways. GRATA also implemented an improved transfer policy, which allows a passenger to use their ticket again within one hour of disembarking on any other route. Lastly, hours of operational service were increased to meet the growing demand (TCRP, 1995).

The most important aspect of GRATA, to our project, is the *Mobile Metro 2020* program. This program lays out a plan for continually improving the transportation system to meet the changing needs of the community. This program allows GRATA to consistently update their system as demand changes. This concept, of a long-term process of improvement would be an important consideration for Merton.

2.75 Ottawa

Ottawa-Carleton Regional Transit Commission (OC TRANSPO) in Ottawa, Ontario is an alternate system suitable for evaluating different methods of transit. OC TRANSPO is in charge of transit within the Regional Municipality of Ottawa-Carleton (RMOC). This metropolitan region consists of eleven municipalities with an overall population of approximately 706,000. In terms of employment, the area supports nearly 370,000 jobs. The region is also a relatively affluent area with little traffic congestion (TCRP, 1995).

The solution to OC TRANSPO's needs is the Transitway, the region's largest transportation project to date. The Transitway is a dedicated system of bus-only roadways that provides an exclusive, rapid transit link for more than 200,000 people per day. It consists of 15.5 miles of road with 18 stations and 190 buses operating in each direction during peak hours. In addition, there are fifty express routes, via the Transitway during peak hours to and from the suburbs to downtown. Forty local routes also provide timed transfers at Transitway stations (TCRP, 1995). According to Katherine Hooper, "without the Transitway, 145 more buses would be required in OC TRANSPO's fleet to carry the same number of passengers at a capital cost of 45 million Canadian dollars. And an annual operating cost of 25 million Canadian dollars" (TCRP, 1995).

OC TRANSPO operates two different types of systems in conjunction with the Transitway. The first type of system is the feeder-line-haul system, which the regular service uses. This is a system where local feeder routes serve individual communities, and terminate at major stations where transfers can be made to main line routes on surface roads or Transitway routes. The second type of system is a radial system of

express routes that are superimposed on the usual network during peak hours. These express routes pick up within individual communities and operate via the Transitway to downtown, and then back again (Khisty, 1990; TCRP, 1995).

To promote the continued success of the Transitway, RMOC has instituted a number of policies in its official transportation plan. It is important to note that the RMOC has some basic approval powers in the areas of municipal zoning, subdivision plans, and traffic by-laws. With this authority, they are able to fully utilize the Transitway through effective planning. For example, one of their policies is that the number of jobs located at Transitway stations will be increased. This will be accomplished by placing all employment centers, employing more than 5000 people, at existing or future Transitway stations. In addition, all large regional shopping centers with more than 375,000 square feet of gross leasable space must be located on the Transitway or a future planned extension. In suburban areas, placement of developments is required to be adjacent existing developments. This is to provide efficient and effective transit at all times (TCRP, 1995).

In addition to the locations of business, RMOC has a set of guidelines for the construction of new roads. These guidelines deem public transportation as an essential service. For instance, collector roads are first designed to meet transit requirements, such as having proper widths and curves to accommodate buses. Additional requirements for autos are later considered. Bus priority lanes might even be required, depending on the location and surrounding demographics of the area (TCRP, 1995).

OC TRANSPO's success is due to its innovative use of dedicated bus only roads in conjunction with its involvement with municipalities and developers in incorporating

transit planning into their designs. The construction of dedicated bus only roads may not be feasible in Merton, however many of the same principles can be used. One example would be the incorporation of the bus roads with other existing systems.

2.76 New York

The New York, Metropolitan Transportation Authority (MTA) is another transit program using innovative ideas and programs. One such program is the use of free bus to subway transfers for commuters. This transfer program allows riders who use the bus to use the subway for no additional charge. After this policy was implemented in July 1997, the New York City transportation officials saw a seventeen-percent increase in the number of people who took the bus. Within one year an increase in ridership of over two thousand people occurred. Revenues increased by four percent. The increase in passengers was due to the ease of use, since riders no longer had to purchase another ticket when they transferred (UTN, 1997).

In conjunction with the free transfer program in New York City, those who ride the buses and subway get a MetroCard. The card can be purchased at bus and subway stations, and works like a credit card. There are three different ride packages: the Unlimited Ride MetroCard, the Pay-Per-Ride MetroCard, and the Fun Pass (MTA 1999). The unlimited ride pass gives unlimited rides on either the subway, or bus for thirty days for sixty-three dollars. The Pay-Per-Ride pass gives one free pass for every ten purchased. The Fun Pass consists of unlimited rides for a twenty-four-hour period. These convenient passes allow people to ride without worrying about exact change and to enjoy the convenience of not having to purchase a new ticket with every ride (UTN, 1997).

New York's attempt to increase ease of ridership could also be a simple solution for Merton's predicament. In conjunction with an improved transit system, Merton could use free transfers and a single pass for all transit modes to promote ridership.

2.77 England

Innovative busing ideas are being implemented in England in response to their growing transportation needs. During a telephone interview, Paul Young informed us that in the Midlands a new bus line, Line 33, has recently been installed. Line 33 is a high-tech bus route that is sponsored by a partnership between two councils in the London areas. The main features of this bus line include modern bus stops, special curbs for docking, a new fleet of buses, and real-time information. The bus stops are well lighted, comfortable, and located in secure areas. The special curbs make it easier for passengers to board and exit the bus. Real time information provides the passengers with the exact arrival time of each bus. Other additions include bus priority lanes, and bus priority traffic lights. The bus priority lanes encompass twenty-eight percent of the routes and are in effect for twelve hours per day. The bus priority traffic lights hold the other traffic at the light, while the buses can continue to go forward. Another factor that has played a role in the success of the bus line is the increase in frequency of service to one bus every 7.5 minutes during the week, and one bus every 20 minutes on Sundays. These changes have resulted in a twenty-five percent increase in ridership.

Another innovative idea in England is the Oxford Guided Transit Express (GTE). During a telephone interview, Paul Young informed us that the goals of the GTE are to provide fast, reliable travel into the center of Oxford, expand Oxford's park and ride service, and reach nearby cities. In addition, the transport services will be centered on

Oxford's City Centre to provide easier access. These goals will be accomplished through the integration of different types of transport service. One type of transport is a guided bus system that would operate on a guided path or roads where necessary. Another form of transport is the light rail, which would run along a fixed rail system. The GTE plans to integrate these two transport forms, as well as use bus priority lanes to increase the quality of the bus service. The planners hope to have the GTE in use by the year 2004.

By examining the previous case studies, some common elements of success can be seen. These elements include, targeted marketing to the business community, involvement in site design/land use issues, increasing transits role in mobility management, and multiple services. Other important elements of success are more service to suburban areas, use of express buses, improved transfers, increased reliability, and more environmentally sound measures. Depending on the situation, any combination of these ideas could be beneficial when planning, developing or improving a transit system. For example in Merton targeted marketing of the business community, as well as the role of transit in mobility management are essential issues. By targeting businesses, Merton should be able to create an increased interest in their transit system, thus resulting in increased ridership. Transit mobility management is important because other modes of public transportation in the area must be effectively integrated with the bus system. For any mode of transit to function efficiently, the different modes must work in conjunction with each other.

2.8 Developments

New bus technologies are important to consider when looking to improve bus service. One new technology is an Automated System for buses. This system includes

hands free driving in bus lanes, as well as a guidance system through the service facilities for routine maintenance. The guided maintenance would reduce labor costs, and employ an automatic collision avoidance system called Advanced Vehicle Control System (AVCS). Although it is not currently being used in the United States, parts of Europe have deployed these automated buses (UT, 1997).

Other innovations include new bus prototypes that have reduced emissions and improved fuel economy to help the environment. These prototypes include Battery-Powered Buses, Electric Hybrid Buses, and Compressed Natural Gas (CNG) Buses. The Battery-Powered buses have electric motors, which use current rather than fuel. The Electric Hybrid buses have diesel engines and electric motors, and the CNG buses are designed to burn cleaner fuel. Currently thirty-three of these new buses are in service, in New York, with an expected increase by the year 2000 (UTN, 1997).

2.81 Bus Priority Lanes

Bus priority lanes are another innovation in transit systems that are currently being used in many parts of Europe. These systems consist of lanes that are reserved specifically for buses, taxis, and emergency vehicles. Bus priority lanes can be used alone or they can be combined with bus priority traffic lights, which will be discussed in a later section (Biora & Franco, 1999). Some of the advantages of bus priority lanes include quick implementation, low costs, and the allowance of incremental development. Incremental development is a process in which bus priority lanes are implemented in stages over a period. The expected implementation costs of bus priority lanes was approximately 80 million pounds for all of London (Bayliss, 1995).

Like every system there are certain problems associated with bus priority lanes. In this case, there is a problem with the enforcement of the lanes. Many commuters choose to travel in these lanes although they are designated buses only. One way to prevent this problem is to install security cameras to discourage commuters, in private vehicles, from using the lanes.

2.82 Bus Priority Traffic Lights

Bus priority traffic lights are traffic lights that are adjusted to decrease the wait time for buses. There are three types of traffic lights depending on the vehicle route, priority level requested by the route, or current traffic conditions. One type of traffic light uses an isolated route or network. In this system, the lights are programmed with an estimate of when the bus will be arriving. When the light determines a bus is arriving, a longer green light will be used for the bus lanes. These estimations are complicated due to the difficult time estimations at the bus stops and other factors on the road that may effect the bus, such as traffic and accidents. In addition, problems arise when two buses on different routes arrive at the same light (Biora & Franco, 1999).

Another bus priority traffic light employs the use of electronic equipment to identify the buses at a certain point before they reach the traffic light. To increase the passage of buses the duration of a green light for non-priority lanes is decreased. This allows a faster cycle between green lights on the priority lanes. However, the light does not automatically change to green for the buses. This would cause problems with the normal traffic flow. This measure allows buses to pass quickly, without disruption to the normal traffic flow (Biora & Franco, 1999).

2.83 Red Routes

Red routes are a traffic management scheme in London used to increase the overall effectiveness of the bus system. There are four main types of red routes, which separate buses from normal traffic. The type of line encapsulating the road distinguishes each one. Red routes with "double red lines are seen only at major junctions, bus stops, or where parking or loading would be dangerous or cause serious congestion," (What is a Red Route, 1999). Due to their location, stopping is not allowed at any time for vehicles other than buses. Red routes with single lines vary from those with double red lines. Single red lines represent restrictions that only apply during the working day, 7 am to 7 pm, afterwards there are no restrictions. Areas with red boxes usually allow parking and loading for a limited time span between 10 am to 4 pm, with restrictions noted on nearby signs. Areas with white boxes allow loading and parking Monday through Saturday from 7 am to 7 pm, and also have restrictions noted on signs surrounding the area. The goal for the various types of red routes is to increase the overall effectiveness of the public transport system in London, decrease car usage, decrease congestion, and improve the environment. Enforcement of red routes is accomplished through the use of parking attendants that track offenders, as well as cameras both attached to buses and mounted at stationary sights recording offenders, who are ticketed later.

2.84 Other Methods

Other possible ways to improve transit are by using light rail, heavy rail, and guided busways. Some of the benefits of light rail include a high carrying capacity, smooth ride, and reduced emissions by using electric propulsion. Some disadvantages of the light rail include the necessity for interchanges onto the rail from feeder corridors,

lack of room for incremental development, and the high cost of implementation. The estimated cost of implementing light rail is approximately between 6-8 million pounds per kilometer.

During a telephone interview with Paul Young, he informed us that heavy rail also has potential benefits such as large passenger carrying capacity and the benefit of having a positive image in the eyes of the public. However, heavy rail is even more expensive, ranging from 40-200 million pounds per kilometer. Due to the large expanse and the large quantities of land necessary, justification is difficult even with large demands and a positive image.

Guided busways use buses that have special guide wheels that run along a track. The advantages of this type of busway are that they can operate in areas with limited space and the tracks can be installed in most areas. As of 1999, guided buses are currently in use in many areas of the United Kingdom, such as Leeds, and more are currently being proposed.

2.9 Summary

Our background research provided knowledge of the factors involved in improving a bus system. From it, we were able to gain an understanding of the details used in the recommendations of new and innovative ideas for transportation systems.

We first began by studying the terminology and basic concepts of a bus system. This included research on specific types of routes, and systems involved in bus transportation. The next step was to investigate various international transportation systems. The purpose was to ascertain how certain criteria were met by implementation of a site specific, transit system.

With the knowledge that we have obtained from this literature review, we will have sufficient background to recommend bus system improvements for the London Borough of Merton.

3.0 Methodology

3.1 Project Goal

Our goal was to suggest a future form of the bus network that may incorporate a spoke and wheel pattern for Merton. Additionally, bus priority lanes, bus priority lights, and other innovative ideas were considered. The intent of our study was to recommend a future design for the bus network based on our research of existing bus networks, demographics, and interviews. We also investigated routes that integrate the existing tramlink project, as well as incorporate ideas from the local transit authorities, into the design of the bus network. The proposal will be considered as a viable option to increase bus ridership while potentially decreasing road congestion and car usage.

3.2 Objectives and Tasks

Our project team delivered a recommendation to the London Borough of Merton and the South and West London Transport Conference (SWELTRAC) for a modernized bus network that will increase ridership, and effectively integrate the tramlink. Our recommendation was formed through research of documented data, international bus networks currently in use, and interviews with people involved in public transport. The people that we interviewed were engineers involved in the design of public transportation systems, administrators involved in their implementation, and commuters that use either public or private transportation. Our final recommendation incorporated the conclusions drawn from the transportation needs of Merton, interviews, and cost estimates. In addition, we compared and contrasted existing bus networks with the situation in Merton.

3.3 Background Research

Before we recommended innovative improvements to Merton's bus network, we examined other bus networks. These systems provided examples of various implementation methods, design patterns, operating environments, and estimated costs. The examination of existing bus networks was accomplished through the use of case studies. Our project team researched case studies while in the United States, and the results were documented in the Literature Review. Additionally, standards by which to measure the quality of a bus transportation system were also researched and documented. This information was used to compare the ridership patterns and network designs of different transportation networks. The necessary information was located in transportation records, journals, books, and on the World Wide Web.

3.4 Site Assessment

In order to recommend a modernized bus network it was necessary to evaluate the current situation in the borough of Merton. This situation included transportation concerns, and demographics. The evaluation was accomplished through a site assessment of the borough. During the site assessment, our project team examined existing roads, current public transportation, ridership patterns, residential distribution, and public opinion. An analysis of the existing roads was made to determine road layout, congested areas, and possible improvements to accommodate the proposed bus network. Our analysis was accomplished using documented data and first hand observations. The documented data consisted of road and bus maps, census data, and ridership patterns. The roads to be examined were chosen using the previously obtained data to locate areas of opportunity.

Public transportation currently in place was also examined. This was accomplished using pre-existing evaluations of the transit system to determine its extent. These evaluations examined locations of bus routes, Underground stops, and the proposed tramlink connections.

Demographics and public opinion were also considered. Demographic information was obtained to determine the population to be served. This information was used to suggest possible improvements. Public opinion was initially obtained from the *London Borough of Merton Alternative Movement Strategy, Public Attitudes Technical Report*, and similar reports. This information was used to determine attitudes toward public transportation and possible ways to improve ridership. Upon completion of the site assessment, all data was combined to form a complete set of notes.

In addition to the site assessment, data obtained from our interviews was a major source of information. Interviews were conducted on engineers and public officials, while surveys were conducted on commuters to obtain their opinions and ideas on our recommendation. This information was then weighted heavily when making our final proposal.

3.5 Primary Analysis

Once the necessary background research was accomplished and the site assessment completed, our group determined what potential improvements could be made to the bus network in Merton. Using the case studies, information on transportation networks, and cost estimates, our team determined which improvements would best meet the needs of the residents. Also, the cost parameters of the London Borough of Merton, which were based on the level of subsidies that the government set aside for public

transportation improvements, were taken into account. Using the previously obtained data, the pros and cons of each type of network were examined, and the changes that would be most beneficial were incorporated into the initial recommendation.

3.6 Pre-test Interviewing Techniques

In order to determine biases in our interviewing strategy, it was necessary for our project team to pre-test our interviews. The pre-test allowed the respondent to identify any potential biases, through an evaluation of the interviewer. The interviewer asked a series of questions, and the respondents gave their opinions on the questions and the manner in which the questions were asked. The respondents also commented on the attire, mannerisms of the interviewer, and the environment in which the interview was conducted. Some of our respondents included our liaison and other individuals who worked for the London Borough of Merton Civic Centre. The pre-tests were followed by practice interviews in which individuals who had similar characteristics, to those to be interviewed, answered the questions. These practice interviews allowed the questions to be tested to determine if they would produce the desired content and detail.

3.7 Interviews

Once the pre-testing was accomplished, we conducted interviews with transportation professionals. We used these to obtain information on previous methods of transit service, innovative ideas, and their opinions on our recommended changes. Information was also obtained on the advantages and disadvantages of the current network and the feasibility of increasing ridership.

In-depth qualitative interviews were conducted with system engineers and company officials that had experience planning bus transportation networks. These were

flexible interviews since the researcher adjusted later questions depending on the responses of the interviewee. The flexibility was advantageous, due to the interviewee's greater knowledge of the subject. This allowed the interviewee to lead the conversation, thus maximizing the amount of information gained. We obtained the names of officials and engineers through recommendations from their peers and appointments were made at their convenience.

Ten interviews were conducted. We arrived at this number after consulting our liaison and investigating various job descriptions of the administrators and engineers. We felt that ten was a larger enough number to acquire various opinions on our proposal and the current transportation system. Some of our questions for the administrators and engineers, and their purposes are as follows:

Where in Merton are the major opportunities for improvements to the bus network?

The purpose of this question was to generate an idea of where the administrators and engineers believe there is the greatest room for improvement. Their expertise in the area of public transport enabled them to advise us where the best opportunities lay.

What types of innovative techniques do you believe can be implemented, and where do you believe they can be used?

This question was meant to obtain a professional opinion of the possible innovations that could be implemented, and the areas in which they were feasible. This

was important, because transport professionals have experience with the bus network in Merton, as well as bus networks in general. Therefore, we gained an understanding of the best techniques for the area.

What are the possible benefits of these innovative ideas?

The previous question revealed the purpose for the installation of new ideas, and the benefits that could be seen. This was necessary information to have when it was time to choose an idea, since every system had certain individual characteristics. These characteristics had to be taken into consideration, and compared against one another.

The previous questions were some of the questions that were asked to administrators and engineers. They were important in obtaining information from experienced individuals in the areas we were researching. The format of the interviews consisted of an overview of the interviewing process and the interview itself. At the conclusion of the interview, contact information was given to the interviewee. The overview described the structure, length, and content of the interview. While one group member administered the interview, another recorded using either a tape recorder or field notes. At the end of the interview, contact information was given to the interviewees. These interviews were used as qualitative data only, since the data was not numerically based. For the purposes of this research, the qualitative data was collected and the results taken as suggestions to improve the design of the system.

A focus group interview was another type of interview that was used to obtain opinions concerning public transportation. The focus group interview was an interview

in which our project team facilitated a small group discussion of the pros and cons of our recommended bus network. The questions were formulated upon completion of our initial proposal. Individuals for this focus group were employees of the London Borough of Merton Civic Centre. The focus group was formed based on the availability of the participants. Tape recorders and field notes recorded the responses of the group.

3.8 Surveys

Surveys were used to obtain information and opinions from commuters. Face-to-face surveys were conducted on a select group of commuters in Merton to obtain firsthand accounts on the advantages and disadvantages of Merton's bus network. The individuals were surveyed on underground railway lines, at bus stops, or in major parking lots at the three major town centres in Merton: Morden town centre, Mitcham town centre, and Wimbledon town centre. The surveys were conducted during the key hours of the morning commute, 0600-1000, and evening commute, 1600-2000. The town centres were chosen due to their nature as commercial, residential, and transportation hubs, therefore individuals who represented the social and economic nature of all Merton residents would be there.

Face-to-face surveys were conducted because they minimized non-responsiveness from the interviewees' and allowed for easy correction of errors due to misunderstanding. Since all surveys were conducted on individuals who lived in Merton and admitted knowledge of the bus network, error due to surveying individuals not related to our project goal did not occur. Sampling error, error that resulted from too few people being interviewed, was built into our survey because we surveyed less than 1% of Merton's

total population. We overcome sampling error by not applying the information acquired from the surveys to all of Merton, but only to the individuals questioned.

Sixty surveys were conducted. The questions and their purposes are as follows.

During a typical week, what are your most common destinations?

This question was asked to commuters to give us an idea of where they travel. Answers to this question gave us an idea of where bus routes should be located.

On a daily basis what is your primary mode of transportation?

This question was asked to determine how commuters get where they need to go. The information obtained from this question was used to determine the current ways that public transportation was being utilized.

If available road space for cars were decreased, would you be more likely to use the bus?

This question was specifically asked to those who consistently use private transportation to determine if they would be willing to change their mode of transportation if road space was reduced. With our recommendation of bus priority measures, road space would need to be reallocated, decreasing the effective capacity of the road system to serve automobiles.

The format of the surveys consisted of an overview of the survey and project, and the survey itself. At the conclusion of the survey, contact information was given to the respondent. The overview described the structure, length, and content of the survey. Surveys began the week of April 11th. Due to time constraints sixty surveys were conducted.

3.9 Secondary Analysis

Once the aforementioned data was collected, we then proceeded with our analysis. The method of triangulation was used to relate all the data. Since most of our data was qualitative, we manually combined the data into appropriate categories, grouping the interviewees' according to their involvement in public transportation. Our conclusion was drawn from comparing and contrasting the answers from the interviewees, and continuously testing it against other research data to ensure validity.

3.10 Proposal

Our proposed bus system was based on all of our gathered data, and was tailored to the transportation needs of Merton. An oral and written recommendation was delivered to officials at the London Borough of Merton and SWELTRAC. Our innovative recommendation contained a map illustrating the locations of new routes, a summary of the information gathered from our interviews, and a cost estimate of our recommendation. Our project recommended regions where different bus systems and routes could be implemented in Merton, and areas where bus priority measures could be effectively implemented. It also suggested innovative measures not previously considered, and a method for integration of the bus network with other forms of public transportation.

4.0 Transportation in London

London is located in the Southeast corner of the United Kingdom. The area contains thirty-three individual boroughs, which are further broken into seven hundred and fifty-five Electoral Wards. This area contains a total population, as of the 1991 census, of seven million four hundred and fifty thousand nine hundred and five people.

From 1981-1991, the number of people employed in London has decreased by approximately a quarter of a million people (Buckingham & Collop, 1991). This decrease was largely concentrated in the manufacturing profession. However, even with the decrease in the number of people employed in London the number of road vehicles entering London has continued to increase. For instance, in 1991, one million people entered the London area on a typical weekday. This was an overall increase of twenty-five percent since 1981. Additionally, the number of people who own cars has increased from fifty-seven percent in 1981 to sixty-one percent in 1991, resulting in increased levels of congestion (Buckingham & Collop, 1991).

On a typical week in London, there are twenty million trips into and out of the area, sixteen million of these involve some form of mechanized transportation. People commuting to and from work make the majority of these trips during rush hour. Shopping dominates the other periods of the day, as the main reason for travel. More importantly, nearly half of these trips are made by car. The volume of car traffic is highest in the outer areas of London, where public transit services are less comprehensive. (Buckingham & Collop, 1991)

In addition to cars, a large number of trips are made using rail and bus services. The rail services are operated by British Rail and London Underground Limited. On a

typical day, 3.1 million trips are made on these rail services, with the largest concentration on the Underground. Two thirds of these trips originate or terminate in Central London.

The bus service in London on a typical weekday, in 1991, carried approximately 2.5 million people. In a typical year, this amounts to one billion one hundred and forty-four million passengers. Residents of inner London make the majority of these trips. An average of 0.48 trips per person per day are made by inner London residents compared to 0.34 trips per person per day for outer London residents (Buckingham & Collop, 1991).

To accommodate these travel needs, the transit system has been continuously changing. Over the last ten to twelve years, approximately eight-five percent of the system has changed, and six thousand new buses have been added to increase the level of service (personal interview, 1999). This evolution is continuing even today, with the push to utilize bus priority measures to further improve transportation. These ideas are incorporated into our recommendations to the London Borough of Merton, which is contained in the following sections.

5.0 Data Analysis

The following section contains the information obtained from our site assessment, interviews, surveys, as well as the applications of this data to our recommendations. A copy of the maps used during the site assessment appears in Appendix C and in the following pages, and the survey questions appear in Appendices K and L.

5.1 Site Assessment

The following section contains information on our initial site assessment of the borough of Merton and the current transportation system. During the site assessment we examined demographic information, and areas of the borough with inadequate public transit service. Furthermore, we examined the current state of the transportation system, specifically the bus system

5.12 Origins of Trips

To effectively recommend changes to the bus network that could potentially increase ridership, it was necessary to determine the areas of the borough that require the greatest service. Our team used information obtained about the borough to determine the potential origins and destinations of trips in Merton. The term origin refers to the place where the first trip begins, such as a residence, and the term destinations refers to the locations that a person is trying to reach from their origins. The origins and destinations will change, since once the traveler reaches their destination, their destination becomes their origin, but for the purposes of this paper, the origin will refer to the initial site of travel.

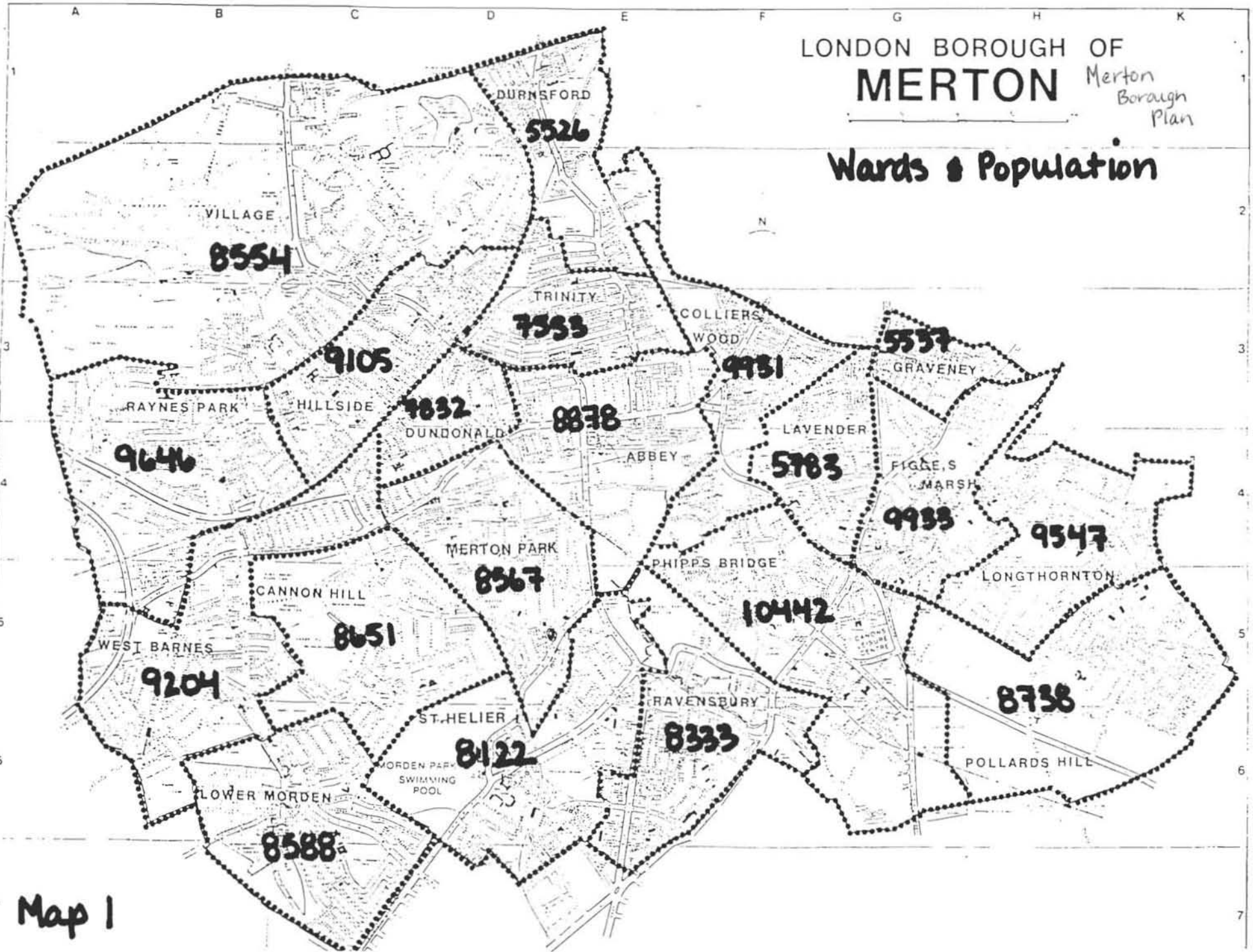
5.121 Residential Areas

The London Borough of Merton is divided into twenty individual wards. A map depicting the layout of these wards is on page 43, and was obtained from the The most current census data, concerning these wards, was obtained from the *Merton Ward Profiles*, which was a summary of the 1991 Population Census. This information included current populations by gender and age brackets, the number of people economically active or inactive, and information on households. This information was specific to each individual ward. This data is contained in Appendix B. In addition to census information our team identified the residential areas of the borough. The residential areas are located in many areas throughout the Borough. The largest concentrations of these areas are located north of Morden town centre and northwest of Mitcham town centre.

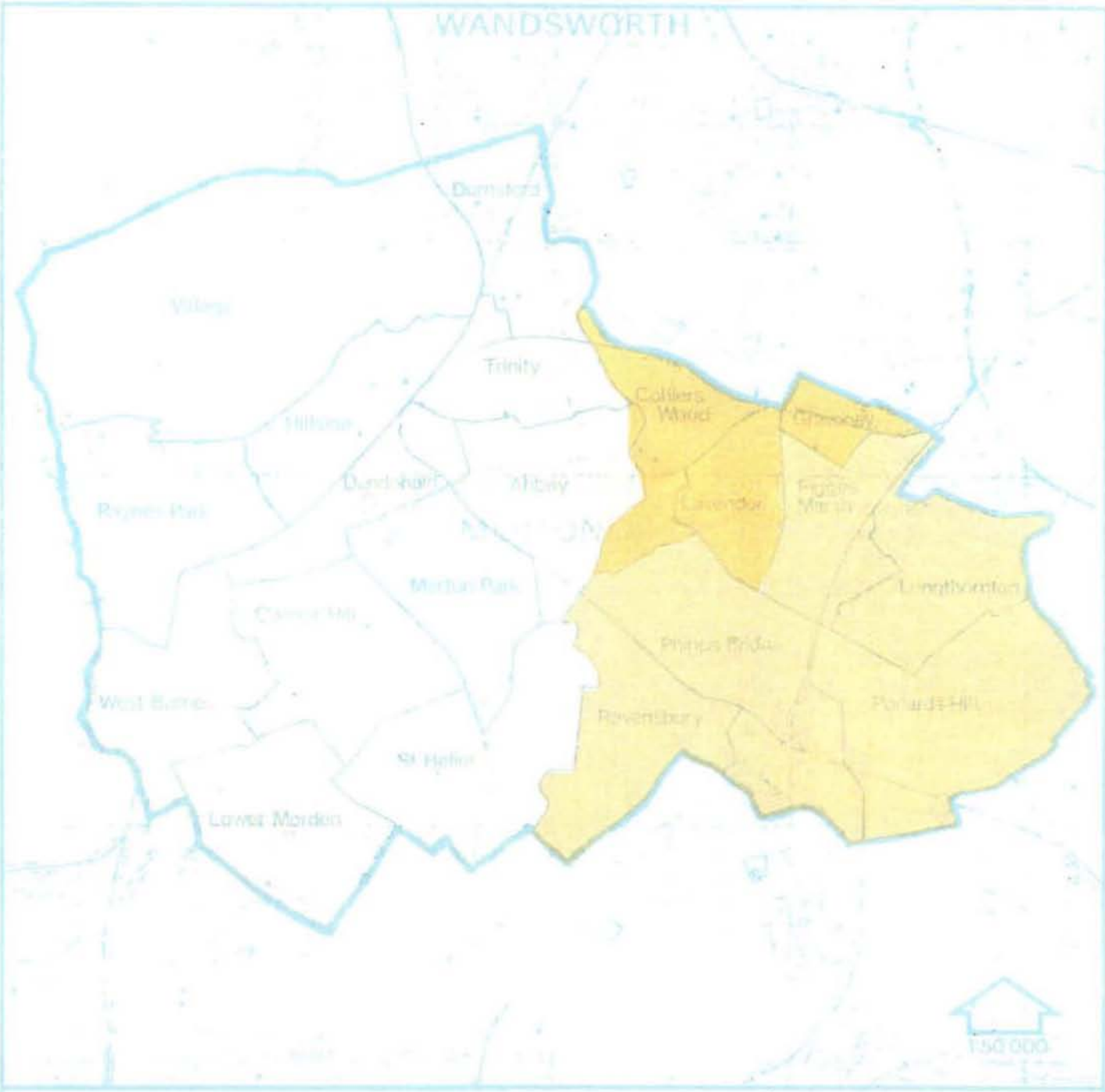
The census information and location of the residential areas are important to our research because it was necessary to know the number of potential users of public transportation, and the potential origins of their trips. This allowed us to determine, in conjunction with other demographic information, how comprehensive the transportation network needed to be for each ward.

5.122 Density of Residential Areas

Information on household densities was also obtained. This information was based on the number of people per one hundred rooms, and was contained in *The Review of the Merton Borough Plan*, published in November of 1988. The wards that contained the highest household densities include Colliers Wood, Lavender, and Graveney.


LONDON BOROUGH OF
MERTON
Merton Boraugh Plan
Wards & Population
DURNSFORD
5526
VILLAGE
8554
TRINITY
7353
COLLIERS WOOD
9981
5557
GRAVENEY
9105
RAYNES PARK
9646
HILLSIDE
9832
DUNDONALD
8878
ABBEY
LAVENDER
5783
FIGGE'S MARSH
9933
9547
LONGTHORNTON
MERTON PARK
8367
PHIPPS BRIDGE
10442
CANNON HILL
8651
WEST BARNES
9204
ST.HELIER
8122
RAVENSBURY
8333
8738
POLLARDS HILL
MORDEN PARK SWIMMING POOL
LOWER MORDEN
8588
N

Map 1



MAP 3·7

Household Density

- 40-49 persons per 100 rooms
- 50-54 " " " "
- 55-59 " " " "
- 60-65 " " " "

Merton Borough Plan

In these areas, the average household density ranged from sixty to sixty-five people per one hundred rooms. Figges Marsh, Longthornton, Pollards Hill, Phipps Bridge, and Ravensbury had the next highest household density. They consisted of fifty-five to fifty-nine people per one hundred rooms. The next set of wards ranged from fifty to fifty-four people per one hundred rooms. These wards consisted of Durnsford, Trinity, Abbey, Dundonald, Merton Park, St Helier, Cannon Hill, Lower Morden, and West Barnes. The areas with the least density, forty to forty-nine people per one hundred rooms, were Village, Raynes Park, and Hillside. This information can be seen on the map on page 44.

The household density information was very important in our efforts to produce recommendations for the bus network. Through comparison of this data with the population data of each ward, some initial discrepancies were seen. For instance, Raynes Park has one of the highest total populations of the wards, however it has one of the lowest household densities. This can be accounted for when the size and the available space for housing are taken into consideration. This conclusion is very important because an area with a high population density is going to need a more frequent service than an area with a low density. Also, an area that has a large total population and a low household density is going to require a much more extensive system of routes to cover a population that is more spread out.

5.13 Destinations of Trips

The destinations of trips are the areas that people travel to, and they consist of commercial areas, town centres, schools, and interchanges with other forms of public transport.

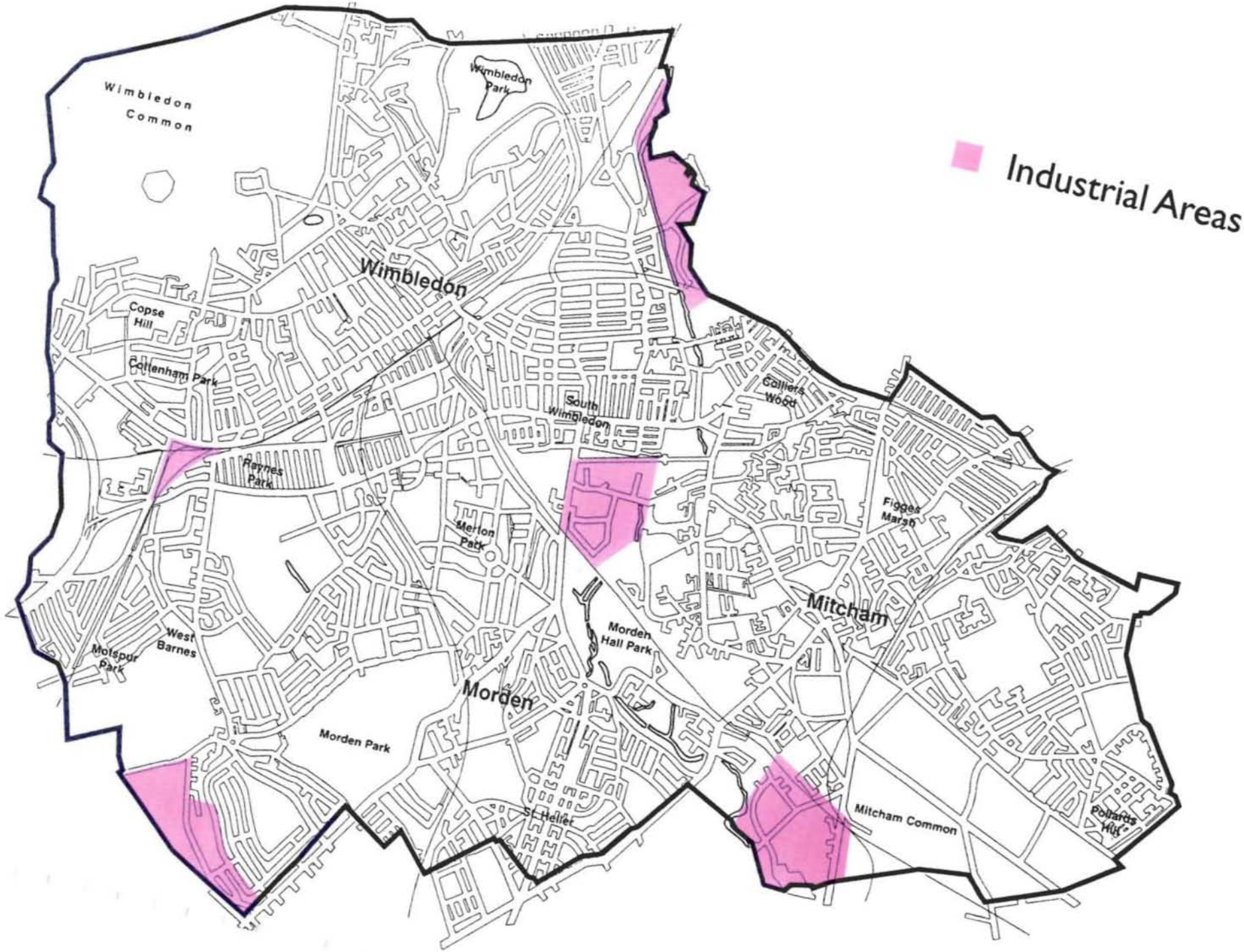
5.131 Commercial Areas

The locations of commercial and industrial areas were identified throughout the Borough using the Unitary Development Plan (UDP), which was published in 1996 by the Merton Council. These areas would include, Durnsford Ward adjacent or near Durnsford Road, Lower Morden Ward along Browning Avenue, which is near the A2043, Phipps Bridge Ward adjacent to Carshalton Road (A237), and Abbey Ward adjacent to Morden Road (A24). Maps detailing these areas can be seen on page 47.

The information pertaining to the location of major industrial areas is an important consideration in the design or improvement of a bus network. A large number of the people who use the buses use them to commute to work either from point to point within the borough or entering from outside the borough to a point contained within the borough. By knowing the locations of the major industrial areas, we could determine if any major areas were under served or missed all together. This allowed us to recommend changes to provide these people an adequate service. Additionally, by providing people easy access to their places of employment we will be able to potentially promote the use of public transit over private (UDP, 1996).

5.132 Town Centres

The next step was to locate the major town centres and retail facilities throughout the borough. There are three major town centres in the Borough of Merton, they consist of Wimbledon town centre, Mitcham town centre, and Morden town centre. They are indicated on the map on page 49. The majority of the major retail facilities are located throughout the borough, three of which are adjacent to the major town centres. There are three retail warehouses, and a superstore located on or adjacent to the Kingston By-Pass.


Industrial Areas
Wimbledon Common
Wimbledon Park
Wimbledon
Copse Hill
Cottenham Park
Raynes Park
South Wimbledon
Colliers Wood
Figges Marsh
Merton Park
Morden Hall Park
Mitcham
West Barnes
Motspur Park
Morden
Morden Park
St Helier
Mitcham Common
Pollards Hill

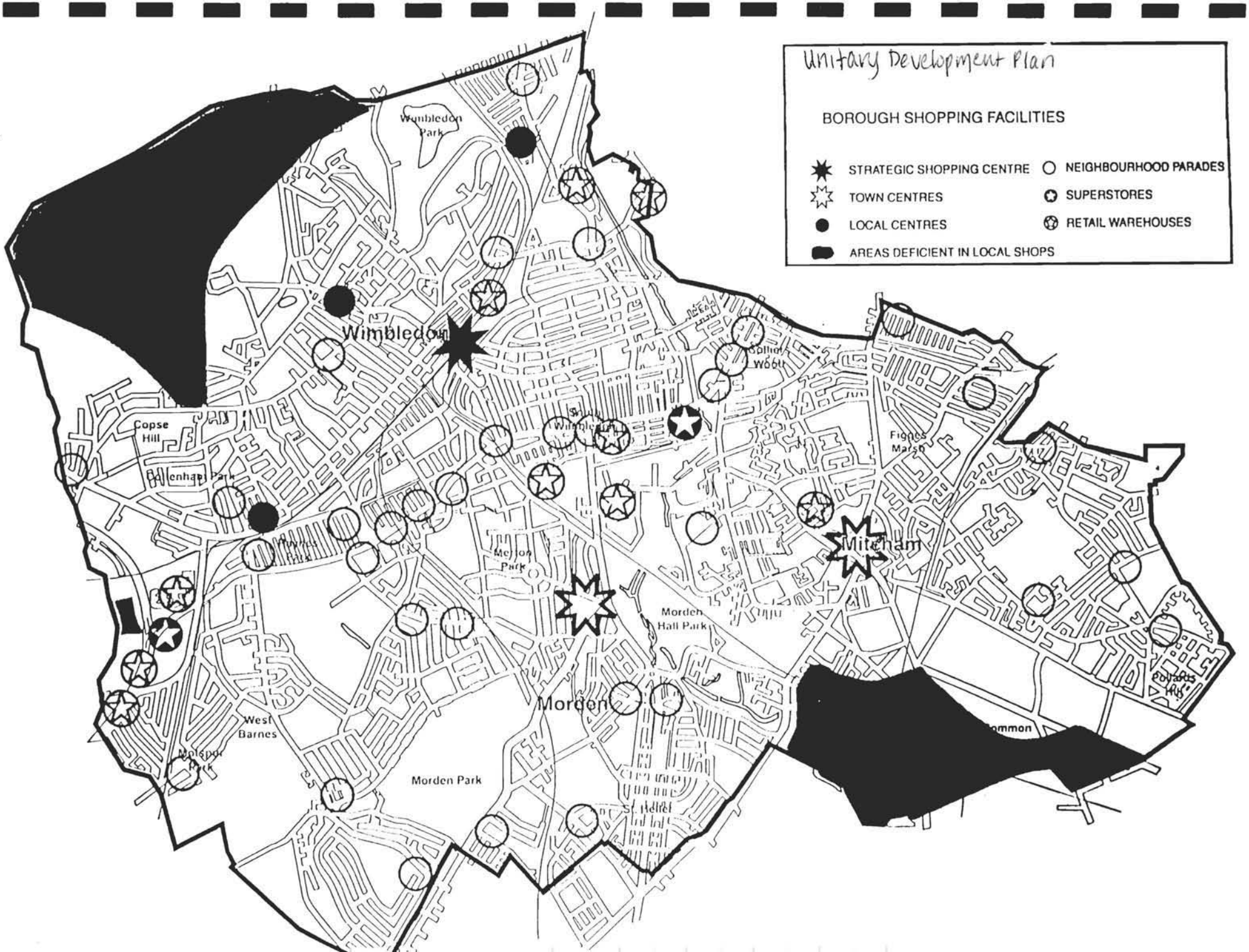
There are three more retail warehouses located to the north of Morden town center. There is also a retail warehouse and one superstore located to the north of Mitcham town centre. The retail warehouse is located on Western Road and the superstore is located on Merantun Way. The last group of retail warehouses is located to the northwest of Wimbledon town centre on Alexandra Road, Durnsford Road, and Garratt Lane. Additionally, small neighborhood parades are located throughout the borough and can be seen on the map located on page 49 (UDP, 1996).

The locations of the retail areas throughout the borough are important aspects that are taken into account in our recommendation. In order to influence people to use public transportation, public transit must be able to replace the majority of the roles of a car. In this particular case, public transport must be able to carry a person to the retail areas to shop. Additionally many people employed in these areas would be able to use the transit service to get to and from work if it were located in a close proximity.

5.133 Schools

We also considered the location of secondary schools. We decided to exclude primary schools because parents are unlikely to allow children that age, to ride the bus unsupervised. They would be more likely to continue to transport their children in person using private transportation. The locations of the schools can be seen on the map on page 51.

The locations of the secondary schools are important to our recommendation because a large percentage of public transportation users are children on their way to school. Therefore, school locations are a necessary consideration when planning the placement or relocation of routes throughout the borough.


Unitary Development Plan
BOROUGH SHOPPING FACILITIES
STRATEGIC SHOPPING CENTRE
TOWN CENTRES
LOCAL CENTRES
AREAS DEFICIENT IN LOCAL SHOPS
NEIGHBOURHOOD PARADES
SUPERSTORES
RETAIL WAREHOUSES
Wimbledon Park
Wimbledon
Copse Hill
Mitcham
Morden
Morden Hall Park
Morden Park
West Barnes

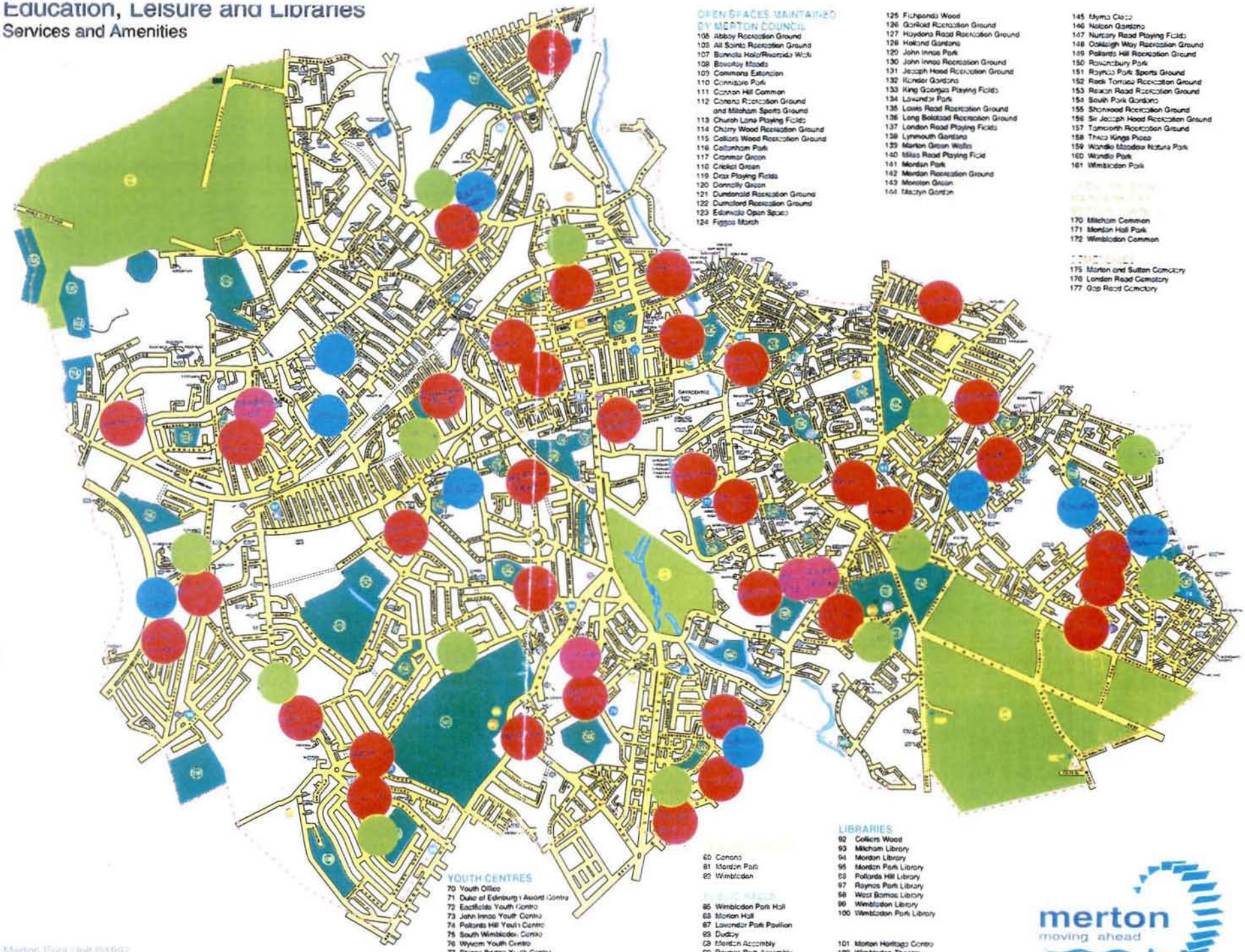
5.134 Locations of Other Public Transport

The locations of the London Underground and future Croydon Tramlink stops throughout the borough were also determined. A map containing the locations of the Underground and Croydon Tramlink stations is on page 52. There are five Underground stops located throughout Merton. The stops on the Northern Line in the borough include Colliers Wood located on Christ Church Road, South Wimbledon located on the corner of Merton High Street and Morden Road, and Morden, which is located on London Road. There are two stops on the District line at Wimbledon Park, which is located on the corner of Home Park and Arthur Road, and Wimbledon, which is located on the corner of The Broadway and Alexandra Road.

In addition to the Underground, there is the new Croydon Tramlink, which connects Wimbledon town center with Croydon. There will be ten stops in the borough of Merton. Beddington Lane located on Beddington Lane. Mitcham Junction located on Carshalton Road. Wandle Way located on Wandle Way. Mitcham located on the corner of Morden and London Road. Belgrave Walk located on the corner of Deer Park. Phipps Bridge located on New Close Road. Morden Road located on the corner of Morden and Dorset Road. Merton Park located on the corner of Kingston and Dorset Road, and Wimbledon town centre located at Wimbledon town centre.

The locations of both the Underground and Tramlink stops were very important considerations when recommending changes to the bus network. Large numbers of people will be entering and leaving the borough through these corridors, resulting in large

Education, Leisure and Libraries
Services and Amenities



KEY

FIRST SCHOOLS
Abbotsbury
Alfred Mizen
All Saints' (C of E)
Bassetsbaine
Benedict
Bishop Gilpin (C of E)
Bond
Bushey
Dundonald
Garfield
Greenwood
Hatfield
Haslemere
Hatfield
Hollymount
Holy Trinity (C of E)
Joseph Hood
Links
Lonesome
Malmesbury
Merton Abbey
Merton Park
Morden
Morden Green
Pelham
Poplar
Sacred Heart (RC)
Sherwood
Singlegate
St John Fisher (RC)
St Mark's
St Mary's(RC)
St Matthew (C of E)
SS Peter and Paul (RC)
St Teresa's (RC)
Tudor
Wimbledon Park

Buchoy
Cranmer
Gorringe Park
Hillcross
Liberty
Malmesbury
Morden Farm
Park House
Priory (C of E)
Stanford
St Catherine's (RC)
St Thomas of Canterbury (RC)
William Morris
Wimbledon Chase

HIGH SCHOOLS
Eastfields
Raynes Park
Records Lodge
Rosson
Rutlish
Tamworth Manor
Ursuline Convent
Wasemeads
Wimbledon College

SPECIAL SCHOOLS
Cambridge House
Cricket Green
Melrose
St Ann's

Morten Adult College
Morten College
Phoenix College
Wimbledon School of Art

OPEN SPACES MAINTAINED BY MERTON COUNCIL
105 Abbey Recreation Ground
106 All Saints Recreation Ground
107 Burnside Hold/Riverside Walk
108 Bowlday Meads
109 Commons Extension
110 Connaught Park
111 Cannon Hill Common
112 Canons Recreation Ground and Mitcham Sports Ground
113 Church Lane Playing Fields
114 Cherry Wood Recreation Ground
115 Colliers Wood Recreation Ground
116 Cottenham Park
117 Cranmer Green
118 Cricket Green
119 Dax Playing Fields
120 Donnelly Green
121 Dundonald Recreation Ground
122 Durnsford Recreation Ground
123 Edenvale Open Space
124 Figges Marsh
125 Fishponds Wood
126 Garfield Recreation Ground
127 Haydons Road Recreation Ground
128 Holland Gardens
129 John Innes Park
130 John Innes Recreation Ground
131 Joseph Hood Recreation Ground
132 Kenser Gardens
133 King Georges Playing Fields
134 Lavender Park
135 Lewis Road Recreation Ground
136 Long Bolstead Recreation Ground
137 London Road Playing Fields
138 Lynmouth Gardens
139 Merton Green Walks
140 Miles Road Playing Field
141 Morden Park
142 Morden Recreation Ground
143 Morston Green
144 Mostyn Gardens
145 Myrna Close
146 Nelson Gardens
147 Nursery Road Playing Fields
148 Oakleigh Way Recreation Ground
149 Pollards Hill Recreation Ground
150 Rowansbury Park
151 Raynes Park Sports Ground
152 Rock Terrace Recreation Ground
153 Reason Road Recreation Ground
154 South Park Gardens
155 Shorwood Recreation Ground
156 Sir Joseph Hood Recreation Ground
157 Tamworth Recreation Ground
158 Three Kings Piece
159 Wandle Meadow Nature Park
160 Wandle Park
161 Wimbledon Park

170 Mitcham Common
171 Morden Hall Park
172 Wimbledon Common

175 Morten and Sutton Cemetery
176 London Road Cemetery
177 Gap Road Cemetery

YOUTH CENTRES
70 Youth Office
71 Duke of Edinburgh Award Centre
72 Eastfields Youth Centre
73 John Innes Youth Centre
74 Pollards Hill Youth Centre
75 South Wimbledon Centre
76 Wyvern Youth Centre
77 Phipps Bridge Youth Centre

80 Canons
81 Morden Park
82 Wimbledon

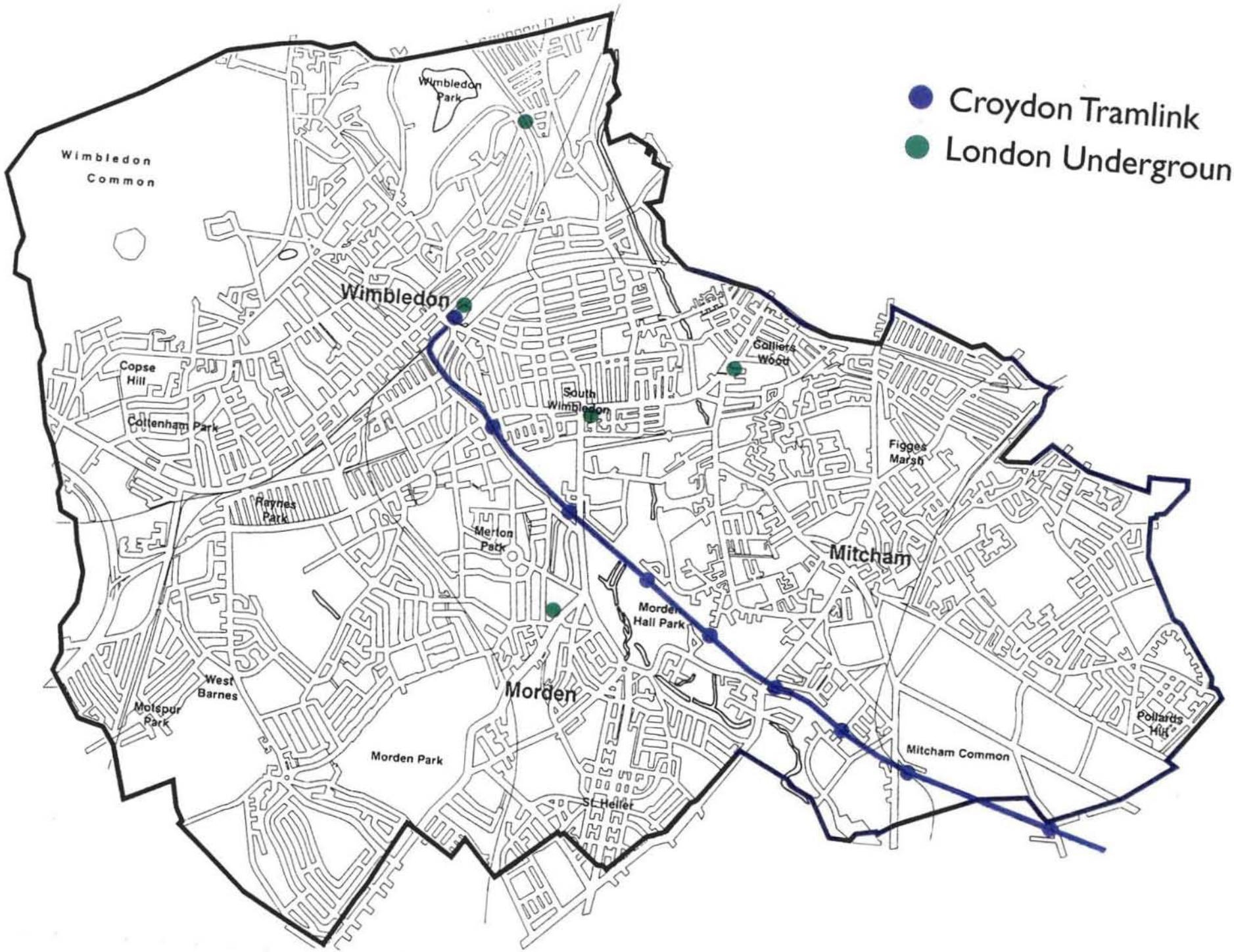
85 Wimbledon Park Hall
86 Morton Hall
87 Lavender Park Pavilion
88 Dudley
89 Morden Assembly
90 Raynes Park Assembly

LIBRARIES
92 Colliers Wood
93 Mitcham Library
94 Morden Library
95 Morden Park Library
96 Pollards Hill Library
97 Raynes Park Library
98 West Barnes Library
99 Wimbledon Library
100 Wimbledon Park Library

101 Morton Heritage Centre
102 Wimbledon Theatre
103 Deen City Farm

merton
moving ahead

Map 5


Croydon Tramlink
London Underground
Wimbledon Park
Wimbledon Common
Wimbledon
Copse Hill
Cottenham Park
Raynes Park
Merton Park
South Wimbledon
Colliers Wood
Figges Marsh
Mitcham
Morden Hall Park
Morden
West Barnes
Motspur Park
Morden Park
St Helier
Mitcham Common
Pollards Hill

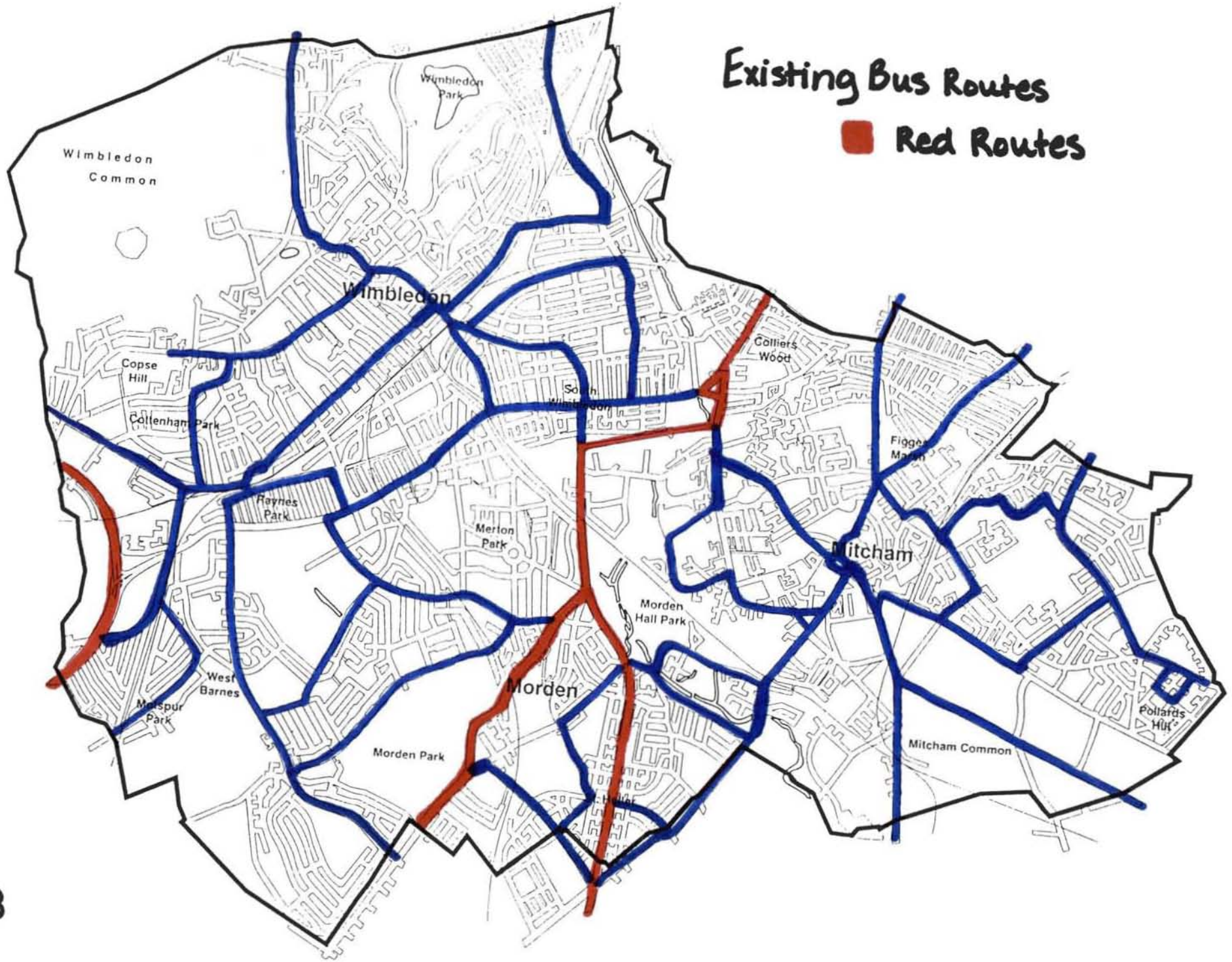
concentrations of people traveling to these specific areas. Without an effective bus network to transfer people to and from these corridors, they are likely to use private transportation, further increasing the congestion in these areas. Therefore, it is necessary to integrate the bus network with these services.

5.14 Existing Services

Once we had determined the major aspects that a modern transportation system must include, we evaluated the current transportation system. This was accomplished by determining the location of the existing bus routes throughout the borough of Merton. A map containing the routes is located on page 54 (London Transport, 1998). Currently there are routes connecting the major town centres. Additionally, the bus network contains routes that extend out of the borough to Croydon, Sutton, Putney, and Tooting Broadway. Information containing the exact routes of the buses was obtained from the London Transport Bus Maps. Maps detailing the exact path of each of these routes can be seen in Appendix C.

5.2 Interviews

Our project team conducted in-depth qualitative interviews to enhance our understanding of the factors involved in recommending changes to a bus network. Ten interviews were conducted of transportation company officials and engineers, three telephone interviews and seven face-to-face interviews. The purpose of the telephone interviews was to learn what type of data we needed to examine, before recommending changes to Merton's bus network. We also hoped to obtain information on how bus services in the London area were designed and operated.


Existing Bus Routes
Red Routes
Wimbledon Common
Wimbledon Park
Wimbledon
Copse Hill
Cottenham Park
Raynes Park
Merton Park
Colliers Wood
Mitcham
Morden Hall Park
Morden
West Barnes
Morden Park
Mitcham Common
Pollards Hill

Map 8

The purpose of the seven face-to-face interviews was to learn what problems were associated with Merton's bus services, as well as suggestions on how to solve them. The face-to-face interview's also supplied us with feedback on some of our proposed ideas, and information on the Croydon Tramlink.

The ten individuals we interviewed all worked in the transportation departments of major transport providers. Their colleagues recommended these interviewees to us. The interviewees' were not asked the same questions. Each interviewees questions were specified to obtain the greatest amount of information about their area of expertise. This section includes a summary of the major questions we asked, responses to these questions, and how they were incorporated into our proposal.

What are some of the goals of London Transport?

This question was only asked to transportation officials who worked at London Transport. Their responses to the question were unified. London Transport's goal is to provide passenger transportation services in Greater London, that are efficient, economical, safe, and meet the transport needs of London commuters. They work to maximize passenger transport service by continually raising the quality of transport to attract more commuters, and focusing on public service, not revenue.

The answers obtained from this question gave us the impression that London Transport would consider any idea we recommended as long as it was efficient, safe, and could improve ridership. Issues such as cost, are addressed using a cost benefit analysis when considering recommendations.

How are the bus routes in your area designed? How are they integrated with other modes of transportation?

This question was asked during telephone interviews conducted of employees of London Transport, and the San Diego Transit Authority. The answers were similar, but had variations since the respondents operated in different regions of the world. While San Diego and London both have umbrella organizations that organize the public transport services in their region, different operators actually provide the services. Both regions have uniform fare structure policies that allows riders to transfer freely from one mode of public transport to another. Transport officials in both areas informed us that cross-town routes, line haul routes, express routes, and feeder routes were used in their bus network. One difference between the two areas' was that London, unlike San Diego, had a bus route connected to every underground rail station. In addition, we found that neither area had a perfect spoke and wheel pattern, but different parts of both networks showed spoke and wheel characteristics.

Answers to this question informed us that London Transport had some of the information, such as ridership figures, that we would need to obtain before we could recommend changes. We also learned that other network designs besides spoke and wheel could be implemented in Merton.

Where do you see the need for public transportation improvements in Merton?

This question was asked to most of the individuals we interviewed. Many of their problem areas overlapped. They all saw a need for improvement in areas such as bus

efficiency, bus reliability, and speed of travel. They also felt service to areas such as schools, retail shops, and leisure sites could be improved. Other areas that the respondents stated needed improvements were boarding times, traffic regulation enforcement, system integration, and information accessibility.

Due to this question, we learned that many of the problems associated with Merton's bus network resulted from traffic congestion. Since one way to decrease traffic congestion is to increase bus ridership, our recommendations primarily focused on increasing bus ridership not decreasing traffic congestion. We did not address other problems such as traffic regulation enforcement, and boarding times, because we felt they did not fall under the scope of this project. These issues should be examined by the bus operators.

What factors do you look at before implementing modifications in the bus network?

This question was asked to transportation officials in both the London and San Diego area. We learned that officials in both areas looked at very similar data before recommending changes, commuter origin and destination studies, passenger demand studies, and operating cost estimates. We also learned that some changes in bus service were not due to recommendations by company employees, but resulted from private sector requests or innovations in public transportation, which would better serve an area. Lastly, before any suggested modifications are implemented the proposed idea must meet company performance standards, and have a beneficial resultant effect on the rest of the network.

The information obtained from this question provided us with the type of data we

would need to justify our suggestions, and questions to ask ourselves before recommending any improvements to Merton's bus services.

What general improvements could we propose for bus services in Merton?

We asked this question to obtain general improvements we could recommend for Merton's bus network. The respondents all recommended we improve the existing system, and not recommend a total reconstruction of the bus network. They also recommended we suggest bus priority measures on the major roads in the borough. The major area of disagreement between the interviewees' concerned radical ideas. One respondent felt that recommending innovative ideas such as guided busways were not a good idea, because implementation was difficult and unlikely. The other two respondents also warned us that implementation would not be immediate, but still encouraged us to recommend such ideas. One transport official suggested we try to change commuter perception of daily costs. He suggested tolls on major roads, a decrease in bus fares, and implementation of inexpensive car parks outside the major areas in Merton, while making parking inside those major areas extremely expensive.

Our recommendations complied with many of the interviewees' responses to the previous question. Only minor route adjustments were recommended to Merton's bus network because of its high accessibility in many areas. We did not recommend the implementation of innovative ideas such as bus gaiting because there was not sufficient evidence to prove it was necessary. Bus gaiting employs specific traffic lights for private vehicles that are placed approximately fifty feet away from the intersection, in addition to regular traffic lights, and allow the bus to pass the cars to reach the intersection first. We

also did not recommend measures to change public perception, because that did not fall under the scope of our project.

In order to meet one goal of the Alternative Movement Strategy, do you believe that a bus route should be located within 400 meters of all residential areas?

This question was asked of some of the interviewees' to learn their opinions on an idea we were considering. They felt that a standard bus route should not be placed near a residential area unless it could warrant sufficient ridership. One interviewee' suggested the use of smaller, midibuses to serve these areas. Another interviewee' suggested bus routes in industrial areas could be better justified. Both interviewees' concluded that passenger demand, not the Alternative Movement Strategy, should be the main reason for the addition of any bus routes in Merton.

The responses we obtained from this question led our project team to only propose bus routes in areas where we were confident ridership would meet London Transport's standards.

Do you think the reallocation of road space for bus priority measures will reduce road congestion?

The two individuals we asked this question gave similar responses. Both individuals felt that the root cause of bus service problems was traffic congestion. They both felt if automobile drivers were continually irritated by measures advantageous to buses, they would be more likely to use the bus. They suggested ideas such as bus priority lanes, bus gaiting, and bus priority traffic lights. Both interviewees' felt that

decreased parking space and high parking prices would decrease car usage and traffic congestion.

These responses supplied us with different ideas on how to decrease road congestion and improve bus services. Many of these ideas were incorporated into our final proposal.

What transportation needs is the Croydon Tramlink supposed to be fulfilling? How can buses be used to supplement the tramlink?

Since our recommended bus service improvements had to supplement the rest of the public transportation network, we needed more information on one part of Merton's public transportation network, the Croydon Tramlink. The individuals we asked this question gave similar responses. They believed that the Croydon Tramlink would be a modern, fast and efficient service that would meet the needs of inter-borough transport between Merton, Croydon, Sutton, and Bromley. They also believed that modernization, and correct advertisement of the service would lead to a solid ridership, and a decrease in road congestion. Both interviewees' felt buses should act as a feeder service connecting different areas in the borough to the tram, and also provide a connection for commuters between the tram and the borough's Underground stations.

These responses led our project team to recommend that buses feed into the tram from other major town centres in the borough. This was in order to facilitate movement across the borough.

Would it be possible for a bus to use the tram corridor as a guided busway for a superbus?

Most of our respondents felt this idea was not feasible due to safety concerns. The speed at which the tram travels compared to buses, and the fact that the tram is in the latter stages of development also led them to dislike the idea.

One of our early ideas was to run a superbus route along the tram to supplement its service. The interviewees' responses to this question and the previous one led us to discard the idea and propose using buses as a feeder service linking the tram to major areas in the borough.

How do you confront the issue of traffic congestion caused by school commuters?

During previous interviews and in an Alternate Movement Strategy document concerning public opinion, one issue that had kept arising was that school commuters contributed immensely to road congestion. We decided to obtain suggestions from transportation officials and engineers on how to confront this issue. One interviewee' stated that at the present time until more policies were in place, making parking near schools more difficult, persuasion was the best means to confront the issue. All the interviewees' suggested we recommend placing bus routes near most schools. Advertising was also suggested as a way to confront the problem.

The information obtained from this question was used as much as possible when we designed our proposal. Bus routes were frequently recommended near schools. Further investigation must be conducted on this problem to correctly address the issue.

What are the benefits of express routes in a bus network?

All of the individuals asked this question gave similar responses. They stated that most commuter bus journeys were short, one or two stops and a conventional bus service with frequent bus stops must be run along with the express bus service. The interviewees' thought express routes were effective ways to transport commuters from other boroughs into and out of Merton, but without the conventional bus route, the express routes were a bad idea.

Due to the responses we obtained from this question, we only suggested express routes, along with a conventional bus service, on the major corridors into and out of the borough.

5.3 Focus Group

On April 26, 1999 a focus group was conducted with three employees of the London Borough of Merton. The group consisted of two public transportation users and a private transportation user. The purpose of this focus group was to identify the reasons why they chose their particular form of transportation. We also wanted to learn about problems associated with bus service, and to obtain feedback on our proposed ideas.

Convenience was the major factor in their choice of their current form of transportation. The two public transportation users stated that they lived in very close proximity to bus and Underground stops respectively. These modes were the easiest way for them to get where they wanted to go, especially to work. The private transportation user also mentioned the accessibility of her car. She had to bring her two children to

different schools, which were located in opposite directions. She said there was no way she had the time to invest in long bus trips, with multiple destinations. The car was her most accessible and convenient option.

Convenience was a major factor in our proposal for the bus network. We addressed this issue by recommending new routes in areas that were not currently located within four hundred meters of public transportation. Additionally, we recommended new routes into industrial areas to provide public transportation services in areas where large numbers of people work. These additions should greatly improve the accessibility and convenience of public transportation.

The main problem, which was identified by both the public and private transportation users, was the poor reliability of the bus service in the Merton area. They all mentioned the inconsistent arrival times of the buses, and one instance was mentioned when a route was canceled without user notification.

Our proposal addressed this issue with combinations of multiple ideas. Bus priority lanes were recommended for major routes to reduce the effects of congestion related delays, which translate to increasing the overall reliability of the service. Bus priority lights, in conjunction with bus priority lanes, were recommended to further decrease delays in congested town centres. The priority lights will decrease the time spent waiting for traffic lights, further increasing efficiency. Finally, we recommended the use of express routes to further increase the reliability of the bus service. The express routes have fewer stops then a regular route, therefore decreasing the time spent at large numbers of bus stops.

The three people were generally in agreement on their opinion of our recommendations. They felt that the use of new routes to improve accessibility was a good idea and might convince people to switch to public transportation. They were in disagreement with one aspect of our recommendation though, which was the use of bus priority lanes. One individual was concerned about the side effect of reducing road space for private vehicles. She felt that rather than influencing people to switch to public transportation, it would just further increase the problem with congestion.

We realize that the recommendation of bus priority lanes would increase the congestion problem for cars. However, this is a necessary first step to improve the quality of public transportation. Through our interviews with engineers at London Transport, we learned that where bus priority lanes have been used in Central London, the benefits far outweighed the side effects. Improvements in reliability and efficiency have been reported on these routes since the use of these lanes has begun.

5.4 Surveys

We conducted surveys, as outlined in our methodology, on a select group of commuters located in the major town centres in Merton during the morning and evening commute. We used the data obtained from these surveys to make sure that the suggestions in our proposal address the concerns of the individuals who will be using the system.

As shown in appendices K and L, the surveys were divided into two categories, private and public transportation. Private transportation surveys were conducted of individuals, who acknowledged that they mainly used private transportation. Public transportation surveys were conducted of individuals who stated that they usually used

public transportation. The first five survey questions in both types of surveys were the same. They were meant to obtain information on the individual's primary mode of transportation. Both surveys then branch off to ask the commuters questions specific to their situation. The results of the survey are in table 5.01-5.10. Below are the conclusions we drew from their responses to each of the questions.

The first question that the individuals we surveyed were asked concerned their primary mode of transportation. The data obtained from this question showed us the biases in our survey. Most of the individuals surveyed were surveyed at bus stops. That is why 41 percent of the individuals we interviewed stated that bus was their primary mode of transportation. The fact that only 14 percent of the individuals we surveyed used car as their primary form of transportation shows that we did not interview many private transportation users. Our project team used the information obtained from this question to categorize the types of transportation users that we interviewed.

Car		14%
Bicycle		0
Bus		41
Tube		25
Walking		17
Other		2
Total		99%

Table 5.01: **Primary Mode of Transportation**

The second question asked why the individuals surveyed used their primary mode of transportation. The question was asked to learn what key attributes our respondents looked at before choosing their primary mode of transportation. The results which are listed in table 5.02 show that most of the respondents valued a high rate of accessibility, reliability, quick travel times, and low costs as the most important factors.

Accessibility		23%
Comfort		5
Cost		16
Safety		7
Speed of Travel		19
Reliability		20
Other		10
Total		100%

Table 5.02: **Key Factors for Deciding on Primary Mode**

Question three, was asked to determine the primary destinations of those we surveyed. Our proposal suggested additional bus routes in major industrial and commercial areas. We used the responses to see if the individuals we surveyed felt our idea was justified. The results of the survey show that a majority of the respondents' primarily used public transportation to go to work and shopping facilities.

Recreation		14%
School		14
Shopping		24
Work		45
Other		2
Total		99%

Table 5.03: **Primary Destinations via Primary Mode of Transport**

Question four, concerned their main hours of transportation usage. We asked this question to individuals to determine if the hours we assumed were peak travel times, were similar to the hours they used their primary form of transportation. The responses of the individuals surveyed suggest they primarily travel in the morning during the hours of 0600-1000, and in the evening during the hours of 1400-1800 or 1800-2200.

0600-1000		39%
1000-1400		13
1400-1800		22
1800-2200		25
2200-0200		0
0200-0600		0
Total		99%

Table 5.04 : **Hours of Usage**

Question five for individuals, that regularly used private transportation, and question seven, for those that primarily used public transportation, concerned what network improvement the individuals surveyed thought were needed. Since the data we had accumulated listed several areas in bus service that needed to be improved, we recommended improvements to bus service in those areas. The questions were asked to make sure our recommendations addressed the areas the individuals surveyed felt were problem areas. Tables 5.05-5.06 show that the respondents had varying responses but reliability was marked down more than any other response.

Accessibility		6%
Cost		6
Lack of Information		22
Speed of Travel		17
Reliability		34
Other		14
Total		99%

Table 5.05: **Needed Improvements Public**

Accessibility		10%
Comfort		8
Cost		10
Lack of Information		37
Speed of Travel		14
Reliability		6
Other		14
Total		99%

Table 5.06: **Needed Improvements Private**

The last survey question we asked to individuals, who used private transportation, concerned their likelihood of using buses if automobile road space was decreased. In our proposal we recommended policies to inconvenience private transportation users, and we wanted to see how likely the individuals we surveyed, were to switch modes, if such policies were implemented. Table 5.07 shows that 60 percent of the individuals we asked this question stated they would use public transportation if car road space were reduced.

Yes		60%
No		40
Total		100%

Table 5.07: **Change to Bus if Road Space Availability Decreased**

The fifth and sixth survey questions we asked of individuals, who primarily used public transportation, concerned how reliable and accessible they felt Merton's bus services were. We suggested improvements in these areas, and asked the question to see if the individuals we interviewed, felt it was a problem area or not. The results in table 5.08-5.09 suggest that improvements were justified, because over 50 percent of the individuals surveyed felt that Merton's bus services were only adequate, but not great in regards to reliability and accessibility.

Good		17%
Average		60
Poor		23
Total		100%

Table 5.08: **Reliability**

Good		38%
Adequate		51
Poor		10
Total		99%

Table 5.09: **Accessibility**

The last survey question we asked of individuals, who used public transportation, concerned whether they were likely to pay an increased fare for improved service. Although government subsidies pay for many improvements, the question was asked to see if the individuals we surveyed were likely to pay an increased fare for implementation of some of our recommendations. Table 5.10 shows that 60 percent of the individuals surveyed were not likely to pay an increased fare for improved bus service.

Yes		40%
No		60
Total		100%

Table 5.10: **Pay increased Fare for Better Service**

5.5 Needs

In order to recommend changes to the bus network, it was necessary to evaluate the transportation needs of the people in Merton. Our team has determined that the basic needs of the people were a reliable service that was both accessible and efficient. Reliability was one common element that was identified as a problem throughout all of the interviews, surveys, and the focus group. Users of public transportation require a service that will provide a consistent arrival time. Some respondents who use public transportation were upset that they had to allow extra time for their journeys due to the unreliability of the bus.

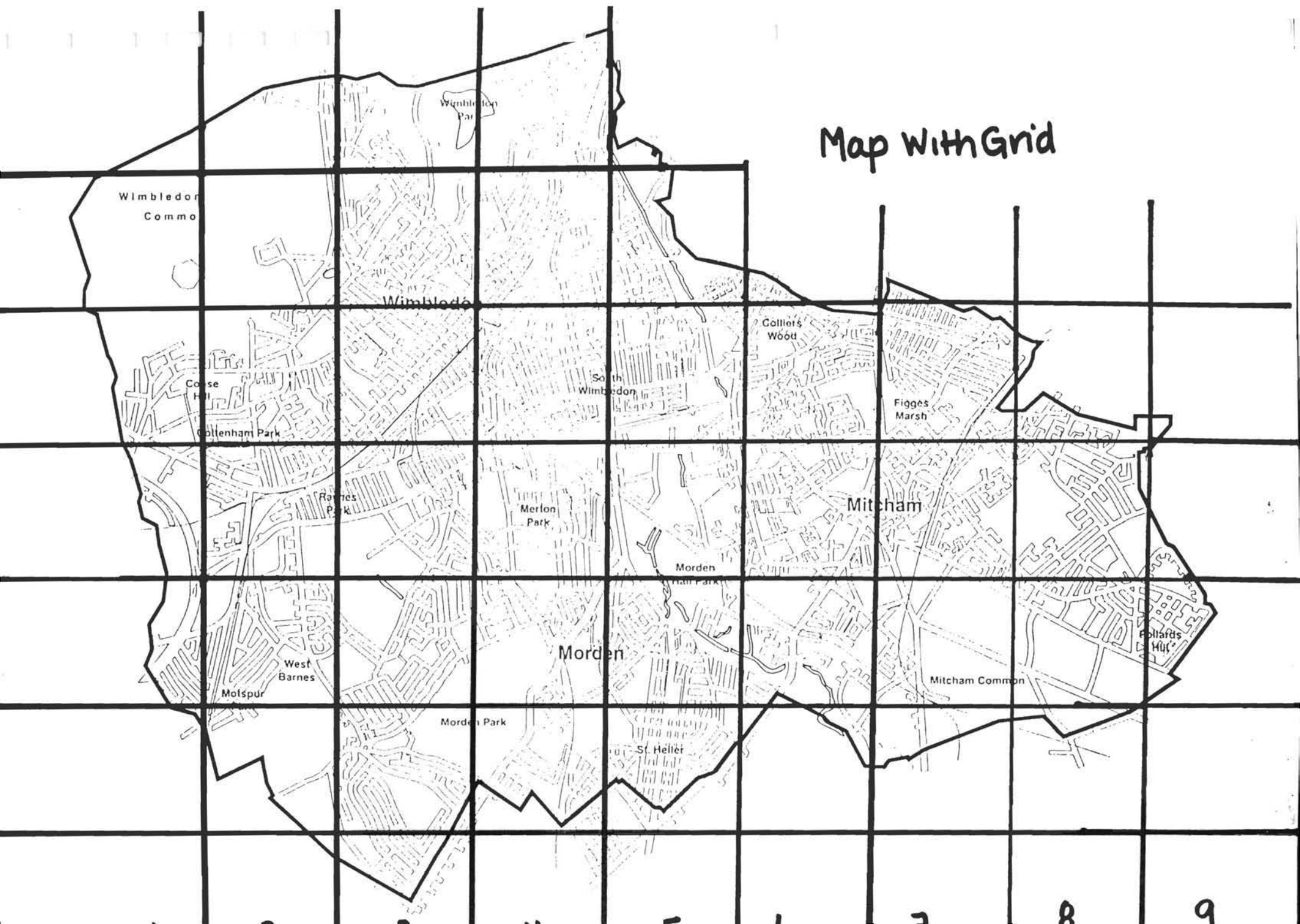
Efficiency was another problem area for the bus service in Merton. Many people avoid using the bus because of the long travel times caused by congestion related delays. In order to address the needs of the people, there must be a change in the current transportation system. The increase in private vehicles has led to an increase in the travel time for buses, causing more people to rely on private vehicles. Many of our proposed

changes work on reducing car usage, which could potentially increase bus efficiency and reliability, and ultimately influence a change to public transportation. Also, accessibility must be addressed in our recommendation. Both residential and commercial areas must have public transportation services located within close proximity to provide an efficient and reliable service. In order to address this need our proposal considered the recommendation of new routes or extensions of existing routes to improve the comprehensiveness of the system, especially in under served areas.

5.6 Opportunities

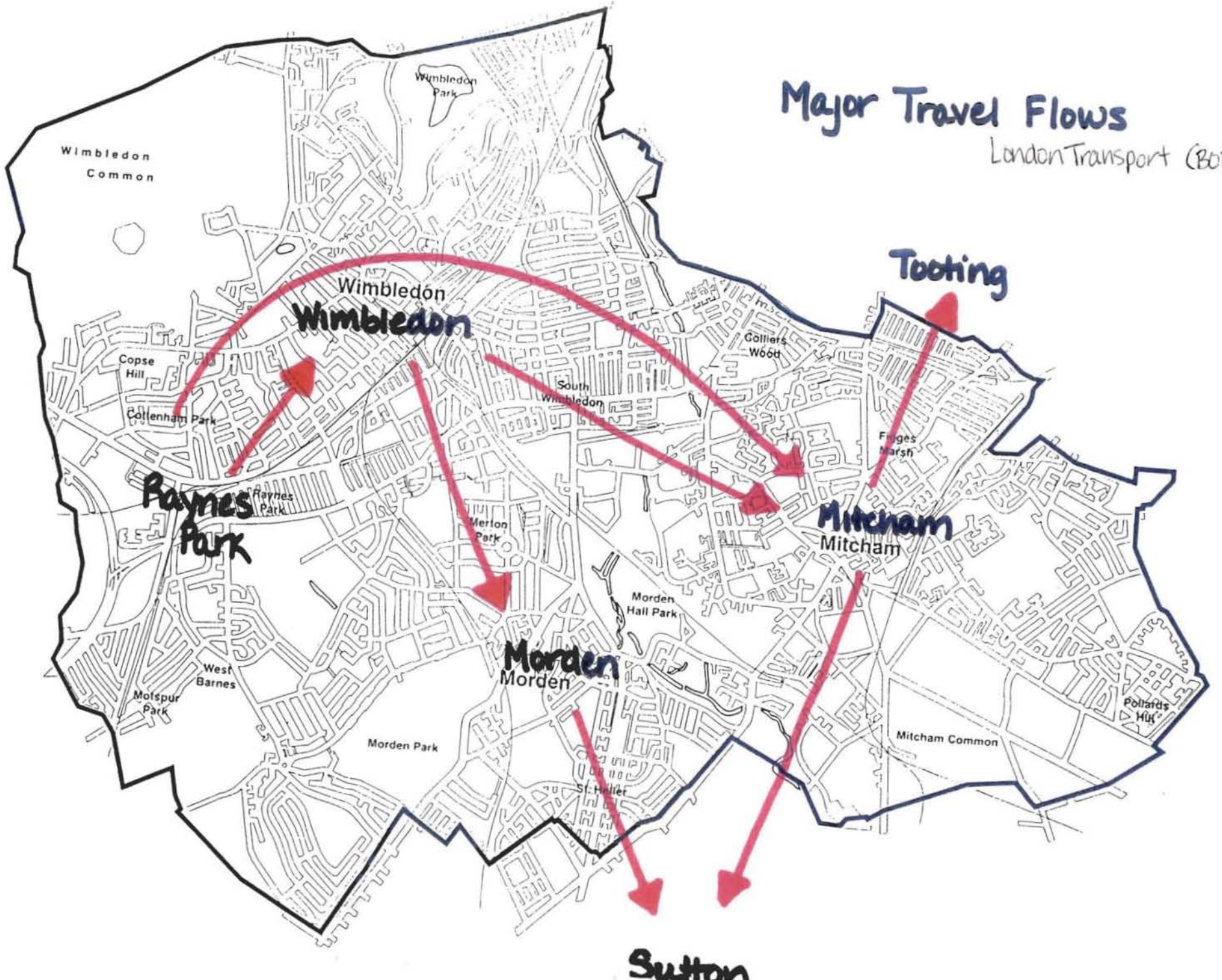
Using the previously identified needs, our team began to examine the areas where there were potential opportunities for change. Once these areas were identified, suitable improvements were recommended. A map with a grid is presented on page 72 to indicate the location of the areas under discussion.

One of the major areas for change was on the routes extending into and out of the town centres identified earlier. There are large levels of congestion associated with these areas that currently effect the reliability of the routes operating on them. Additionally, there are large demands for service into and out of these areas, which can be seen in the ridership data and the map showing major travel flows contained in Appendix A and on page 73 respectively. This map was constructed using the Bus Origin and Destination Study (BODS), to determine the ridership patterns in Merton. Some of the major roads in these areas were examined to determine the feasibility of bus priority lanes. Once we determined that it was feasible in certain areas potential origins and destinations of these lanes were formulated.


Map With Grid
Wimbledon Common
Wimbledon
Coombe Hill
Cottenham Park
South Wimbledon
Colliers Wood
Figges Marsh
Barnes Park
Merton Park
Mitcham
Morden Hall Park
Morden
West Barnes
Motspur
Morden Park
St. Heller
Pollards Hill
Mitcham Common

Major Travel Flows

London Transport (BODS)



The use of bus priority lanes beginning at Wimbledon town centre and extending to Putney would provide quicker north to south service from Wimbledon, while lanes from Mitcham town centre to Tooting would provide a quicker north to south service in that area. London Road in E5, F4, and G3 could provide out of borough service to Morden town centre, which would also improve north to south transit. Finally, bus priority lanes could be used on Bushey road to facilitate an efficient east to west service to the Kingston By-Pass, which is located in D1 and E1 in the southwest corner of the borough.

In conjunction with the use of bus priority lanes, express routes could be used to provide a fast service between two major areas. These express routes would begin at major areas, run along a specified route at high speeds, and stop approximately every mile. The use of these types of routes would facilitate east to west movement and north to south movement.

Other areas of opportunity were new industrial areas located throughout the Borough. The establishment of new routes in these specific locations could best deal with this problem. Some of these areas include B5, G3, and F7, which can be seen on the map on page 72. Some of the possible roads where new routes could be recommended are Weir Circle, Garth Road, and Wandle Way.

In addition to new routes into industrial areas, residential areas not previously served are also areas of opportunity. There are many residential areas, which do not have public transportation within four hundred meters. These areas and routes are identified in the following section: A new route or an extension of a route operating in A4, B3, B4, which is located in the Village Ward. A new route or an extension of a route into C1, and

C2 in the Raynes Park Ward, and a new route or an extension of a route to service D4, which is located in the Merton Park Ward.

One last potential area for opportunity is the Croydon Tramlink track. One of our more radical ideas was to use a guided busway that would operate on both roads and the track of the Croydon Tramlink. A bus operating on this route would begin its journey in the Borough in Sutton, located South of Merton. The bus would run along St. Helier Road and then it would turn onto Morden Hall Road. It would then proceed until Morden Hall Road turned into Morden Road and the Tramlink track crossed the road. At this point, the bus would either drive along a paved path on either side of the track or lower special wheels and ride on the track into Wimbledon town centre.

The main benefits of this idea are that the bus will be able to avoid the large amounts of congestion in the areas around Wimbledon town centre. It would provide a fast and efficient way for people from Sutton and the southern area of the borough to travel into the Wimbledon area.

These areas of opportunity and potential solutions were generated from the knowledge that we had gained in the United States and during the first week in Merton. These ideas were then discussed in many of our interviews to determine their feasibility. Through our interviews, we have determined that many of the opportunities that we have identified were feasible. Our more radical idea using the tram track as a bus lane however, was not possible with the Croydon Tramlink, since construction of the Croydon Tramlink was almost complete, and timing with the buses would be a safety concern. This idea could be implemented with the Merton Tramlink, but requires further research.

5.7 Trends

Through our research and interviews, we have determined the general travel trends of the people in Merton. Retired individuals tend to travel during the day when the bus is the least crowded due to their lack of time constraints. Their origins are their homes, and their destinations are usually shopping areas or friends homes located in other areas of the borough. Individuals who are employed tend to travel to the industrial areas within and outside of the borough for work. This information shows that the majority of bus rides originates in residential areas, and terminates at places of work, schools, or shopping.

Travel trends to specific areas have also been identified through the use of the Bus Origin and Destination Study (BODS). These trends have been identified for three areas in the borough of Merton, as well as in Tooting and Sutton. A map indicating the trends is on page 73 as well as approximate numbers of people traveling between areas per day, which is contained in Appendix A. The BODS have shown that Wimbledon town centre has a large influx of people from Raynes Park area. The rest of the borough contributes an equal share of commuters. People from the Wimbledon area have demonstrated a tendency to travel to Morden and Mitcham. The travel trends from Mitcham show the majority of the people traveling south to Sutton, or north to Tooting. Finally, the trends in Morden show that there is approximately equal travel to all of the identified areas.

The travel trends indicate the areas where the majority of people in Merton are traveling. This information was an important factor to consider when making our recommendation, since the bus routes should go to the areas where the demand is the greatest.

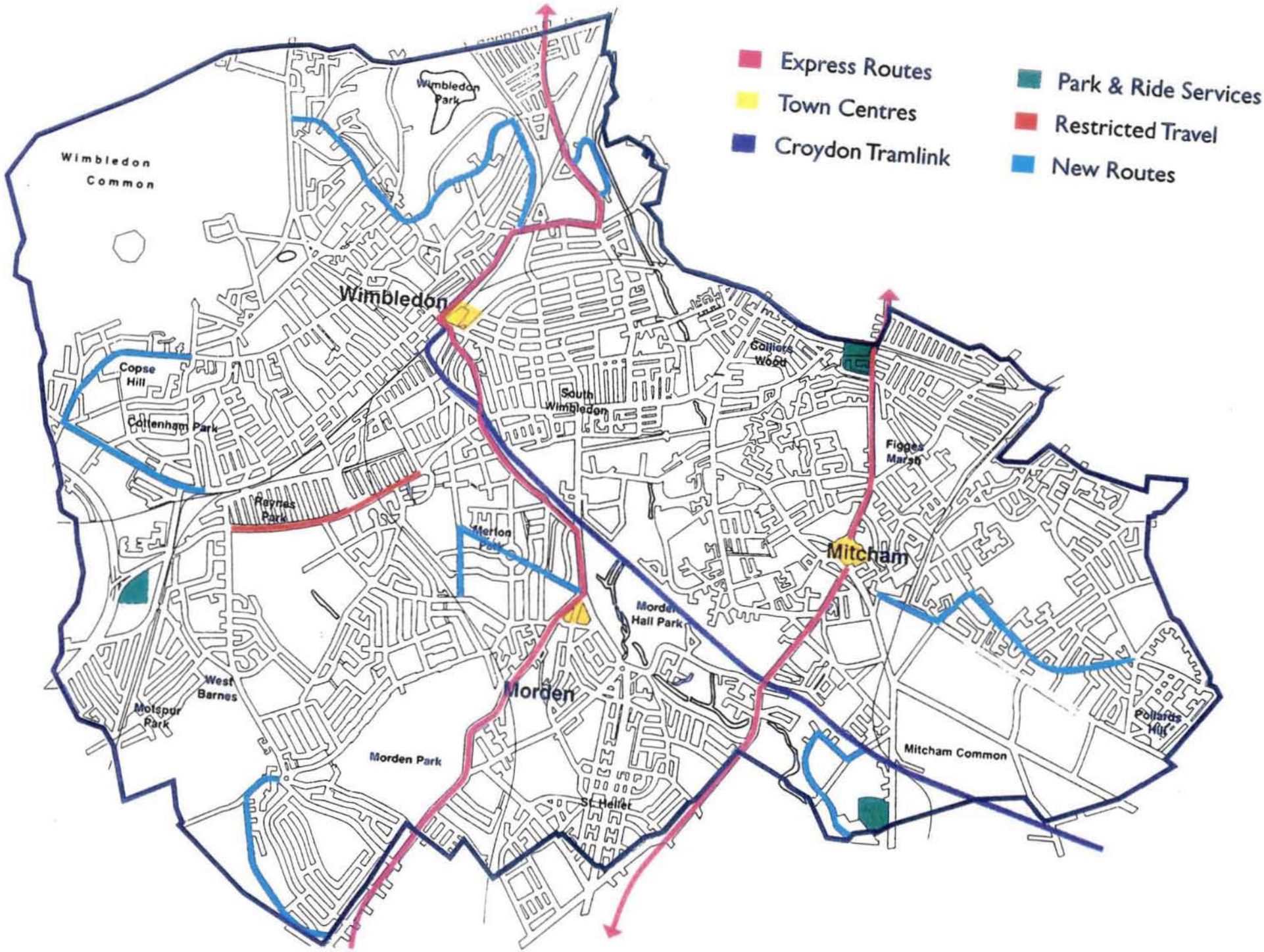
6.0 Proposal

Once our team had finished analyzing the data, we proceeded to formulate our proposal. This proposal consists of the recommendations for the addition of new routes, extension of existing routes, the addition of bus priority measures, and other ideas to maximize the efficiency of the buses. The general direction of our proposed changes is to feed traffic into the central areas, such as town centres. The system does not have a "Spoke and Wheel" pattern, but there are still many feeder services to main areas. Page 54 shows a map of the existing bus network. A map of Proposed changes (Map 10) is on page 78, and a table showing the recommended changes is shown on page 94.

6.1 Route 1

The first recommendation was the addition of an express bus route, which would begin at either Sutton town centre or Cheam, and run north through Morden town centre, and either terminate at Wimbledon town centre, or continue to Putney. It is important to understand that for areas where an express route is recommended, there is also non-express service on those routes, to provide service for passengers that cannot access the express stops. The reason is that passengers must be able to access public transportation in areas that are not near the express route stops. This express route would operate at peak hours only, since peak hours are the only time with sufficient demand to justify the installation of the express route.

There is currently a non-express route running from Sutton station to Wimbledon station (164) and another running from Morden station to Wimbledon station (163). However, these routes do not provide as direct a service as the express route we proposed. The reasons for the addition of this express route is to bring passengers from


Express Routes
Town Centres
Croydon Tramlink
Park & Ride Services
Restricted Travel
New Routes
Wimbledon Common
Wimbledon Park
Wimbledon
Copse Hill
Cottenham Park
Raynes Park
Merton Park
South Wimbledon
Colliers Wood
Figges Marsh
Mitcham
Morden Hall Park
Morden
West Barnes
Motspur Park
Morden Park
St Helier
Mitcham Common
Pollards Hill

Sutton town centre, or Cheam, which are major town centres, to the Morden Underground station, and then to Wimbledon and out of the borough. Ridership data has shown that London Road, between the southern edge of the borough and Morden town centre, carries 19.5 buses and 273 people per hour on average for the day. St. Helier Road carries 18 buses and 230 people per hour. These figures indicate a high level of demand for service along this route.

The addition of an express route along one of these roads would allow quicker service into Morden, therefore the express route could be chosen over the non-express form of service, increasing the travel along that road. The site assessment has also shown that 36,000 out of 70,000 people commute from outer London into Merton everyday, therefore there needs to be service that reflects this transportation need (Buckingham & Collop, 1991). This service must provide adequate connections with transportation into central London. The Underground station is important because twenty-three percent of all rail trips are made to outer London, and twenty-six percent of all rail trips begin in outer London (Buckingham & Collop, 1991). One member of our focus group indicated that the Underground is an integral part of his commute, as did many of the individuals surveyed. Therefore, this is further justification for a fast and reliable route, which is what our express route will provide. The map on page 81 shows arrows indicating that there is a need for improved or additional public transport along this route as well.

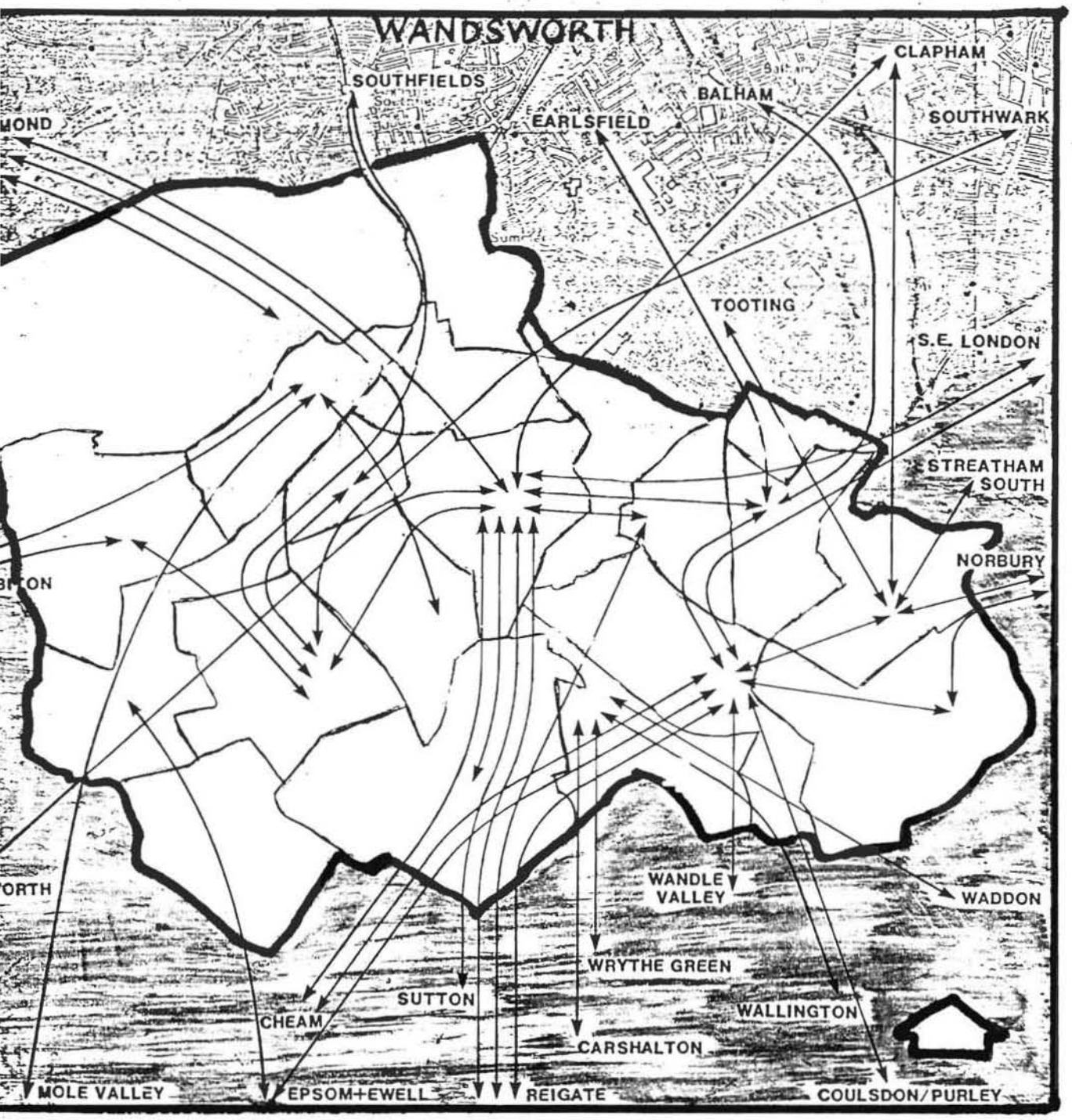
In order for this express route to effectively transport passengers, bus priority measures need to be installed along these routes. Bus priority measures include the use of bus priority lanes and bus priority traffic lights. Since bus priority lanes require ten meters of space in the road to install a lane on one side of the road, roads would have to

be examined in further detail to determine if they would be feasible. Alternatively, schemes would have to be developed which would provide more space on the roads.

Bus priority traffic lights have been shown to reduce travel times by three to five seconds per light per bus per journey. If there were five lights on a route from Morden to Wimbledon, that would result in a fifteen to twenty-five second decrease in travel time. The area located between Westferry Road and Burdett Circus, located in central London has undertaken the use of bus priority lanes. Between the years 1991 and 1995, London Transport observed that this measure, has cut certain journeys in half, and has saved passengers between five and ten minutes per journey (London Transport, 1995). The information obtained from our focus group and surveys showed that many individuals found the slowness of bus service to be a problem. The addition of an express route with bus priority measures would cut those times significantly.

6.2 Route 2

Another express route is recommended from Sutton town centre, through Mitcham town centre and north to Tooting. The reason for the addition of this route is that there is currently no direct bus service from Sutton to Tooting, or from Sutton to Mitcham. Since the services connecting these areas are limited, the need for an express route is great. This route lets passengers efficiently travel where they need to go. This express route would also only operate at peak hours, since only the increased amount of travel at peak hours would justify the installation of the route. Ridership data has shown that between the hours of 7:00 and 18:00 there is an average of twenty-three buses per hour, and three hundred and forty two people per hour. These figures result in three



NEED FOR ADDITIONAL OR IMPROVED PUBLIC TRANSPORT

Map 10

Merton Borough Plan

thousand two hundred and twelve people traveling between Mitcham and Tooting every day. The ridership data has also shown that there are eleven buses and one hundred and fifty eight people per hour on routes operating on London Road from Sutton to Mitcham. Although the Alternate Movement Strategy states that bus lanes are justified when there are more than twenty buses per hour and more than five hundred passengers, the proposed park and ride services located north of Mitcham, which will be discussed in a later section, would increase the passenger numbers enough to implement the express route.

There are also Underground Stations located at Tooting Broadway and Tooting Bec, and a stop on the new Croydon Tramlink located on that road. For the reasons cited previously, the Underground Station is a major area that needs to be serviced. Our interviews have also shown that there should be service located at all rail stops, such as the new ones on the Croydon Tramlink. The map on page 81 shows arrows that indicate there is also a need for additional or improved service along this route.

Bus priority measures would also make this express route more efficient in transporting passengers from one town centre to another. For reasons cited previously, they would be an important part of the recommendation for this express route.

6.3 Routes to Unserviced Areas

The addition or extension of routes was also recommended into industrial and residential areas. The benefits of providing improved service in these areas can be seen in our case studies, located in the Literature Review. For example, in Grand Rapids, Michigan, two additional mini-buses that were added to serve residential and commercial locations resulted in nearly fifteen thousand additional passengers in the first two months.

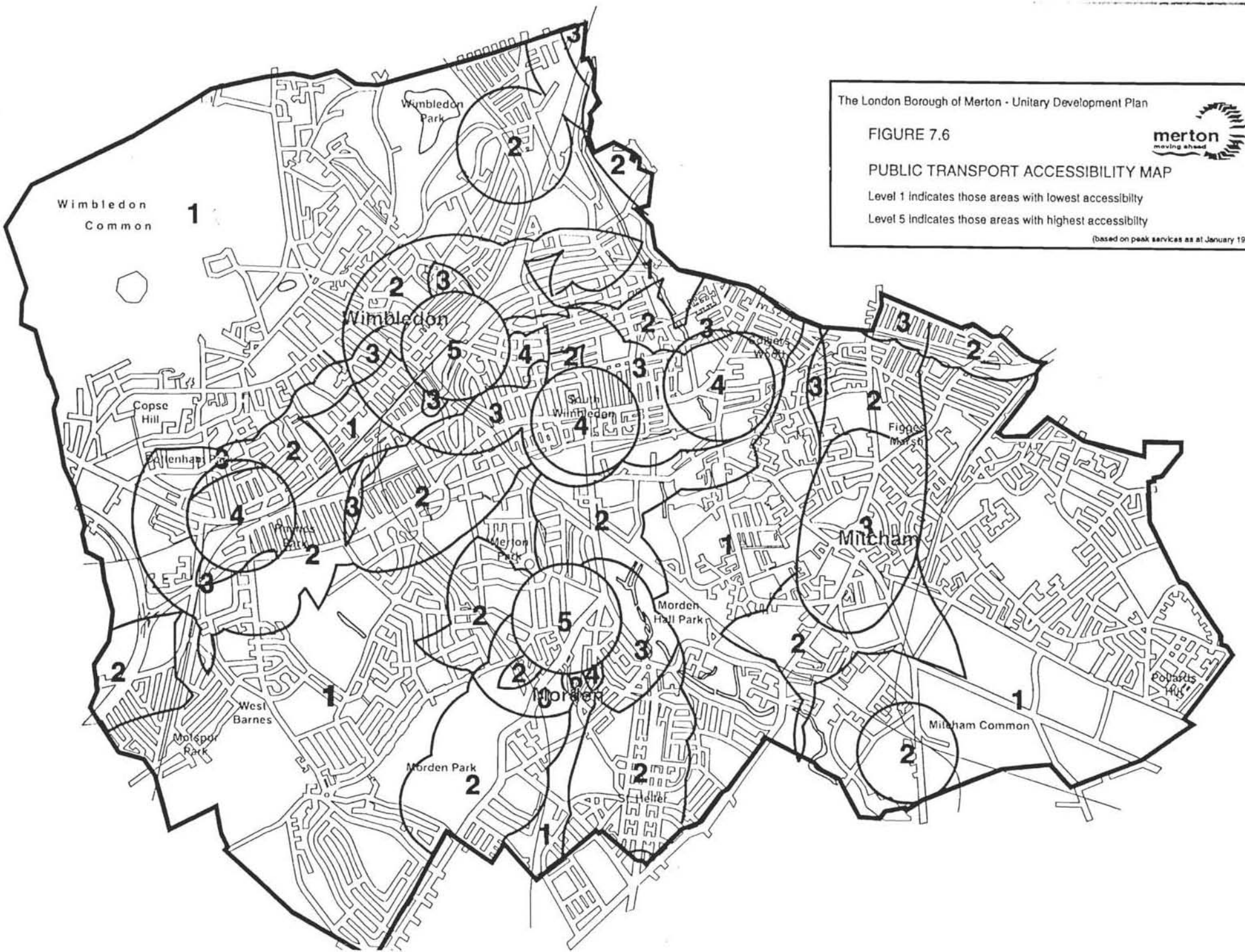
6.31 Addition 1

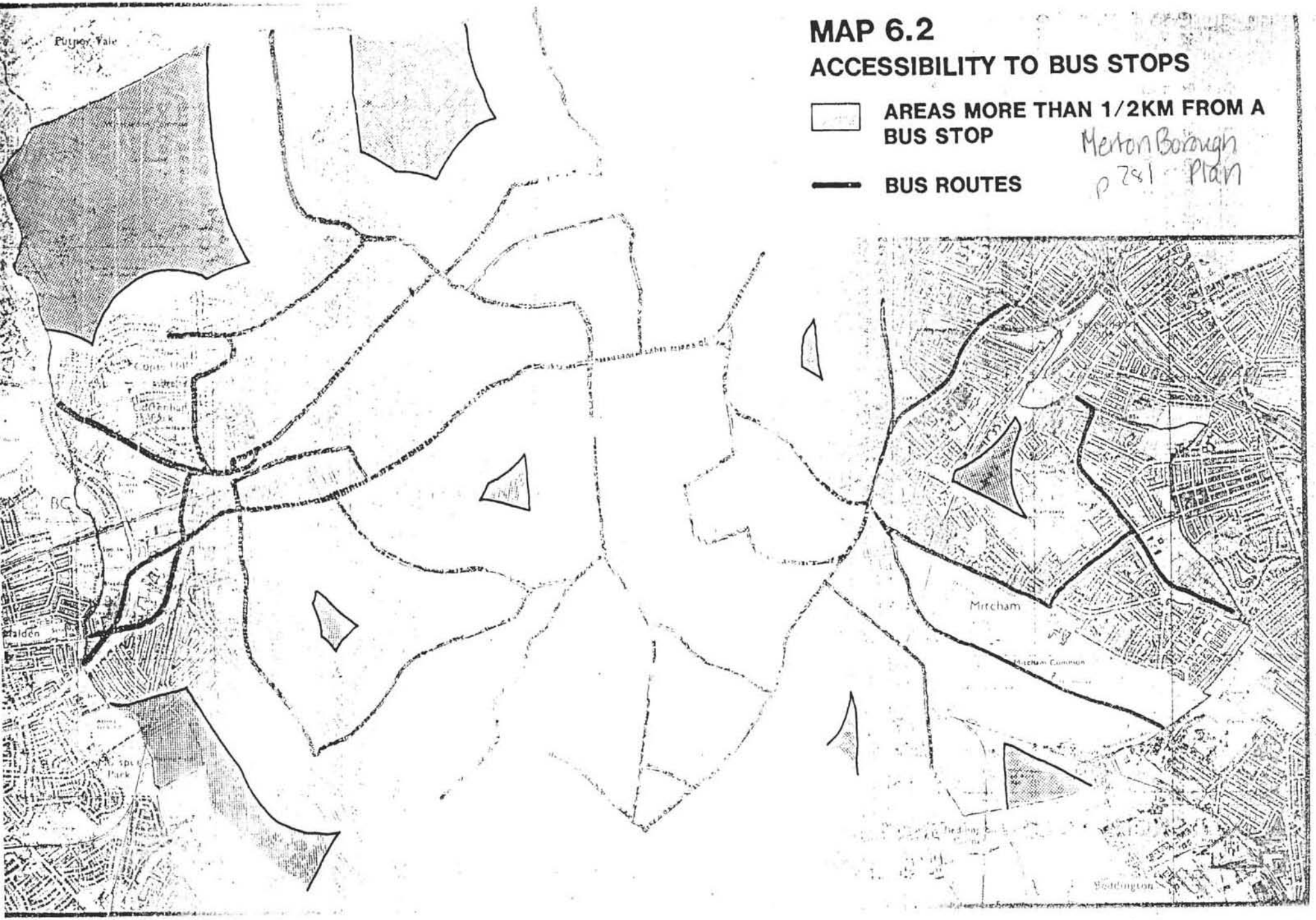
The first area for which our team recommended an entirely near route was located at B4 and B5, in the area of Wimbledon Park. This recommendation is called Addition 1. Presently there is no bus service in this area. The reason for the addition of this route is to increase accessibility to this area, which, was rated between a one and two for accessibility (Unitary Development Plan, 1996). A one to five scale was used with one meaning very low accessibility, and five meaning excellent accessibility. The UDP would like most areas in the borough to be at three or above on the accessibility scale. Another factor contributing to the lack of accessibility is that the area is located more than one half of a kilometer from a bus stop (Merton Borough Plan, 1988). A map indicating the accessibility of public transportation for all areas of the borough is contained on page 84, and a map indicating accessibility to bus stops is contained on page 85.

It is important to increase accessibility since this area contains retail warehouses, local centres, and neighborhood parades. More importantly, the residents have no easy access to public transportation, forcing them to use either private transportation or to walk. Additionally, there is a primary school, secondary school, and an Underground station at Wimbledon Park that this route will provide service for. Reasons for access to the Underground have been identified previously, and school access is important so children can get to school without being driven.

6.32 Addition 2

Other areas where service should be added are in the industrial areas of Merton. One area is located at G3, near Tudor Drive and Garth Road, and the new route here is


The London Borough of Merton - Unitary Development Plan
FIGURE 7.6
merton
moving ahead
PUBLIC TRANSPORT ACCESSIBILITY MAP
Level 1 indicates those areas with lowest accessibilty
Level 5 indicates those areas with highest accessibility
(based on peak services as at January 1992)
Wimbledon Common
Wimbledon Park
Wimbledon
Copse Hill
Wimbledon Chase
Merton Park
Morden Hall Park
Morden
Morden Park
West Barnes
Mitcham
Mitcham Common


MAP 6.2
ACCESSIBILITY TO BUS STOPS
AREAS MORE THAN 1/2KM FROM A BUS STOP
BUS ROUTES
Merton Borough Plan p 281
Putney Vale
Malden
Mitcham
Mitcham Common
Beddington

called Addition 2. The present bus network services London Road, and Hillcross Road, but not the area in between. This additional route would operate at peak hours only, unless a need for more service was demonstrated. Then more service would be added throughout the day. The reason behind the addition of this route is that the area was rated a one for accessibility and is a major industrial area (UDP, 1996). Since it is an industrial area, and the added services would be for people working in the area, the service would only operate at peak hours.

This route would also meet the goal of the Alternate Movement Strategy, which states that there would ideally be no area that is not within four hundred meters of a bus stop. In our interviews, differing views were expressed regarding this idea. Some opinions were that this was a reasonable distance for accessibility, and the addition of routes into these areas would increase ridership. Standards that define quality service stated that high quality service serves a high percentage of the mobility market. Increasing service to under served areas increases accessibility to more of the mobility market. Other officials, though, indicated that having the service does not guarantee that it will be utilized. However, we felt with its close proximity to an industrial area with a large number of potential users that this would be a good location for a new route.

6.33 Addition 3

Another industrial area where an additional route is suggested is at F7, the Wandle Way area, which will be called Addition 3. This service would also operate only at peak hours for reasons listed above. The reasons for the addition of this route are to service the Wandle Way area, which has been identified as an industrial area by the Unitary Development Plan. This area was rated a two for accessibility, although the ward

contains over 10,000 residents. The addition of this route would provide the industrial area with more public transportation, since there is none through the area, and provide a link to the Croydon Tramlink.

6.34 Addition 4

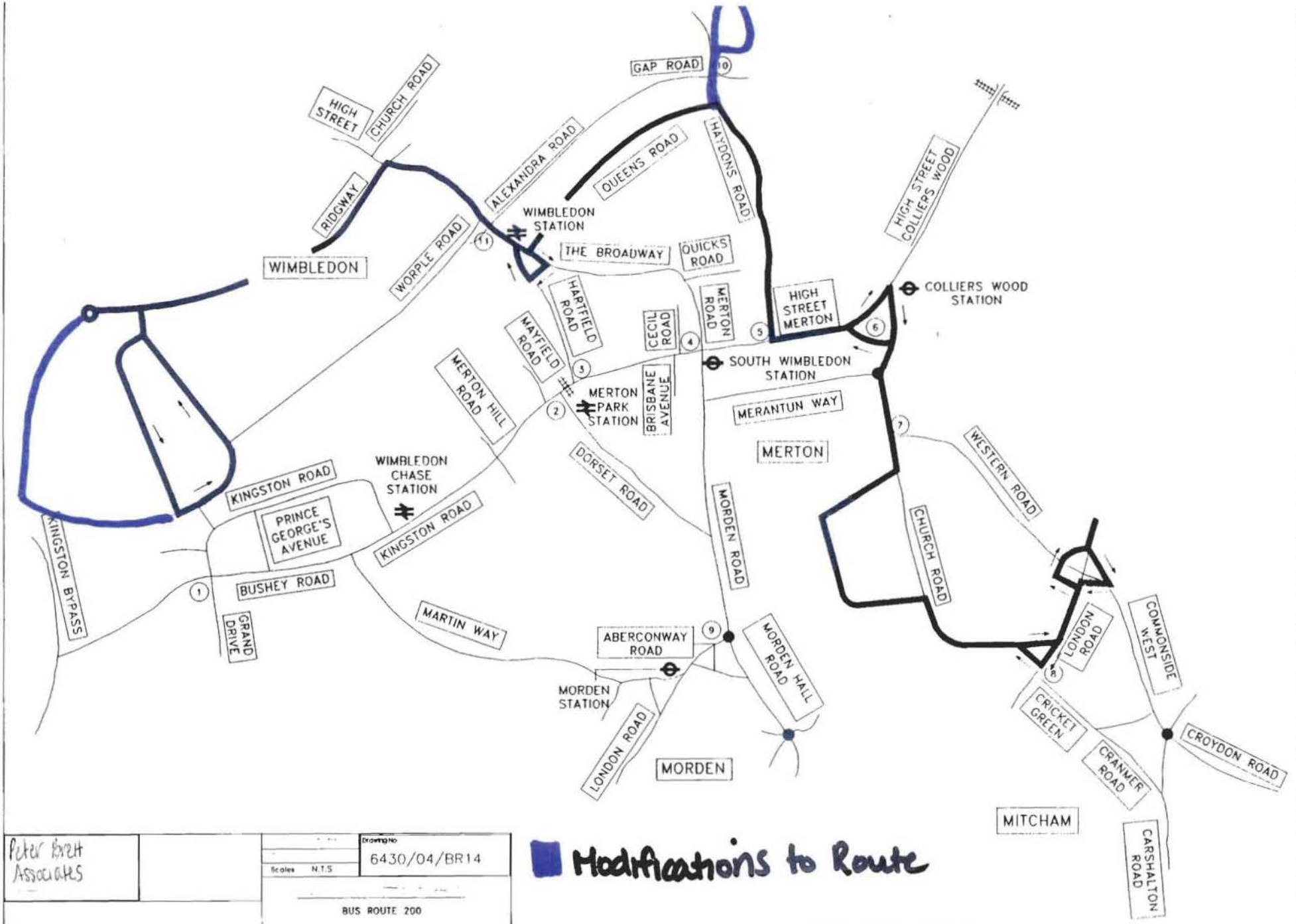
One residential area where the addition of a route is recommended is in the area located at D4 and E4, near Merton Park. This will be called Addition 4. This route would travel on Kenley Road in the area nearby Merton Park. This route would operate all day, and could be either an extension of an existing route, or an alternating extension of an existing route, in which this area would be only serviced by every second bus. One reason for the addition of this route is that the area was rated a two for accessibility. There is also more than four hundred meters from the center of this area to any of the nearby routes. In order to follow one AMS policy, we decided that there should be service located within four hundred meters of the area.

6.4 Modifications of Existing Routes

Through our examination of the current situation in Merton, we have identified some existing routes that should be updated. Our modifications will extend the routes into under served areas.

6.41 Modification 1

Modification 1, concerns route 200. A map, on page 88, shows the existing route and our recommended changes to it. Our team recommended that this route should be an alternating route. An alternating route means that the first bus would follow the route as planned, and the second bus would run on a different route in an additional area, rejoin the original route, and continue as planned. The first bus on route 200 would begin


GAP ROAD
HIGH STREET
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
WIMBLEDON STATION
WIMBLEDON
WORPLE ROAD
THE BROADWAY
QUICKS ROAD
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
COLLIERS WOOD STATION
MAYFIELD ROAD
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
MORDEN HALL ROAD
LONDON ROAD
COMMONSIDE WEST
MORDEN STATION
LONDON ROAD
CRICKET GREEN
CRANMER ROAD
CROYDON ROAD
MORDEN
MITCHAM
CARSHALTON ROAD
Modifications to Route
Peter Brett Associates
Drawing No 6430/04/BR14
Scales N.T.S
BUS ROUTE 200

at Raynes Park station and go north on Durham Road to Corpse Hill. The bus would then go east on Ridgeway and turn right onto Wimbledon Hill road. When the bus reached Queens Road, it would turn left and continue to Haydons Road, where it would turn left to go north. Upon arrival at Weir Circle, the bus would follow Weir Circle back onto Haydons Road, where it would go south. Once the circle around Weir Circle is complete, the bus would continue as originally planned.

The other route that a bus would take is to begin at Raynes Park station, and go west on Coombe Lane. Once the bus reached Corpse Hill, it would turn right and follow Corpse Hill to Ridgeway, where it would continue as originally planned.

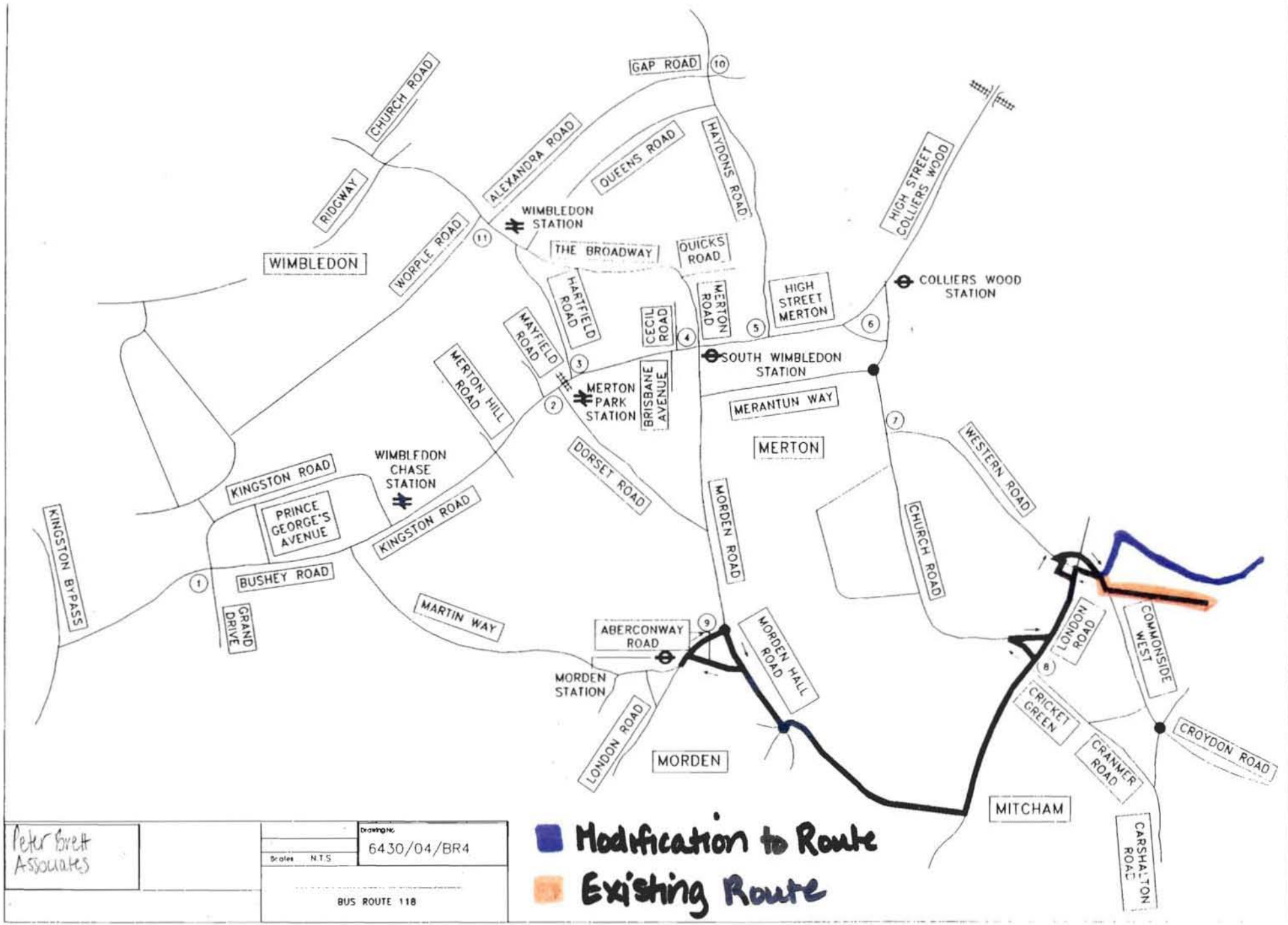
The previous inaccessibility of the added areas, was the reason for changing the route. Weir Circle was identified as a commercial and industrial area in the Unitary Development Plan, but was given as accessibility rating of one. The ward of Durnsford, where Weir Circle is located, has 5,526 residents, which is a large number considering the size of the ward. The reasons for the changes to the other section of the alternating route are that the area, which contains one school and a neighborhood parade, was rated as a one for accessibility. This area has also been identified as an area more than one kilometer from a rail station. Since twenty-six percent of all rail trips originate in outer London, and twenty-three percent of all rail trips terminate in outer London, rail access is important (London Research Centre, 1991). The other ward this modification affects, Raynes Park has 9,646 residents with more than half of them employed. The large number of employed residents requires greater service to this area.

6.42 Modification 2

A second route that our project team recommended to change was route 118, which will be called Modification 2. A map of the current route, and the proposed changes is on page 91. This route currently begins at Morden station, and runs through Mitcham town centre to Brixton. The area where our team recommended a change was near Mitcham Common. The change would begin at Commonside East. Upon arriving on Commonside East, the bus would turn left onto Grove Road, and turn right onto Tamworth Lane, where it would rejoin the original route on Manor Road. The reasons for this changes are that on the original route the right side of the road is a park, while on Tamworth Lane, the bus would be able to service more residential areas. With the current route, the Tamworth Lane area is further that one-half of a kilometer from a bus stop, and rates a one for accessibility. The Tamworth Lane area also contains a Neighborhood Parade, and the ward contains 9,933 residents. The change to this route would bring the bus into the more residential areas, rather than through the park, therefore the route would benefit more people. The park would instead be serviced by the 264, which would transport people into Mitcham town centre, or to Croydon.

6.5 Park and Ride Services

In addition to routes, our project team recommends other ideas to improve the bus network. One of these ideas is the installation of park and ride services. According to the Alternate Movement Strategy Main Report, thirty-six percent of people believe that the introduction of park and ride services would likely improve the parking problem in Merton (AMS 1991). The areas chosen for park and ride services are general, and specific sites would require further investigation. Some potential problems with the park


GAP ROAD
10
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
WIMBLEDON STATION
WIMBLEDON
WORPLE ROAD
11
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
MAYFIELD ROAD
3
4
5
6
SOUTH WIMBLEDON STATION
MERTON HILL
2
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
7
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
1
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
9
MORDEN HALL ROAD
LONDON ROAD
8
COMMONSIDE WEST
MORDEN STATION
CRICKET GREEN
CRANMER ROAD
CROYDON ROAD
LONDON ROAD
MORDEN
MITCHAM
CARSHALTON ROAD
Modification to Route
Existing Route
Peter Brett Associates
Drawing No. 6430/04/BR4
Scales N.T.S
BUS ROUTE 118

and ride service are that there is no guarantee that they will be utilized, and they may promote car usage.

Our project team believes that in order to try and convince private transport users to change to public transportation, there needs to be an intermediate solution, which allows people to slowly begin to use the buses. Surveys and a focus group have shown that the people will not just sell their cars and change to public transportation. Our proposed park and ride service would be an intermediate step allowing people to slowly switch to public transportation. The park and ride services will also reduce the number of cars parked on roads, decreasing congestion related delays for buses. One way in which park and ride services can look more enticing is to offer reduced fares to those who use them within the borough. Additionally, making movement harder for private transportation through reduced parking and road space within the borough will further encourage park and ride services. Our case studies show that in New Jersey there has been a steady increase in ridership partly due to the use of park and ride services in conjunction with other public transportation.

The three areas, we believe, park and ride services would be most effective were identified. The first area was at the intersection of the Kingston By-Pass and Bushey Road, located at D1 and E1. This area will be called Park and Ride 1. The reasons for this choice as a site are that the Kingston By-Pass is a major artery for commuters into the borough. Additionally, it is located on the outskirts of the western part of the borough. If people were to utilize the facility, it would greatly reduce the number of cars and potentially the congestion within the borough.

Another area where park and ride services could be beneficial is at the intersection of London Road, and Finborough Road, located at B6 and C6, which will be called park and ride 2. This area was chosen due to its location at the northern outskirts of the borough near Tooting. Travelers utilizing the park and ride services, would leave their cars at the car park, and would be able to use either a regular bus or an express bus to get to Mitcham town centre, Sutton town centre, or to the Croydon Tramlink.

The third area where park and ride services could be beneficial is at the intersection between Carshalton Road and the outer edge of the borough, located at F6. This location will be called park and ride 3. This area was chosen due to its location at the outskirts of the borough, as well as its location near the Croydon Tramlink. This service will allow people to park their cars and use the Tramlink to travel throughout the borough. This would address one of the concerns identified in an interview with a transportation official from the London Borough of Merton, which was that people would park around the tram and cause major congestion in those areas. The park and ride service in this area would allow people to park and use the tram, without causing parking congestion on nearby roads.

6.6 Restricted Travel

In order to increase the efficiency of the buses in a congested area, another method would be to use specific traffic calming measures. One recommendation, in particular, is to allow only residents and buses access to travel on certain roads. All other traffic would have to find alternate routes, which would decrease congestion for the buses. This restricted access would be enforced with signs, and resident stickers for cars. A form of restricted access lanes is currently in use in Oxford city centre, where

there is a physical barrier in the road. Buses and taxis are equipped with a signal, which lowered the barrier so that the vehicles could pass. This led to less congestion in that area. One possible area for this idea is at the intersection of Grand Drive and Bushey Road, leading north on Bushey Road into Kingston Road. This area will be called restricted access lane 1.

This route has been identified by the Alternate Movement Strategy as a route with delays due to the variation of the standard of the highway. Our team recommended this route, since there are delays, and the other traffic would have multiple options for alternate routes. The implementation of this scheme would also increase the efficiency of the route from our recommended park and ride service at the junction of Bushey Road and the Kingston By-Pass, thereby further promoting the park and ride service.

Table 6.1 **Proposed Changes**

Changes	Location of Change	Reasons for Change
Route 1	Express route running from Sutton or Cheam north through Morden town centre to Wimbledon town centre and north out of the Borough.	Express route will connect major town centres and locations of other forms of public transport. Allows quicker travel on frequently traveled roads.

Route 2	Express route running from Sutton north through Mitcham town centre, and north to Tooting.	Express route will connect major town centres to each other, and lead north to the Underground Station in Tooting. Allows quicker service which, could promote park and ride Services.
Addition 1	Route into B4 and B5, in the Wimbledon Park area beginning at Wimbledon town centre.	This additional service would increase accessibility for residents, and for the retail area in this area. An Underground Station is located here, as well as two schools.
Addition 2	Route into G3 to Tudor Drive from Morden town centre. Would operate at Peak Hours.	A route into this area is necessary since this is an industrial area with no accessible service.
Addition 3	Route into F7 in the area near Wandle Way from the Croydon Tramlink. Would operate at Peak Hours.	A route into this area is necessary since this is an industrial area with no accessible service.
Addition 4	Route into D4 and E4 located near Merton Park from Morden town centre. Buses would operate all day, possibly on alternating routes.	A route into this area is necessary since this is a residential area with poor accessibility.
Modification 1	Route 200. This route would become an alternating route. The first route would add service north into B5, located at Weir Circle, and then continue as scheduled, while the second route would run west on Coombe Lane and run on Corpse Hill to Ridgeway where it would continue as scheduled.	This modification would provide service to a residential and industrial area with poor accessibility. The alternating service will make the routes shorter, so that people can get to their destinations faster.

Modification 2	Route 118. This route would run as scheduled. Instead of running on Commonside East, it would run on Tamworth Lane, and continue as scheduled.	This route would be changed since there is currently a park on one side of Commonside East, while the area north of Tamworth has poor accessibility.
Park and Ride 1	This park and ride service would be located at G2, near the Kingston By-Pass. Recommended in conjunction with a red route.	This park and ride service would provide an area for cars to park and use bus service throughout the borough. Efficient bus service into Wimbledon, and reduced fares will entice people to use the services.
Park and Ride 2	This park and ride service would be located at C7, at the border of Merton and Tooting.	This park and ride service would provide an area where commuters from Tooting can park their cars, and use the bus to get into the borough. Ridership data has shown that there is a large commute from Tooting.
Park and Ride 3	This park and ride service is located at F7, at the border of Merton and Sutton. This is located near an industrial area.	This park and ride service would provide an area for commuters from Sutton to park on their way into the borough. It is located near an industrial area, and the Croydon Tramlink.

Restricted Access Lane 1	Bushey Road, beginning at Grand Drive, and terminating at Kingston Road.	The restricted lane would allow quicker service from the Kingston By-Pass into Wimbledon town centre, further promoting the park and ride services, since this road has been identified as a congested area.

6.7 Phasing

The recommendations that our project team proposed, suggested many changes to the bus network in the London Borough of Merton. Consequently, these ideas cannot all be implemented at the same time, and they must be planned in phases. Our recommendation is divided into four phases, which will span approximately ten years. A table of the phases is on page 99.

6.71 Phase 1

The first phase of changes will involve the modifications of the routes 200, and 118, which are currently in service. The modifications of these routes do not require extensive construction, additional planning, or large amounts of funding, therefore they should be considered first. These changes, though, would require information to be made available to the passengers so they can plan their journeys accordingly.

Phase 1 would also begin the research on exact sites for park and ride facilities. It is necessary to determine these locations and begin planning so the park and ride facilities can be constructed as soon as possible. The early construction of the park and ride facilities, combined with increased parking fares in town centres, will get car users out of their cars and on the buses sooner.

Exact roads for the express routes will also be determined during this phase, and any alteration to the roads must be planned. The ideal roads must be examined for space constraints, and any problem areas must be addressed. Routes must also be planned into industrial and residential areas.

6.72 Phase 2

Once phase 1 was complete, phase 2 would begin. Phase 2 would involve the construction of park and ride facilities at the determined locations, and the introduction of the restricted lane on Bushey Road, which would only allow access to buses and residents.

Planning of the express routes would continue, and the exact stops and frequencies would be determined. This would require the use of origin and destination studies. The additional routes into the industrial areas and residential areas would also be added.

6.73 Phase 3

Phase 3 would begin with the opening and promotion of park and ride services. The promotion of the park and ride services would involve an increase in parking prices, so that it would be cheaper to use these facilities than parking in the town centres. Bus priority measures would also be installed on the express routes, and the express routes would begin service.

6.74 Phase 4

Once all of our recommendations are in place, the final phase would be to purchase new environmentally friendly buses. These environmentally friendly buses would decrease the emissions produced from the additional buses.

Table 6.2 **Phasing**

Phase	Changes
Phase 1	Modification of Routes 118 and 200. Locate exact park and ride facilities. Determine exact roads for express routes. Determine routes into industrial and residential areas.
Phase 2	Construction of park and ride facilities. Begin restricted road. Determine locations and frequencies of stops for express routes. Add routes into industrial and residential areas.
Phase 3	Begin opening and promotion of park and ride services. Bus priority measures installed on express routes. Begin express routes.
Phase 4	Purchase environmentally friendly buses.

7.0 Conclusions

The goal of our project was to recommend improvements to the bus network in Merton based on our research of existing bus networks, demographics, and interviews. We feel that our recommendations should make the Merton bus network a more viable option for individuals to use for daily travel. Our proposal highlighted areas in Merton where we feel that bus services are lacking, as well as measures that can be implemented to address some of the problems associated with Merton's bus services.

Costs are always an issue when recommending improvements, but we feel many of our suggestions will pay for themselves. In areas where bus priority measures, such as red routes and bus priority lanes have been implemented, London Transport has seen a drastic decrease in travel times, and increase in service frequency. Two examples of this are bus route 220, and the area of Shepherd's Bush.

Bus route 220, which runs from northwest London to southwest London has shown a 15-16 percent increase in service frequency because of the implementation of bus priority measures. Ridership on that route has increased by 21 percent because of the increase in bus frequency. Attitude surveys in the areas have also shown that 2 percent of passengers on services where this bus runs were more likely to use the bus, when compared to last year. Five percent of individuals were also less likely to stop using the bus. These results are a representative example of what can happen as a result of implementing some of our suggestions.

Areas in London such as Shepherd's Bush where similar bus priority measures were implemented have seen bus journey times reduced by 27-48 percent during weekday peak hours and a 33-49 percent reduction during Saturday peak periods.

Shepherd's Bush also illustrates how bus priority measures, in the end, pay for themselves. Implementation of the schemes at Shepherd's Bush cost £326,000, but the schemes save £400,000 a year. This saving is a result of 100,000 person-hour savings per year of the employees (Bus Advance Areas, 1996). These person hour savings result in reduced maintenance time and cost from the reduced wear and tear on the vehicles. This is not to say that all of our recommendations will have results on the same level as Shepherd's Bush, but studies have shown that the implementation of bus priority in most areas have been beneficial to buses. By themselves, many of our recommendations could be implemented within a year, and the resultant beneficial effects would be realized quickly. The phasing section of our paper proposes a time scheme for implementation of many of our proposals. Due to policies in place at London Transport, an accurate cost estimate for our recommendations could not be obtained.

Some possible implementation schemes on our proposed additions would include the extension of existing routes, possible using an alternating pattern. Another possibility would be the use of an entirely new route to serve these additional areas. Finally the use of a shuttle route could be used to the industrial areas to provide service since there would be little demand during off peak hours.

Our recommendations to the bus network in Merton could provide a reduction in the amount of private vehicle traffic on the roads in Merton. The installation of express routes for all of London would cause a ten-percent increase in bus use, therefore a ten percent increase could also be seen in Merton following the installation of our recommended express routes. Through our interviews with transportation officials and engineers, we learned that our team would not be able to determine the amount of traffic

reduction that our recommendations would cause. This is due to the fact that there is no way to determine whether or not our additional routes will be utilized, or who will be using the park and ride facilities. Ideally, the park and ride services will be used by commuters into the borough, but they could also be used by commuters who drive through the borough to get on an Underground train. Origin and destination studies of car users would need to be conducted to determine the potential traffic decreases due to the park and ride facilities.

When we recommended changes to the bus network, we tried to stay within the goals of our project. Our data showed that there were many problem with bus service that should be addressed. Since we did not feel our recommendation could adequately address many of these problems, we recommended more research be done in those areas. These areas include the lack of information provided at bus stops and environmentally unfriendly buses. The Countdown System is one way in which passengers can obtain real time information concerning when the bus will arrive. The Countdown System is a device that provides actual timing of buses on a digitized screen. An example of the Countdown System is seen on the London Underground. Cleaner buses with friendlier drivers would also improve the overall perception of the buses.

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Appendix A

Ridership Data

St. Heliers Avenue

Route	Average Occupancy	Frequency	Total Trips	Total Passengers	Buses Per Hour	Passengers Per Hour
157	17	10 min	66	858		
164	13	10min	16	91	18 Buses Per Hour	
420	7	30min	66	1122	230 People Per Hour	
80	9	15min	44	396		

London Road (North of Mitcham)

Route	Average Occupancy	Frequency	Total Trips	Total Passengers	Buses Per Hour	Passengers Per Hour
264	18	10min	66	1188		
270	16	10min	66	1056	23 Buses Per Hour	
280	13	10min	66	858	342 People Per Hour	
355	12	12min	55	660		

Kingston Road

Route	Average Occupancy	Frequency	Total Trips	Total Passengers	Buses Per Hour	Passengers Per Hour
152	16	15min	44	440		
163	9	10min	66	594	12 Buses Per Hour	
420	7	30min	13	91	90 People Per Hour	

London Road connecting to Epsom Road

Route	Average Occupancy	Frequency	Total Trips	Total Passengers	Buses Per Hour	Passengers Per Hour
80	9	15min	44	396		
93	15	8min	8205	1237.5	19.5 Buses Per Hour	
154	17	10min	66	1122	272.5 People Per Hour	
293	11	30min	22	242		

Bishopsford Road connecting to London Road

Route	Average Occupancy	Frequency	Total Trips	Total Passengers	Buses Per Hour	Passengers Per Hour
117	16	12min	55	880		
280	13	10min	66	858	11Buses Per Hour	
N44	4	60min	6	24	158 People Per Hour	

Appendix B

Census Information

					Merton Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	5860	4994	4341	11342	15955	11948	8874	7508	5932	3443	648
Female	5562	4605	4079	11650	16339	12066	9075	8094	7699	6212	2244

	Total	Male	Female
# People economically active	86810	48910	37900
# People economically inactive	48880	14870	34010

	No Car
All Households	23660
Households with Children	3557

					Abbey Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	331	184	150	493	1233	606	344	375	275	166	39
Female	297	162	152	670	1214	581	389	360	395	348	11

	Total	Male	Female
# People economically active	4960	2830	2130
# People economically inactive	2390	750	1640

	No Car
All Households	1834
Households with Children	267

					Cannon Hill Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	234	261	263	632	569	636	518	516	366	185	47
Female	224	252	242	516	545	679	534	521	397	389	123

	Total	Male	Female
# People economically active	4510	2540	1970
# People economically inactive	2680	830	1850

	No Car
All Households	881
Households with Children	84

					Colliers Wood Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	383	271	204	762	1518	710	454	322	193	117	27
Female	335	216	174	906	1436	643	430	313	230	217	72

	Total	Male	Female
# People economically active	4510	2540	1970
# People economically inactive	2680	830	1850

	No Car
All Households	881
Households with Children	84

					Dundonald Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	265	176	171	503	951	647	360	302	253	150	24
Female	206	161	147	524	983	594	397	307	343	279	86

	Total	Male	Female
# People economically active	4570	2400	2170
# People economically inactive	2230	780	1450

	No Car
All Households	1254
Households with Children	117

					Durnsford Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	208	132	120	374	608	459	301	209	146	108	17
Female	194	143	108	370	644	406	307	225	227	169	49

	Total	Male	Female
# People economically active	2990	1580	1410
# People economically inactive	1490	470	1020

	No Car
All Households	734
Households with Children	72

					Figges Marsh Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	427	312	273	772	902	663	536	424	319	186	26
Female	405	303	279	743	949	666	545	470	378	273	87

	Total	Male	Female
# People economically active	4840	2810	2030
# People economically inactive	2440	790	1650

	No Car
All Households	1316
Households with Children	2821

					Graveney Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	182	160	137	513	648	379	321	223	158	80	8
Female	170	147	153	411	567	404	289	238	182	138	27

	Total	Male	Female
# People economically active	2990	1560	1430
# People economically inactive	1960	760	1200

	No Car
All Households	807
Households with Children	139

					Hillside Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	237	196	190	553	1005	708	436	340	269	211	47
Female	266	200	180	563	1071	649	452	406	491	462	175

	Total	Male	Female
# People economically active	4350	2540	1810
# People economically inactive	3140	860	2280

	No Car
All Households	1509
Households with Children	67

					Lavender Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	226	200	217	436	482	315	294	254	183	81	27
Female	209	222	169	471	543	375	295	290	245	181	69

	Total	Male	Female
# People economically active	2740	1490	1250
# People economically inactive	1660	480	1180

	No Car
All Households	999
Households with Children	233

					Longthornton Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	328	319	274	637	761	667	577	455	360	183	41
Female	365	302	233	632	826	686	609	495	438	276	86

	Total	Male	Female
# People economically active	5210	2850	2360
# People economically inactive	2390	760	1630

	No Car
All Households	1032
Households with Children	181

					Lower Morden Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	274	280	232	511	680	655	513	409	333	260	19
Female	267	256	243	478	679	647	505	428	451	385	84

	Total	Male	Female
# People economically active	4520	2710	1810
# People economically inactive	2530	800	1730

	No Car
All Households	791
Households with Children	73

					Merton Park Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	239	341	260	439	716	650	513	394	308	156	49
Female	238	192	241	595	698	690	528	417	373	324	135

	Total	Male	Female
# People economically active	4190	2340	1850
# People economically inactive	2730	820	1910

	No Car
All Households	966
Households with Children	87

					Phipps Bridge Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	421	338	275	655	988	704	474	453	361	221	43
Female	448	364	292	743	1056	695	459	476	479	366	133

	Total	Male	Female
# People economically active	5270	2990	2280
# People economically inactive	2840	750	2090

	No Car
All Households	1854
Households with Children	428

					Pollards Hill Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	440	340	291	658	680	557	450	406	246	144	22
Female	434	327	229	652	790	553	489	396	328	253	73

	Total	Male	Female
# People economically active	4150	2330	1820
# People economically inactive	2270	530	1740

	No Car
All Households	1083
Households with Children	336

					Ravensbury Ward						
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	276	270	204	509	6472	485	431	491	445	223	38
Female	250	204	176	516	632	491	453	544	531	377	144

	Total	Male	Female
# People economically active	3940	2330	1610
# People economically inactive	2980	960	2020

	No Car
All Households	1365
Households with Children	84

Raynes Park Ward											
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	329	272	228	619	750	685	563	387	360	226	39
Female	303	260	695	797	759	759	580	446	502	423	186

	Total	Male	Female
# People economically active	4990	2810	2180
# People economically inactive	3330	1100	2160

	No Car
All Households	1134
Households with Children	97

St. Helier Ward											
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	236	264	178	446	587	502	411	466	480	234	37
Female	219	213	185	391	616	484	433	552	584	431	172

	Total	Male	Female
# People economically active	3910	2290	1620
# People economically inactive	3000	850	2150

	No Car
All Households	1545
Households with Children	202

Trinity Ward											
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	273	204	133	489	938	571	350	287	209	143	26
Female	211	162	145	547	949	623	323	211	328	241	92

	Total	Male	Female
# People economically active	4570	2480	2090
# People economically inactive	1800	520	1280

	No Car
All Households	1287
Households with Children	128

Village Ward											
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	236	284	273	545	532	629	552	389	320	190	49
Female	220	255	236	636	590	694	551	428	380	367	197

	Total	Male	Female
# People economically active	3800	2290	1510
# People economically inactive	3130	900	2230

	No Car
All Households	660
Households with Children	44

					West Barnes Ward					
Gender	0 - 4	5 -- 9	10 -- 14	15 -- 24	25 --34	35 -- 44	45 -- 54	55 -- 64	65 -- 74	75 -- 84	85 +
Male	313	2910	264	637	766	721	489	409	352	181	34
Female	301	270	255	583	756	741	502	466	418	328	134

	Total	Male	Female
# People economically active	4630	2690	1940
# People economically inactive	2650	790	1860

	No Car
All Households	927
Households with Children	104

Appendix C

Existing Bus Network

BUS ROUTES IN THE LONDON BOROUGH OF MERTON

ROUTE NO.	TERMINAL POINTS
57	Streatham Hill - Kingston
60	South Croydon garage - Clapham Common
80	Banstead/Belmont - Morden Station
93	North Cheam - Putney Bridge Station
118	Morden station - Streatham Hill Brixton Station
127	Tooting Broadway - Purley Cross
131	Wimbledon Station - West Molesey - Weybridge
152	New Malden - Pollards Hill
154	Morden Station - West Croydon
155	Wimbledon Station - Stockwell
156	Wimbledon Station - Clapham Junction
157	Morden Station - Crystal Palace
163	Morden Station - Wimbledon Station
164	Sutton Station - Wimbledon Station
200	Raynes Park - Streatham Hill
219	Collier's Wood - Battersea
264	Tooting Broadway - South Croydon Garage
265	Tolworth - Putney Bridge Station
270	Mitcham, "Cricketers" - Putney Bridge Station
280	Tooting, St. George's Hospital - Belmont Station
293	Merton Abbey - Epsom

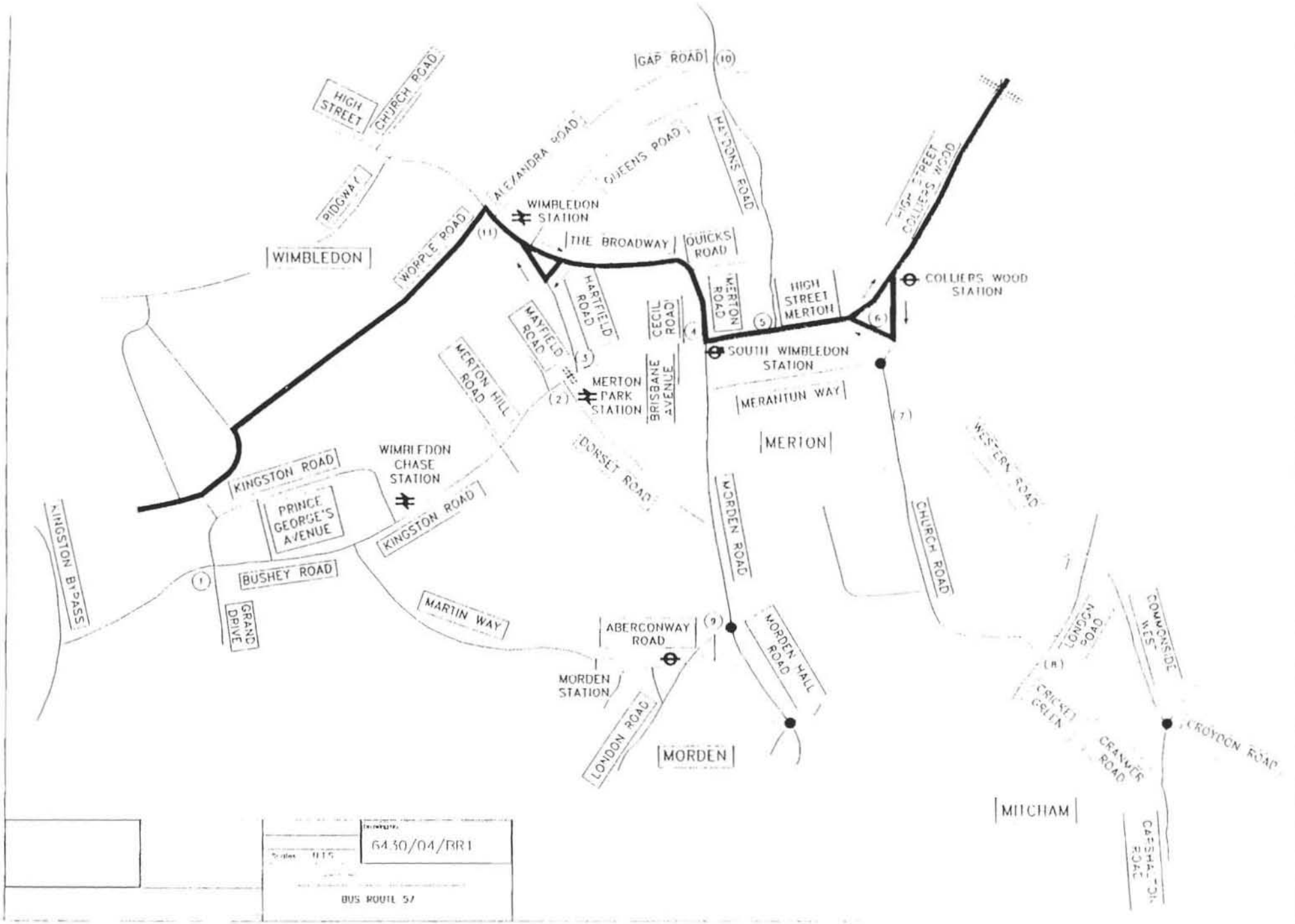
355 Mitcham, "Cricketers" - Elephant and Castle

393 Hackbridge - Morden Station

413 Lower Morden - Belmont Station

420 Raynes Park - Horley

422 Raynes Park - Redhill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QUEENS ROAD
HAYDONS ROAD
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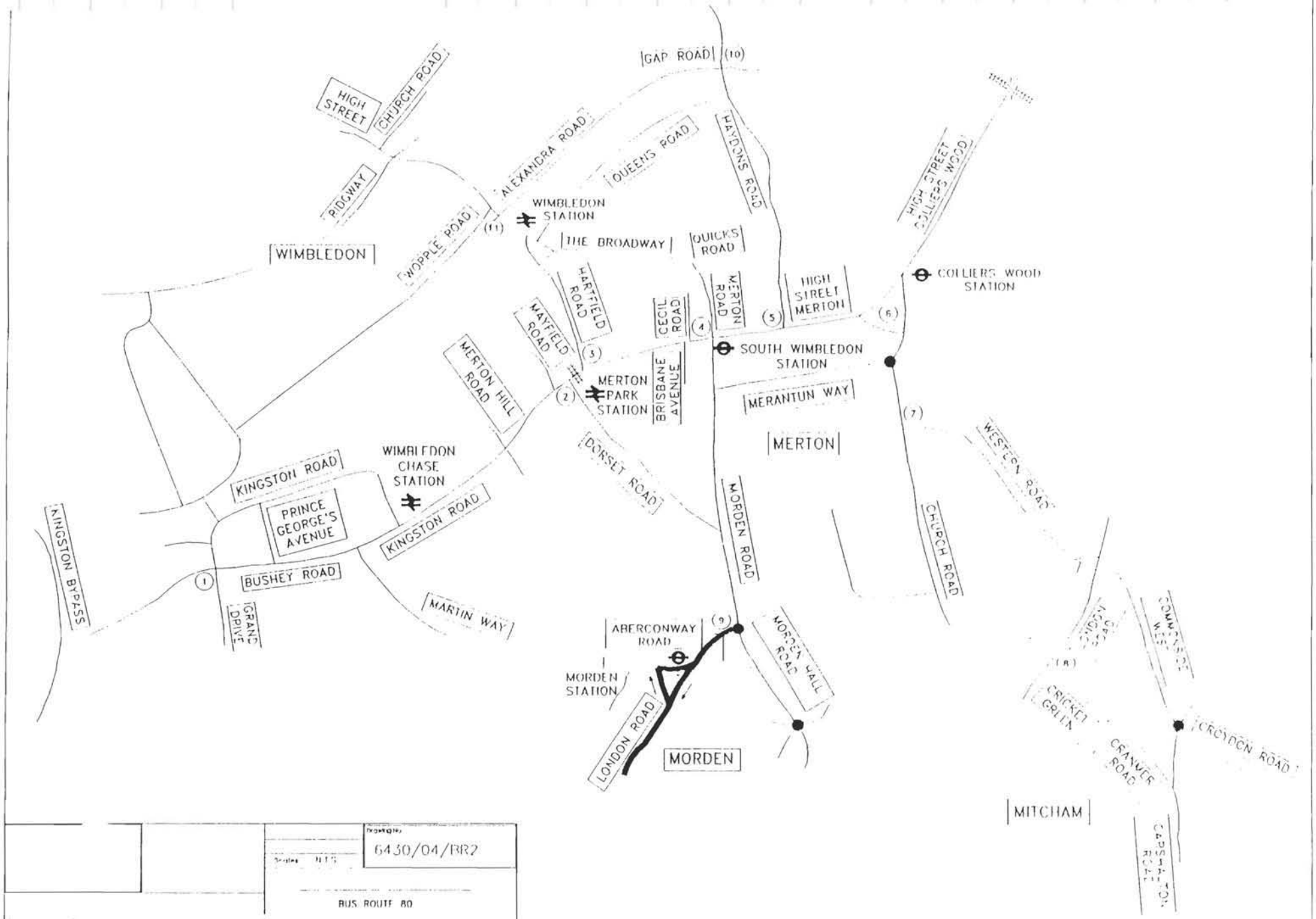
WIMBLEDON
WORPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
DORSET ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
MORDEN ROAD
CHURCH ROAD
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
(8)
CRICKET GREEN
CROYDON ROAD
CRANMER ROAD
MITCHAM
CARSHALTON ROAD
64.30/04/BR1
BUS ROUTE 57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HAYDONS ROAD
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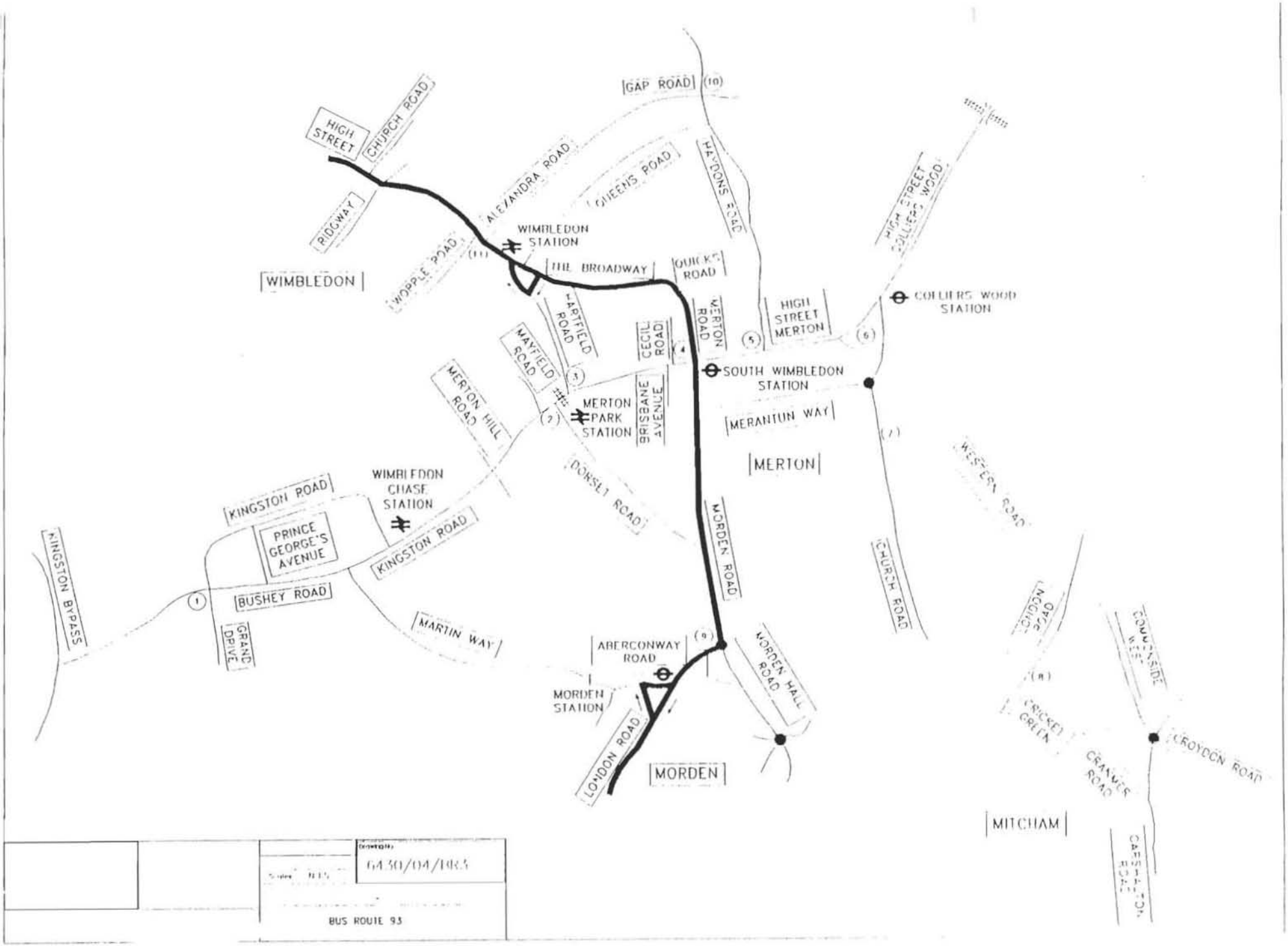
WIMBLEDON STATION
WOPPLE ROAD
(11)
WIMBLEDON
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(4)
(5)
(6)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
(3)
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
(7)
MERTON
WESTCOTT ROAD
DORSET ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL
MORDEN STATION
LONDON ROAD
MORDEN
(8)
CRICKET GREEN
CRANMER ROAD
CROYDON ROAD
MITCHAM
6430/04/BR2
BUS ROUTE 80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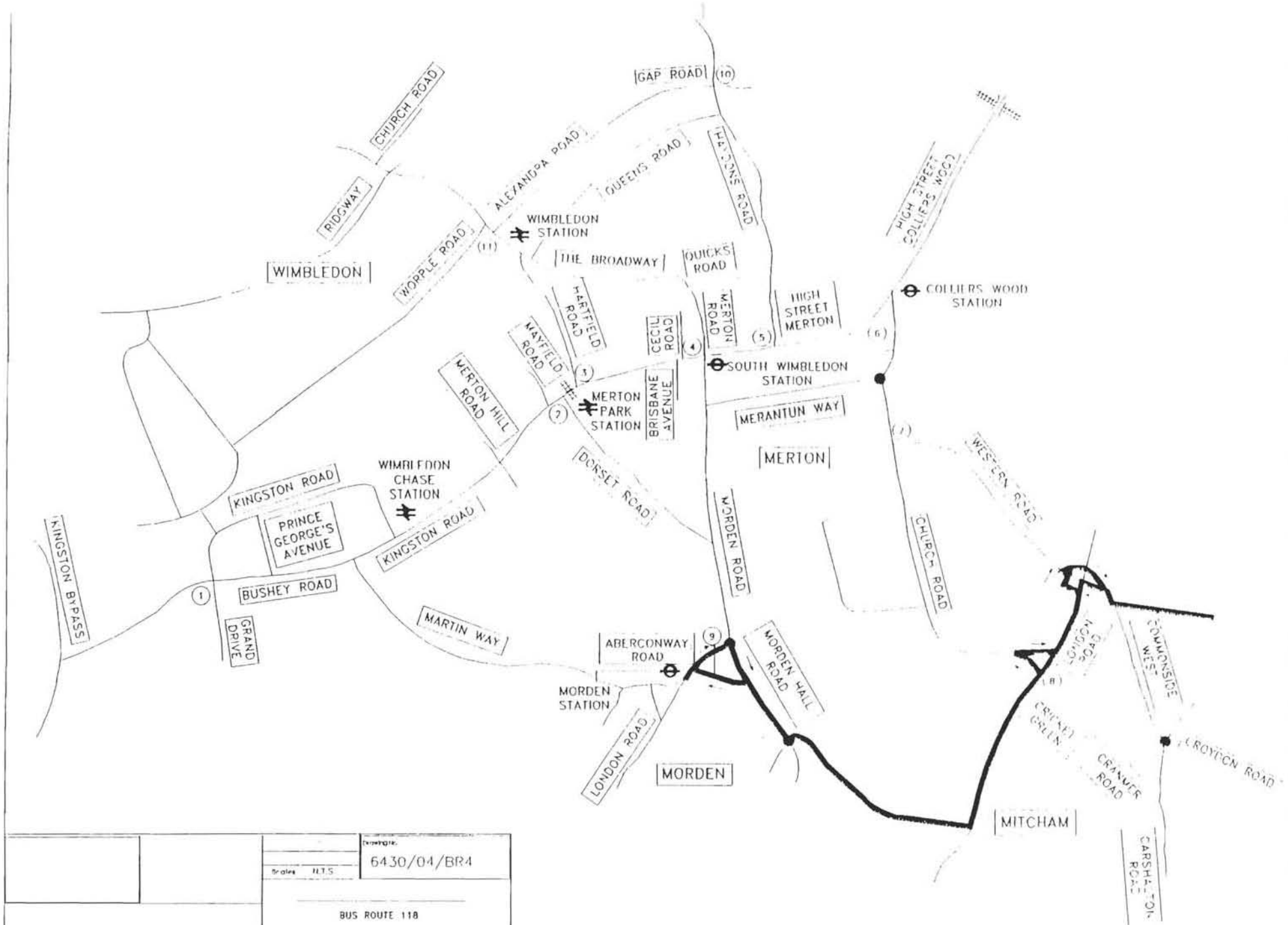
HIGH STREET
CHURCH ROAD
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
RIDGWAY
WIMBLEDON STATION
WIMBLEDON
WORPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
MAYFIELD ROAD
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
DORSET ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
MORDEN ROAD
CHURCH ROAD
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
BUSHEY ROAD
(1)
KINGSTON ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
LONDON ROAD
MORDEN STATION
MORDEN
CROYDON ROAD
(8)
CROOKED LANE
CRANMER ROAD
CROYDON ROAD
MITCHAM
CARSHALTON ROAD
64.30/04/1883
BUS ROUTE 93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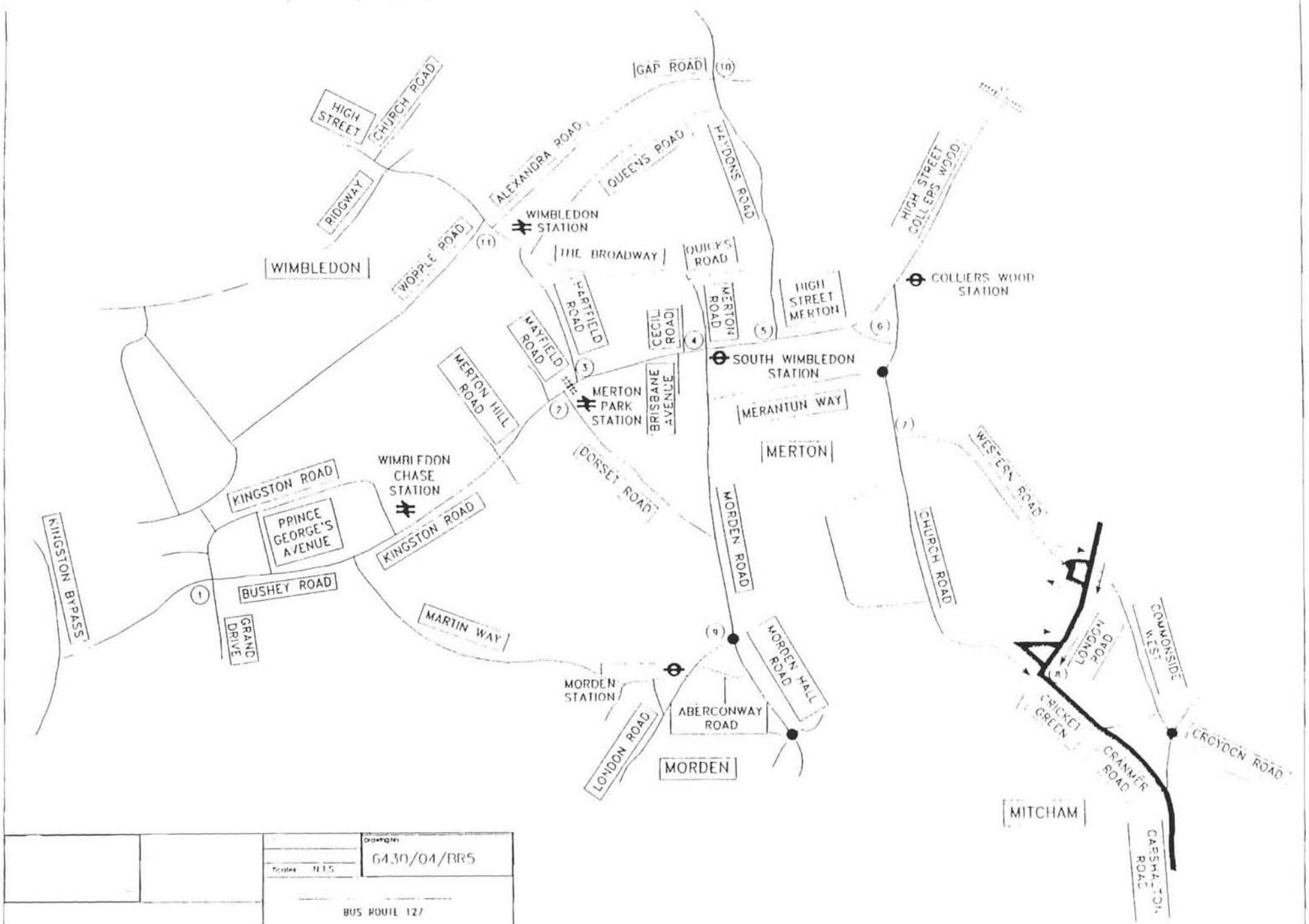
(10)
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
WIMBLEDON STATION
WIMBLEDON
WORPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(6)
(5)
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
(2)
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
DORSET ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
LONDON ROAD
COMMONSIDE WEST
(8)
MORDEN STATION
LONDON ROAD
MORDEN
CROYDON ROAD
CRANMER ROAD
MITCHAM
CARSHALTON ROAD
6430/04/BR4
Scales N.T.S.
BUS ROUTE 118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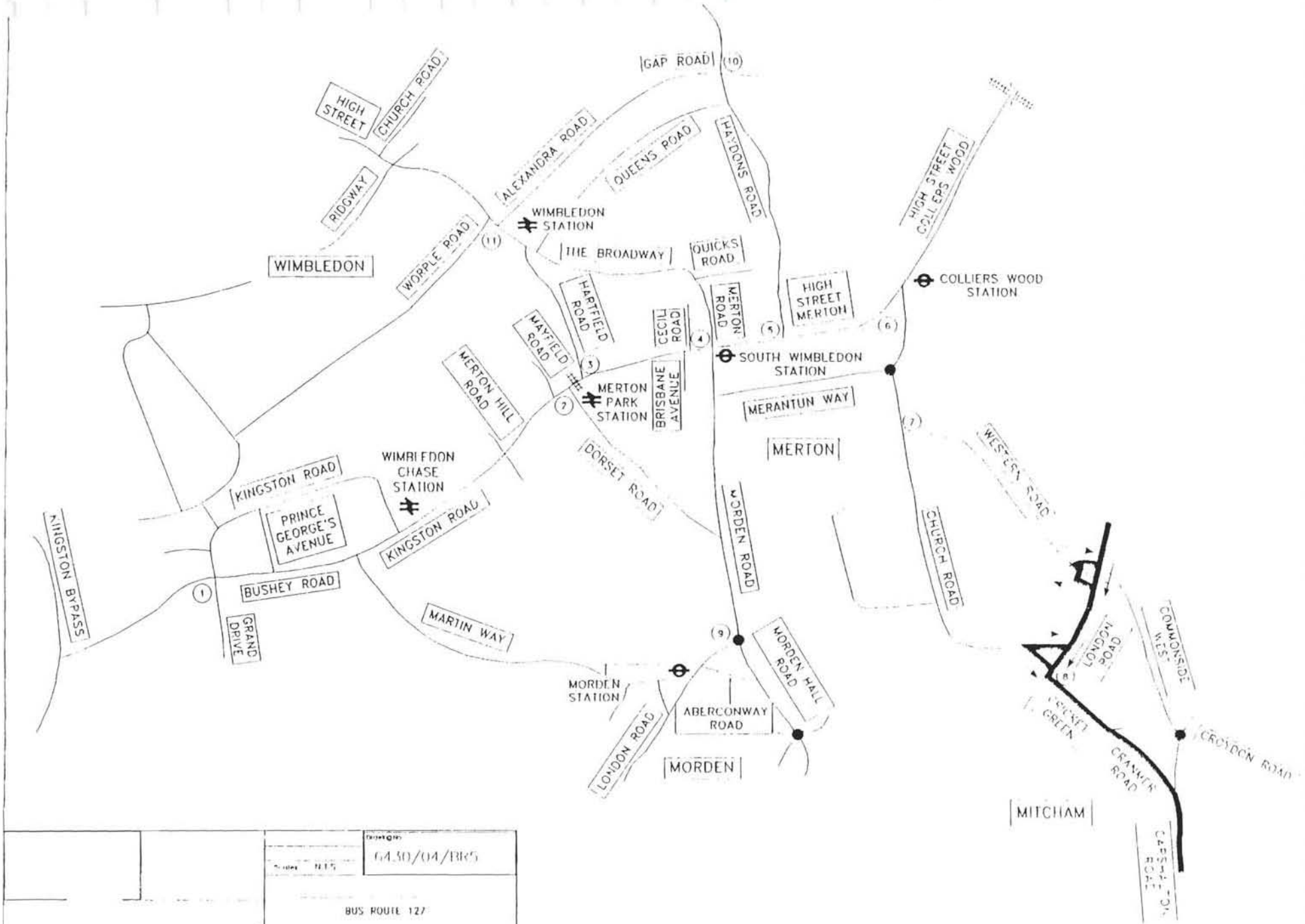
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
WIMBLEDON STATION
WOPPLE ROAD
(11)
WIMBLEDON
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLEYS WOOD
COLLIERS WOOD STATION
GARFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
MORDEN ROAD
CHURCH ROAD
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
KINGSTON ROAD
BUSHEY ROAD
(1)
GRAND DRIVE
MARTIN WAY
(9)
MORDEN HALL ROAD
MORDEN STATION
ABERCONWAY ROAD
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
(5)
CRICKET GREEN
CRANMER ROAD
CROYDON ROAD
MITCHAM
CARSHALTON ROAD
6430/04/BR5
Scales N.T.S.
BUS ROUTE 127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QUEENS ROAD
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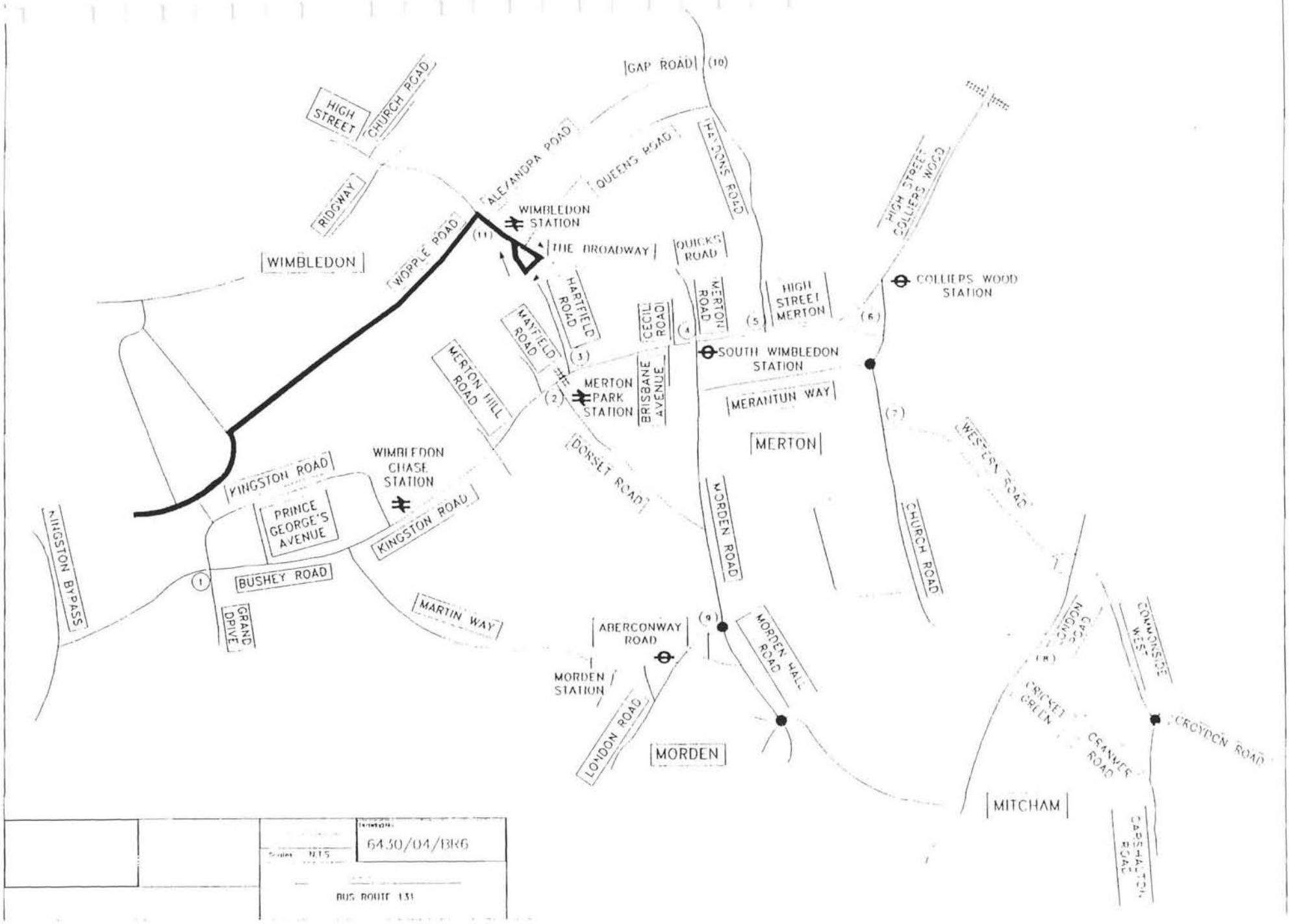
RIDGWAY
WIMBLEDON STATION
WIMBLEDON
WORPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(6)
(5)
(4)
MAYFIELD ROAD
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
(3)
MERTON PARK STATION
BRISBANE AVENUE
(2)
MERANTUN WAY
MERTON
(7)
WESTCOT ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
(9)
MORDEN HALL ROAD
MORDEN STATION
ABERCONWAY ROAD
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
(8)
CRANMER ROAD
CROYDON ROAD
MITCHAM
CARSHALTON ROAD
64.30/04/BR5
BUS ROUTE 127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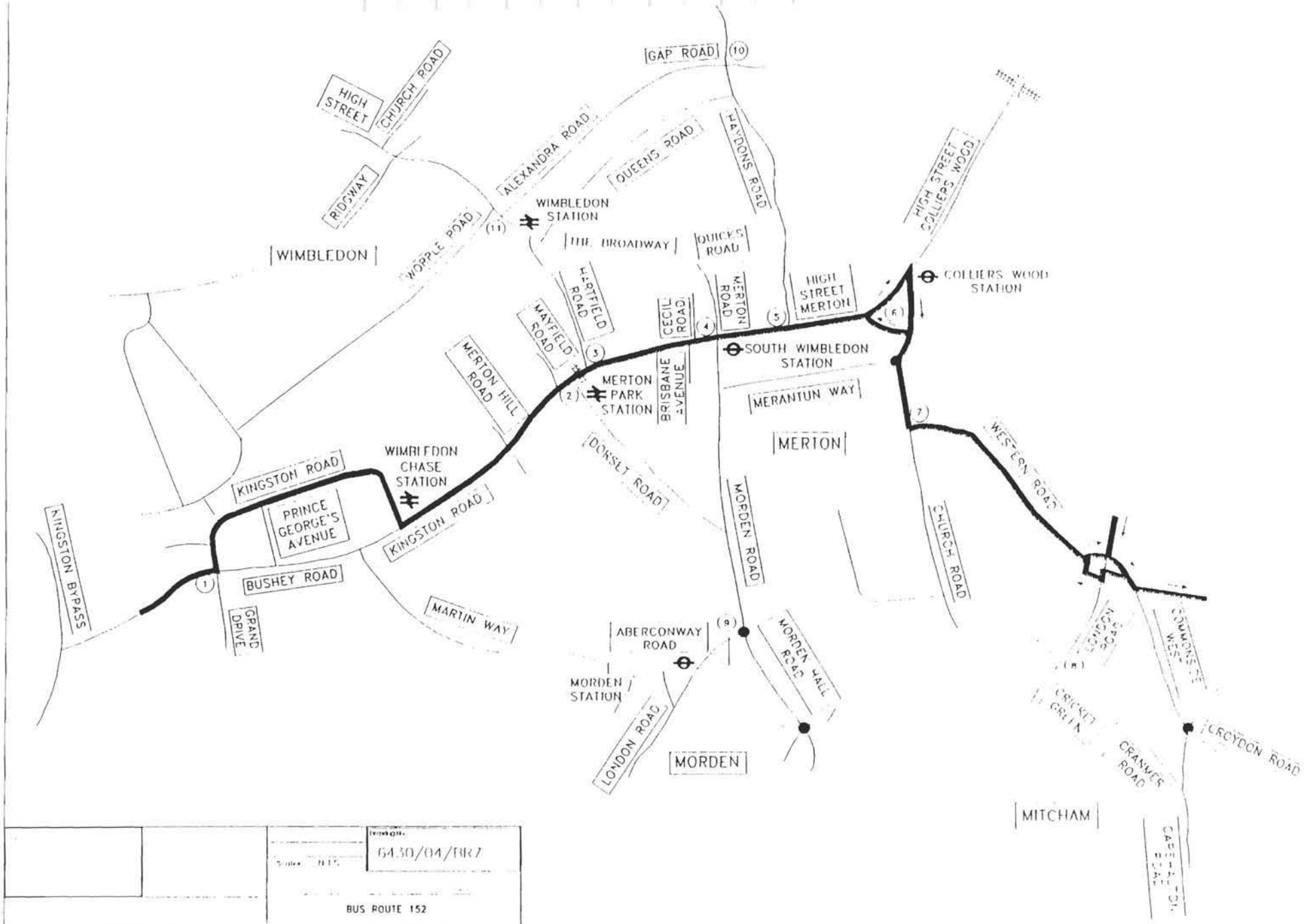
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
WIMBLEDON STATION
WORPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
WIMBLEDON
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
DORSET ROAD
MORDEN ROAD
CHURCH ROAD
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
KINGSTON ROAD
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
LONDON ROAD
(8)
COMMONSIDE WEST
MORDEN STATION
CRICKET GREEN
CROYDON ROAD
LONDON ROAD
MORDEN
CRANMER ROAD
MITCHAM
CARSHALTON ROAD
6430/04/BR6
BUS ROUTE 131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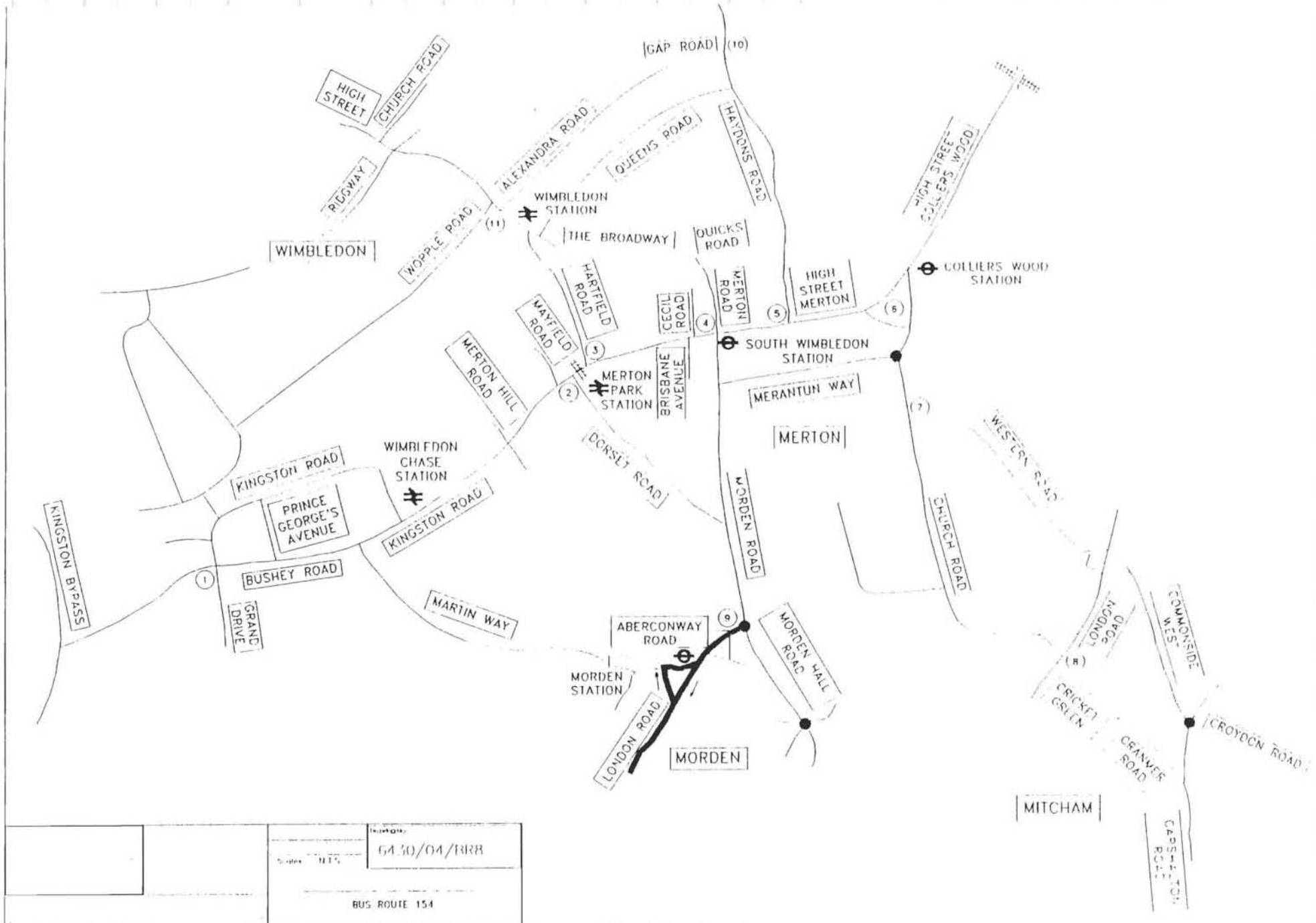
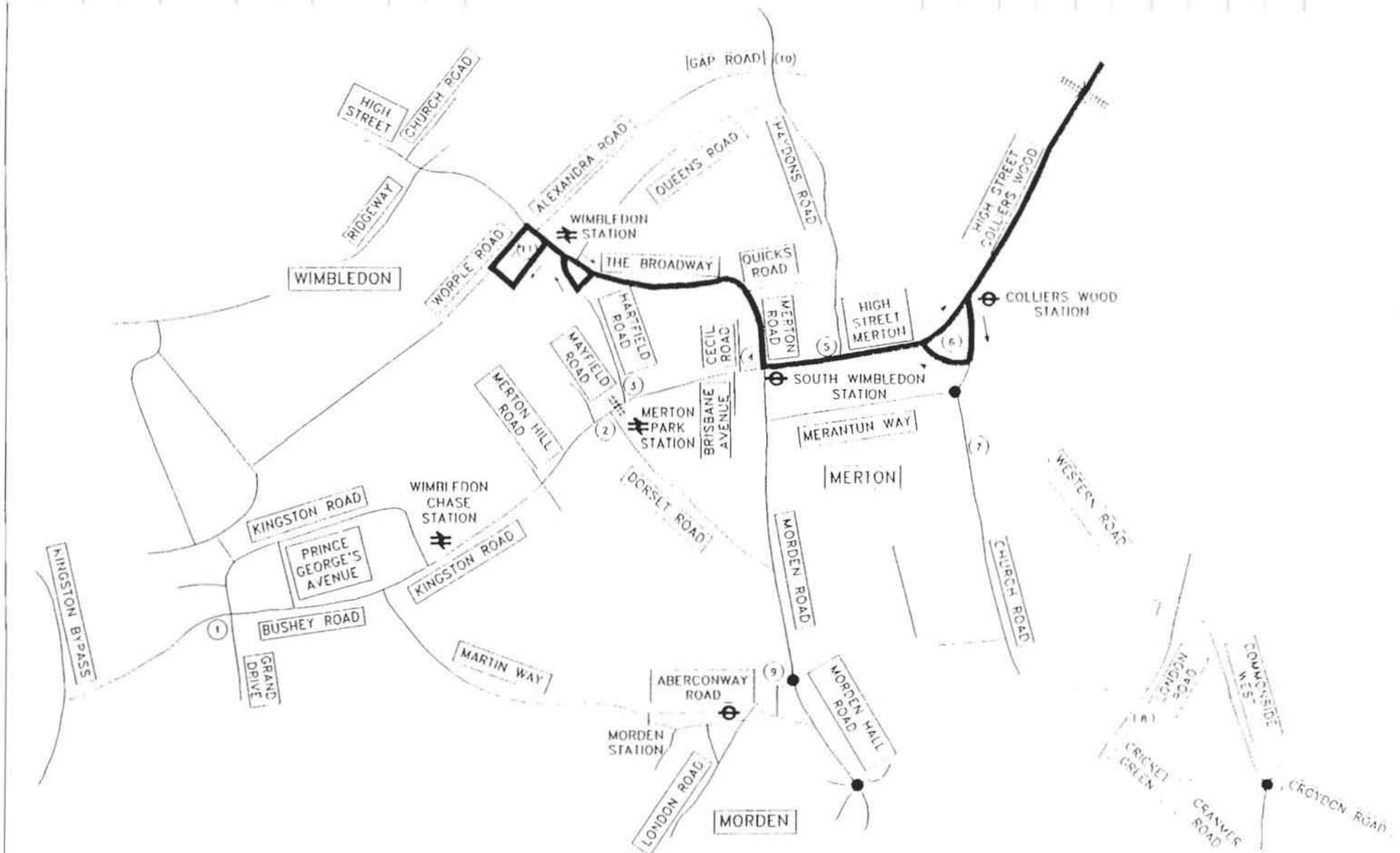
(10)
HIGH STREET
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
WIMBLEDON STATION
WIMBLEDON
WOPPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HIGH STREET MERTON
MERTON ROAD
CECIL ROAD
HARTFIELD ROAD
MAYFIELD ROAD
(6)
(5)
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
MORDEN ROAD
CHURCH ROAD
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
BUSHEY ROAD
(1)
KINGSTON ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN ROAD HALL
MORDEN STATION
LONDON ROAD
MORDEN
(8)
CROYDON ROAD
CRANMER ROAD
MITCHAM
64.30/04/BR7
BUS ROUTE 152


GAP ROAD
(10)
HIGH STREET
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
WIMBLEDON STATION
(11)
WIMBLEDON
NOPPLE ROAD
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
MAYFIELD ROAD
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
(7)
MERTON
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
MORDEN ROAD
CHURCH ROAD
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
LONDON ROAD
(8)
COMMONSIDE WEST
CRICKET GREEN
CRANMER ROAD
CROYDON ROAD
MORDEN STATION
LONDON ROAD
MORDEN
MITCHAM
CARSHALTON ROAD
64/30/04/BR8
BUS ROUTE 154



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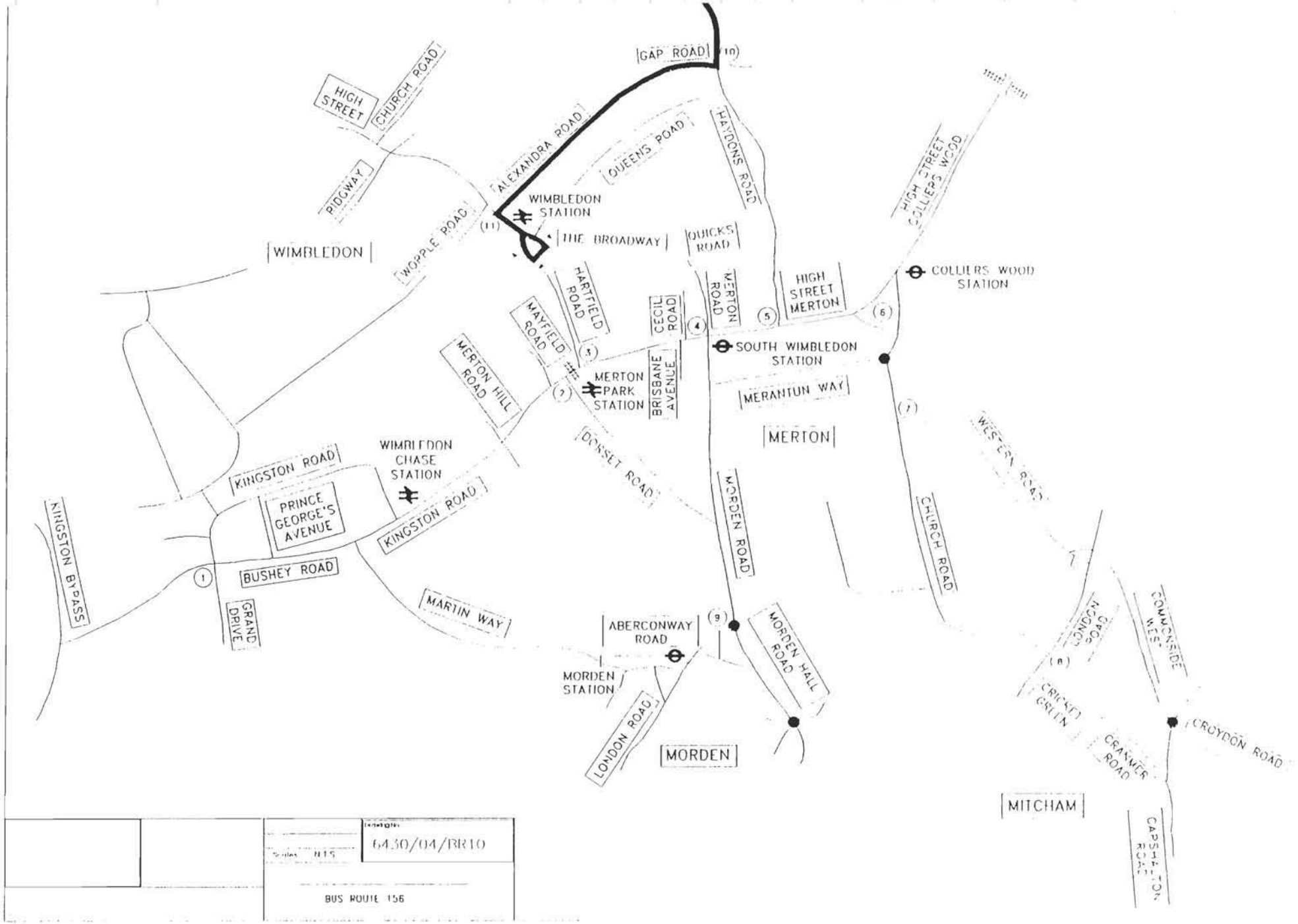
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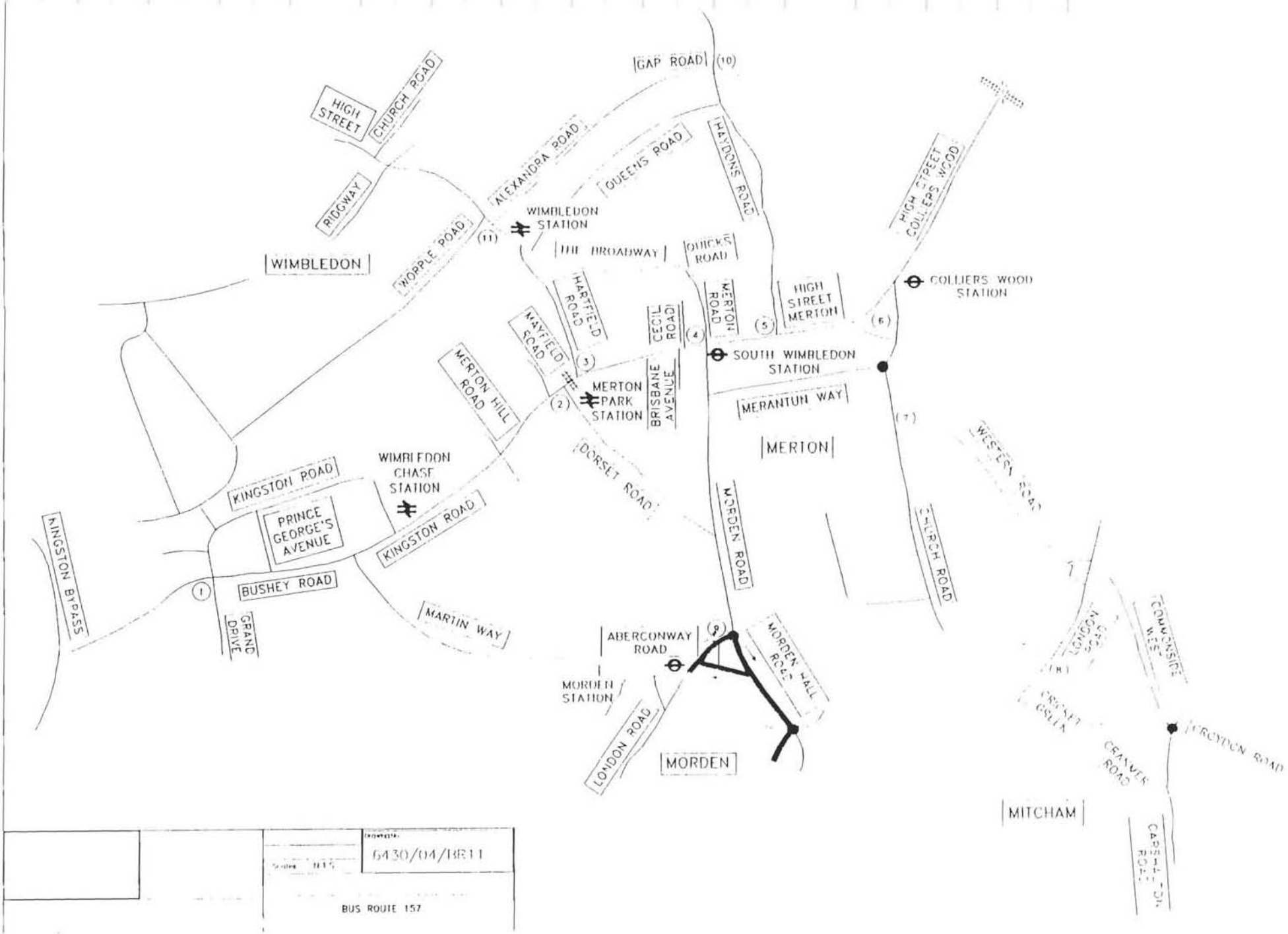
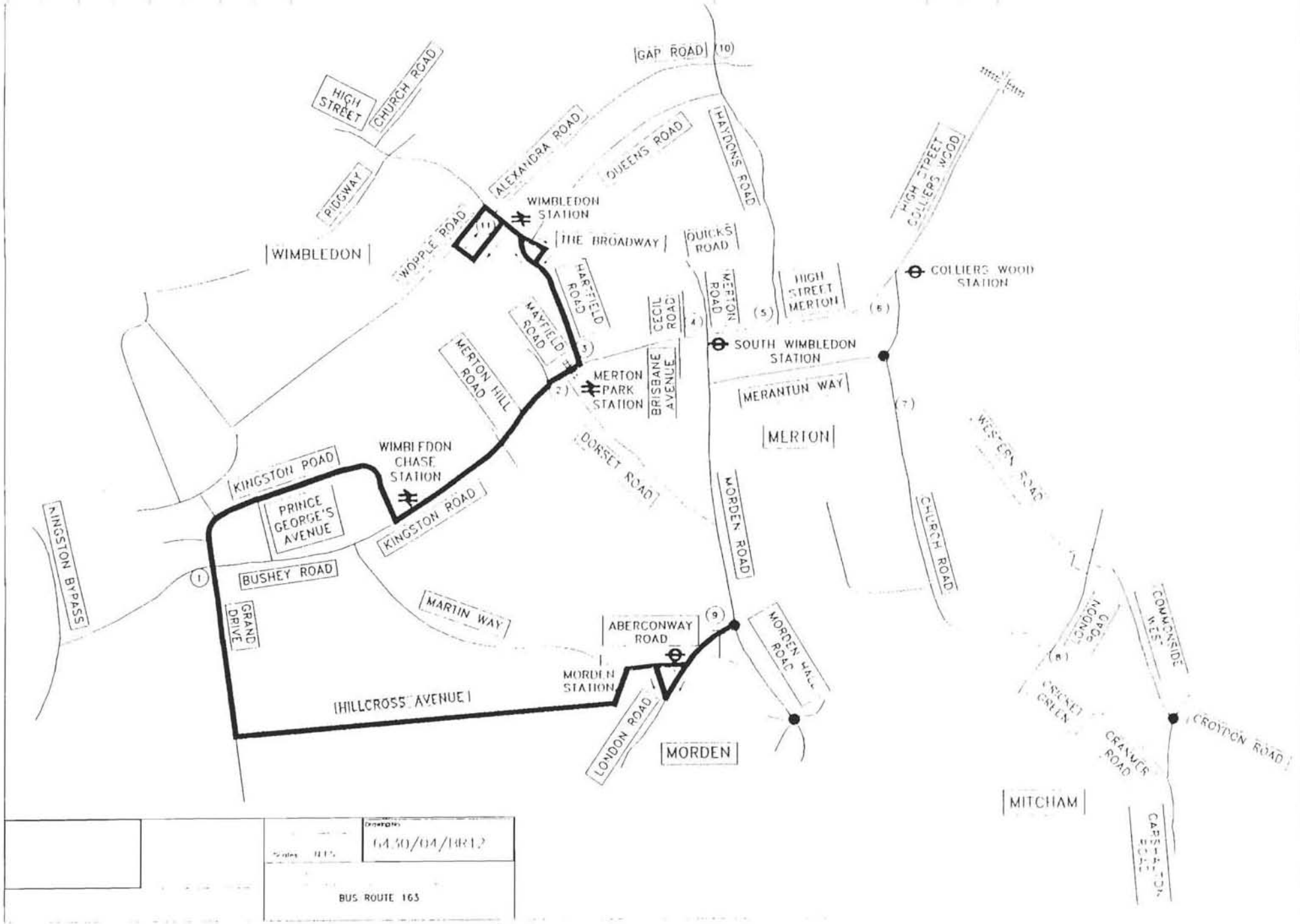
CHURCH ROAD
PIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
WIMBLEDON STATION
WIMBLEDON
WOPPLE ROAD
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
SOUTH WIMBLEDON STATION
MERTON ROAD HILL
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
DORSET ROAD
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
MORDEN ROAD
CHURCH ROAD
ABERCONWAY ROAD
MORDEN STATION
MORDEN HALL ROAD
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
CRICKET GREEN
CRANMER ROAD
CROYDON ROAD
MITCHAM
CAPSTATION ROAD
6430/04/BR10
BUS ROUTE 156



6430/04/BR11

BUS ROUTE 157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HIGH STREET
CHURCH ROAD
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
PIGGWAY
WIMBLEDON STATION
WIMBLEDON
WOPPLE ROAD
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
WESTCOTT ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
PRINCE GEORGE'S AVENUE
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
MORDEN HALL ROAD
LONDON ROAD
COMMONSIDE WEST
CROYDON ROAD
CRICKET GREEN
CRANMER ROAD
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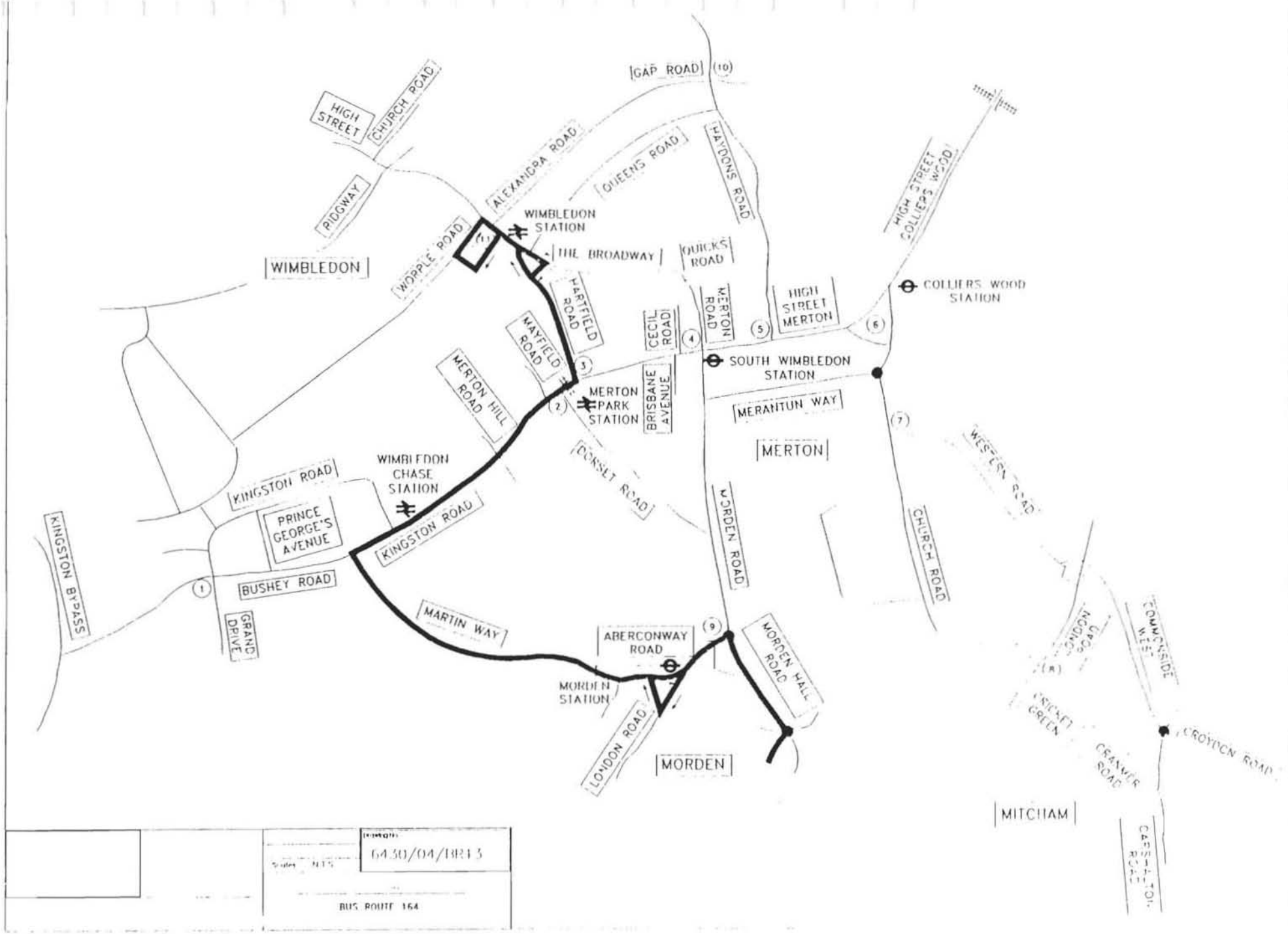
HILLCROSS AVENUE
MORDEN
MITCHAM
CARSHALTON ROAD
64.30/04/1812
BUS ROUTE 163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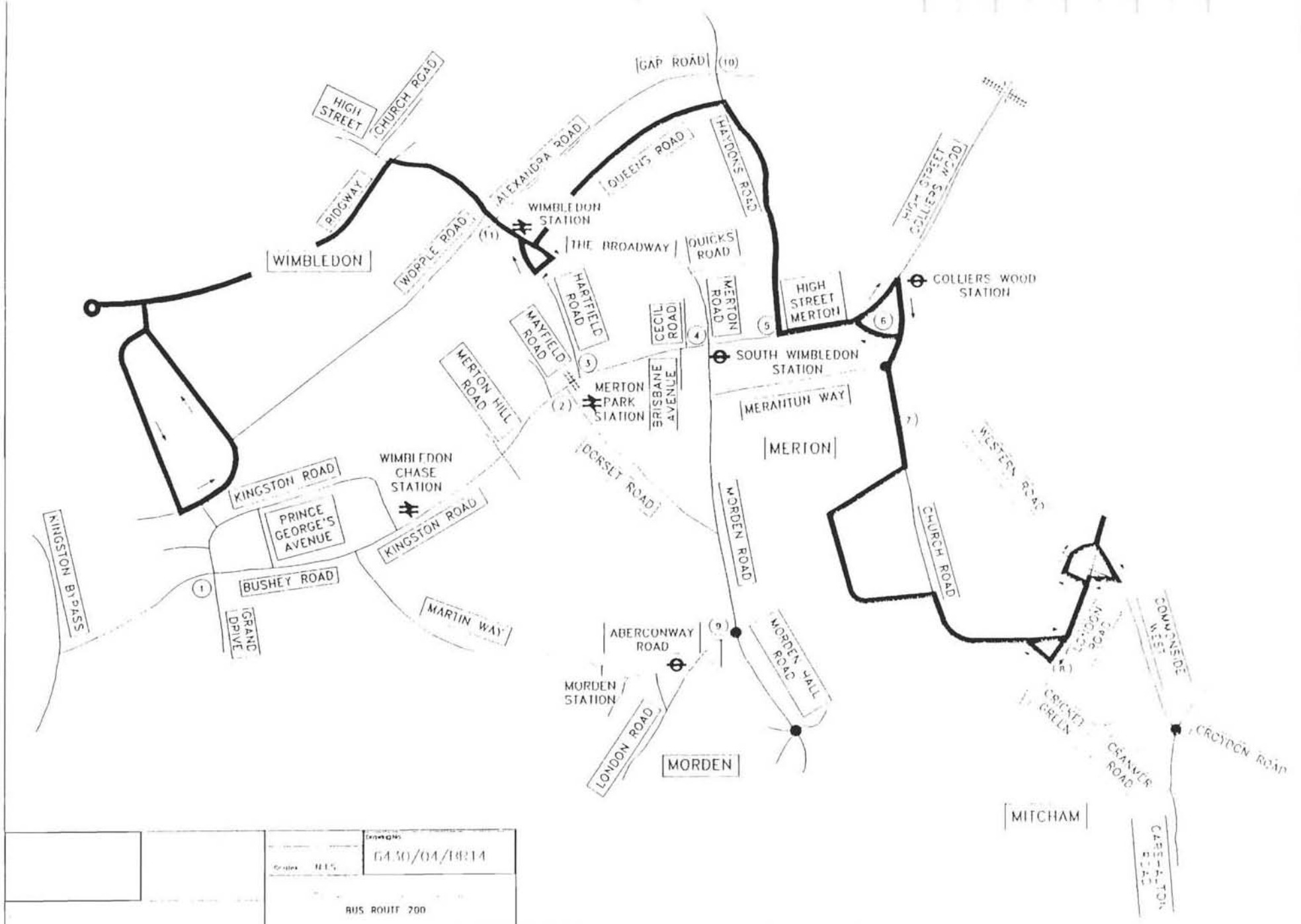
HIGH STREET
CHURCH ROAD
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
HIGH STREET COLLIERS WOOD
RIDGWAY
WIMBLEDON STATION
WIMBLEDON
WOPPLE ROAD
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
COOKSEY ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
PRINCE GEORGE'S AVENUE
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
MORDEN HALL ROAD
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
DOWNSIDE WEST
CROYDON ROAD
CRAMER ROAD
MITCHAM
CARSHALTON ROAD
6430/04/1813
BUS ROUTE 164



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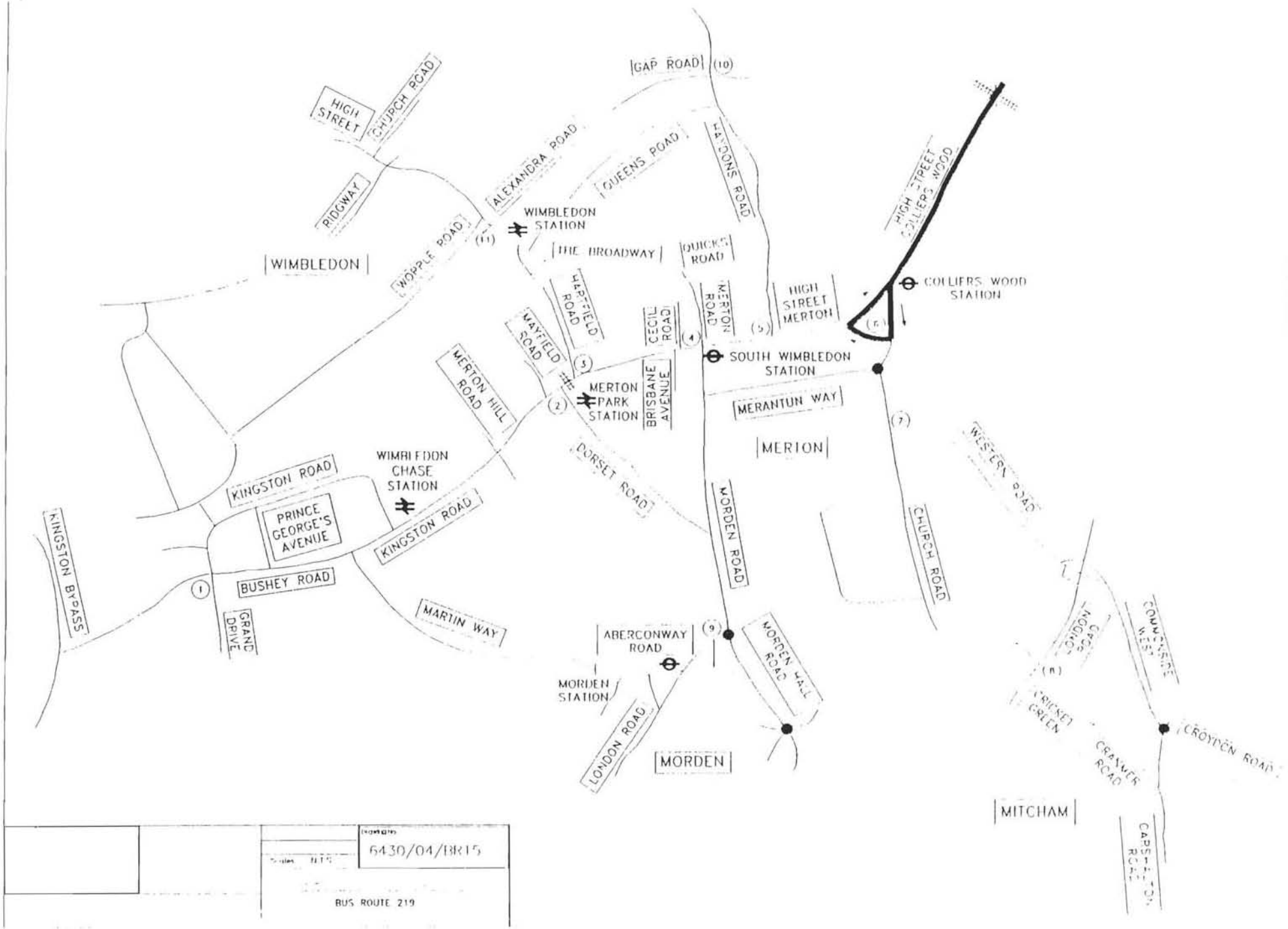
		Scales N.T.S.	
		BUS ROUTE 200	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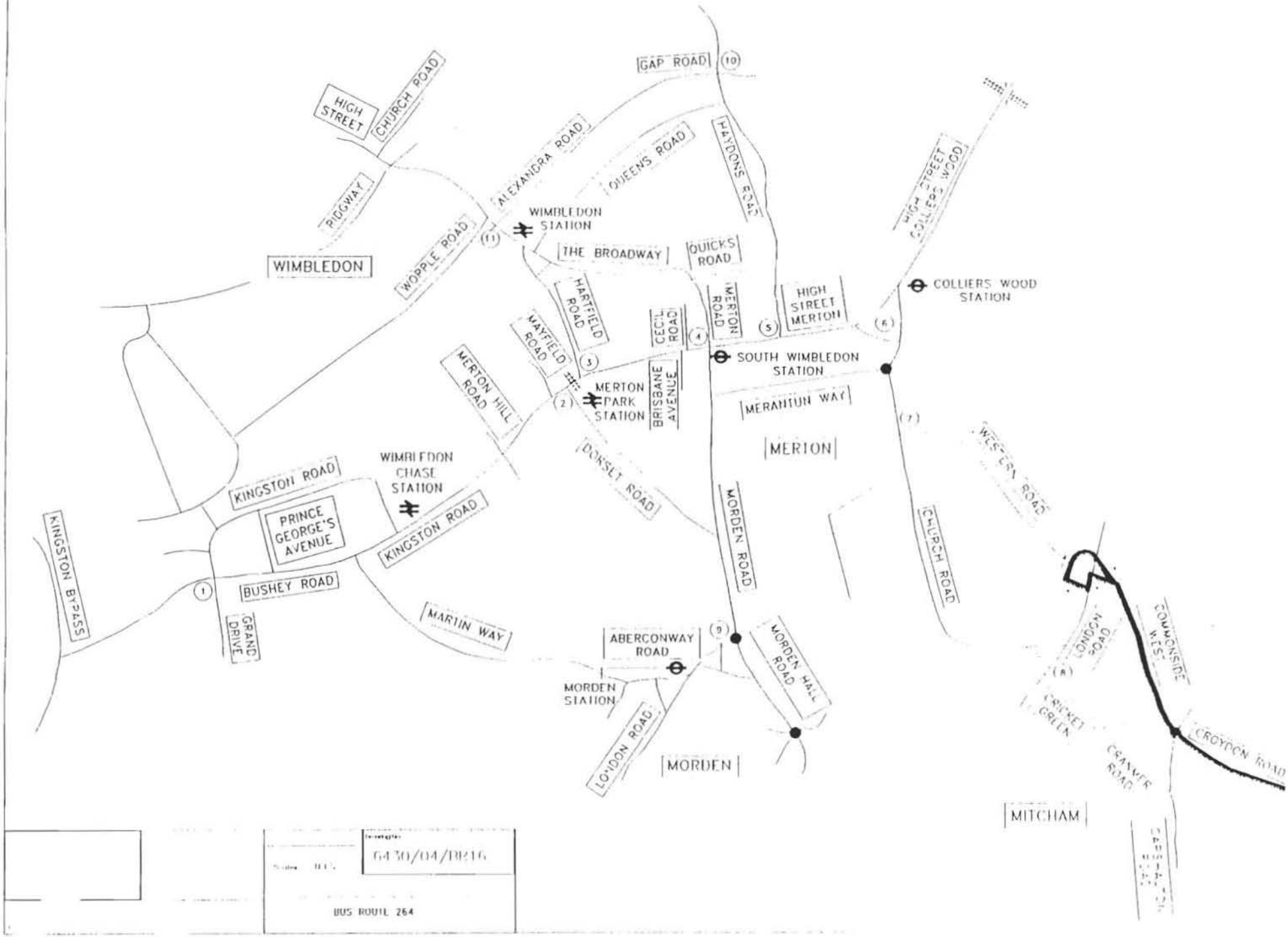
CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
LAYDONS ROAD
WIMBLEDON STATION
WIMBLEDON
COPPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
MAYFIELD ROAD
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL
MERTON PARK STATION
BRISBANE AVENUE
(2)
MERANTUN WAY
(7)
MERTON
WESTERN ROAD
DORSET ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN ROAD MALL
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
CONNAUGHT WEST
(8)
CRICKET GREEN
CROYDON ROAD
CRANMER ROAD
MITCHAM
CARSHALTON ROAD
6430/04/BR15
BUS ROUTE 219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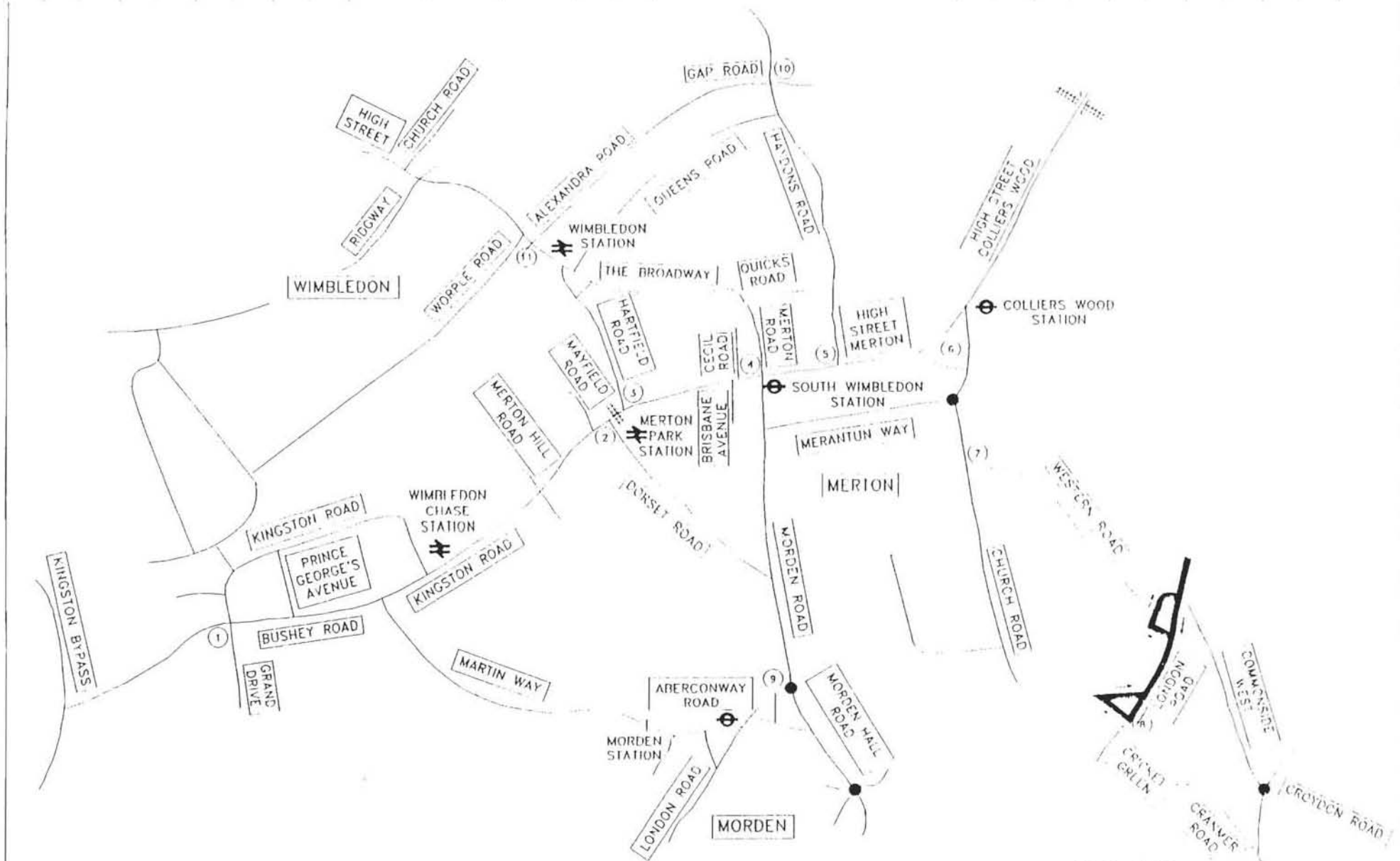
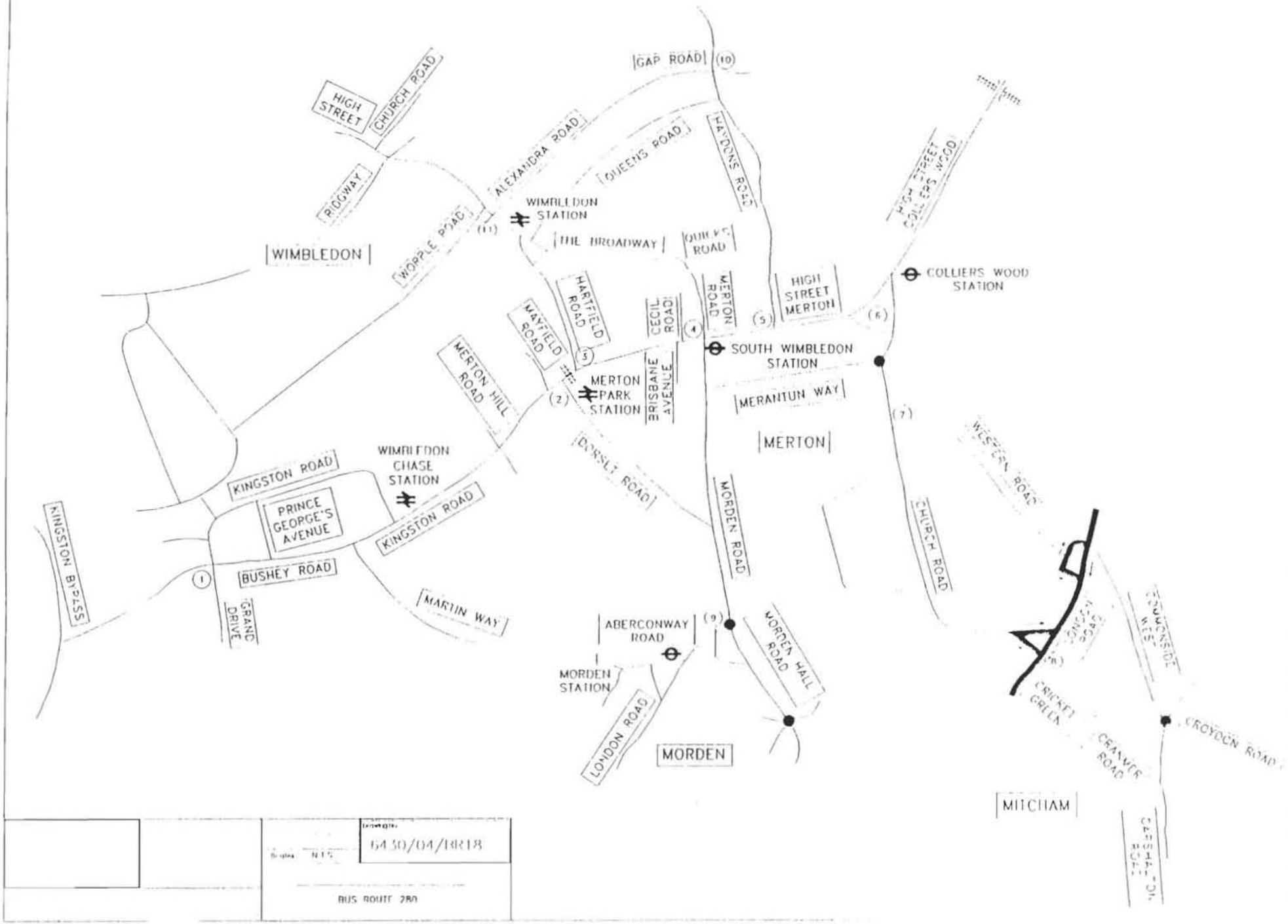
CHURCH ROAD
PIGGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
WIMBLEDON STATION
11
WIMBLEDON
WOPPLE ROAD
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
5
6
MAYFIELD ROAD
4
3
SOUTH WIMBLEDON STATION
MERTON HILL
MERTON PARK STATION
2
BRISBANE AVENUE
MERANTUN WAY
MERTON
7
WESTERN ROAD
DORSET ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
1
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
9
MORDEN ROAD
MORDEN HALL ROAD
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
8
COMMONSIDE WEST
CRICKET GREEN
CROYDON ROAD
CRANMER ROAD
MITCHAM
64 30/04/18216
BUS ROUTE 264


HIGH STREET
CHURCH ROAD
RIDGWAY
WORPLE ROAD
WIMBLEDON
ALEXANDRA ROAD
GAP ROAD
(10)
QUEENS ROAD
HAYDONS ROAD
WIMBLEDON STATION
(11)
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(4)
(5)
(6)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
(3)
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTCOTT ROAD
DORSET ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
KINGSTON BYPASS
MORDEN ROAD
CHURCH ROAD
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
(8)
CROYDON ROAD
CRAMNER ROAD
CAPSHALTON ROAD
MITCHAM
64.30/04/BR17
Scale N.T.S
BUS ROUTE 270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(10)
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CHURCH ROAD
RIDGWAY
ALEXANDRA ROAD
QUEENS ROAD
HAYDONS ROAD
WIMBLEDON STATION
WIMBLEDON
WORPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
MAYFIELD ROAD
(4)
(5)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
(7)
MERTON
DORSET ROAD
WESTERN ROAD
KINGSTON ROAD
WIMBLEDON CHASE STATION
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
MORDEN STATION
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CRICKET GREEN
CROYDON ROAD
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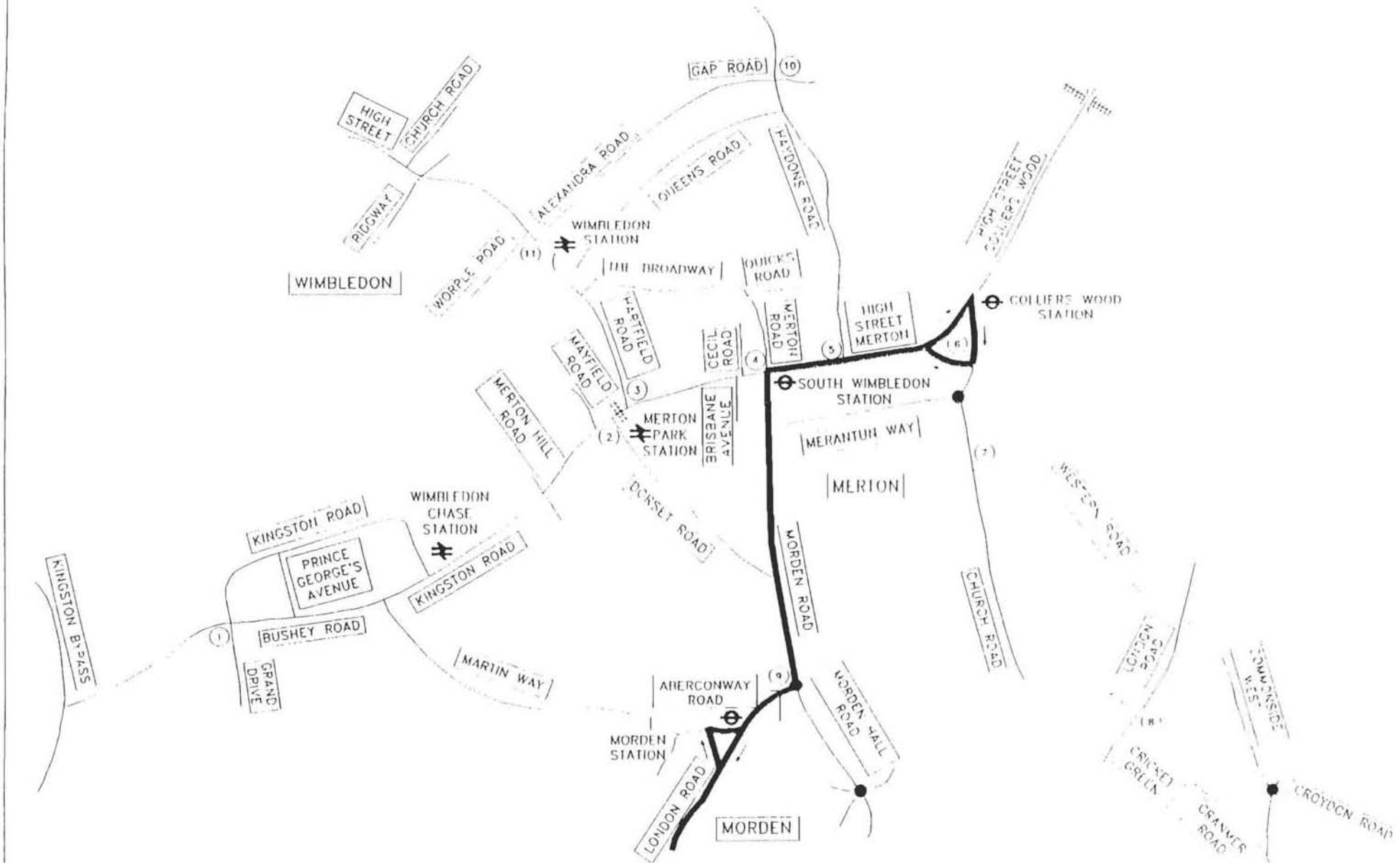
MITCHAM
6430/04/1818
BUS ROUTE 280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QUEENS ROAD
HAYDONS ROAD
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WORPLE ROAD
11
THE BROADWAY
QUICKS ROAD
WIMBLEDON
HIGH STREET COLLIERS WOOD
COLLIERS WOOD STATION
HATFIELD ROAD
MANFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
5
6
4
SOUTH WIMBLEDON STATION
3
MERTON HILL ROAD
MERTON PARK STATION
2
BRISBANE AVENUE
MERANTUN WAY
MERTON
7
WESTCOTT ROAD
DORSET ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
1
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GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
9
MORDEN HALL ROAD
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
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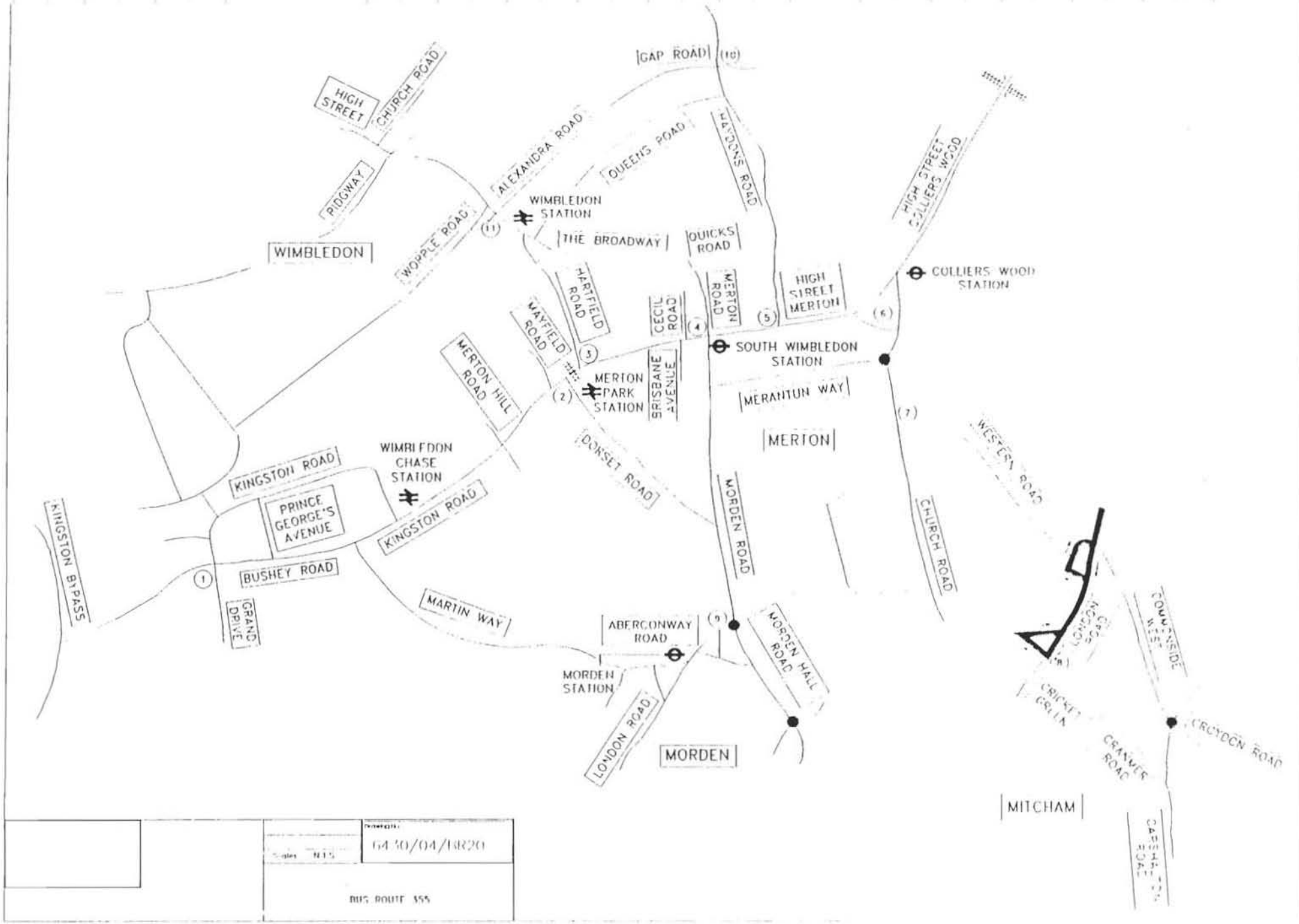
MITCHAM
CARSHALTON ROAD
64.30/04/1821
BUS ROUTE 293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WIMBLEDON
WOPPLE ROAD
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
MAYFIELD ROAD
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
BRISBANE AVENUE
MERANTUN WAY
MERTON
WESTERN ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
DORSET ROAD
PRINCE GEORGE'S AVENUE
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
MORDEN HALL ROAD
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CROYDON ROAD
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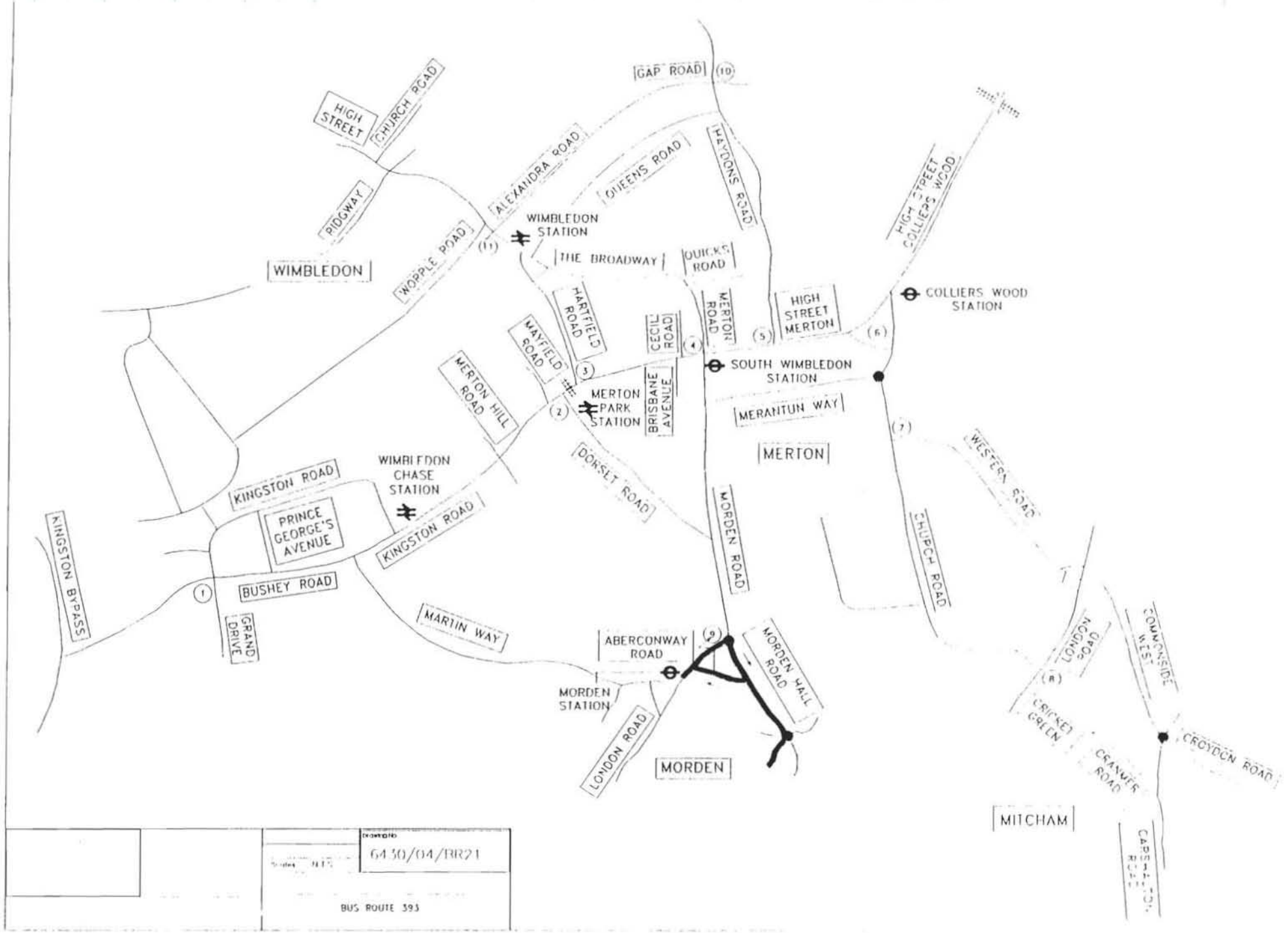
MITCHAM
64/30/04/1820
BUS ROUTE 355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WIMBLEDON
WOPPLE ROAD
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
SOUTH WIMBLEDON STATION
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MERANTUN WAY
MERTON
WESTERN ROAD
DORSET ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
PRINCE GEORGE'S AVENUE
KINGSTON BYPASS
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ABERCONWAY ROAD
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MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
CRICKET GREEN
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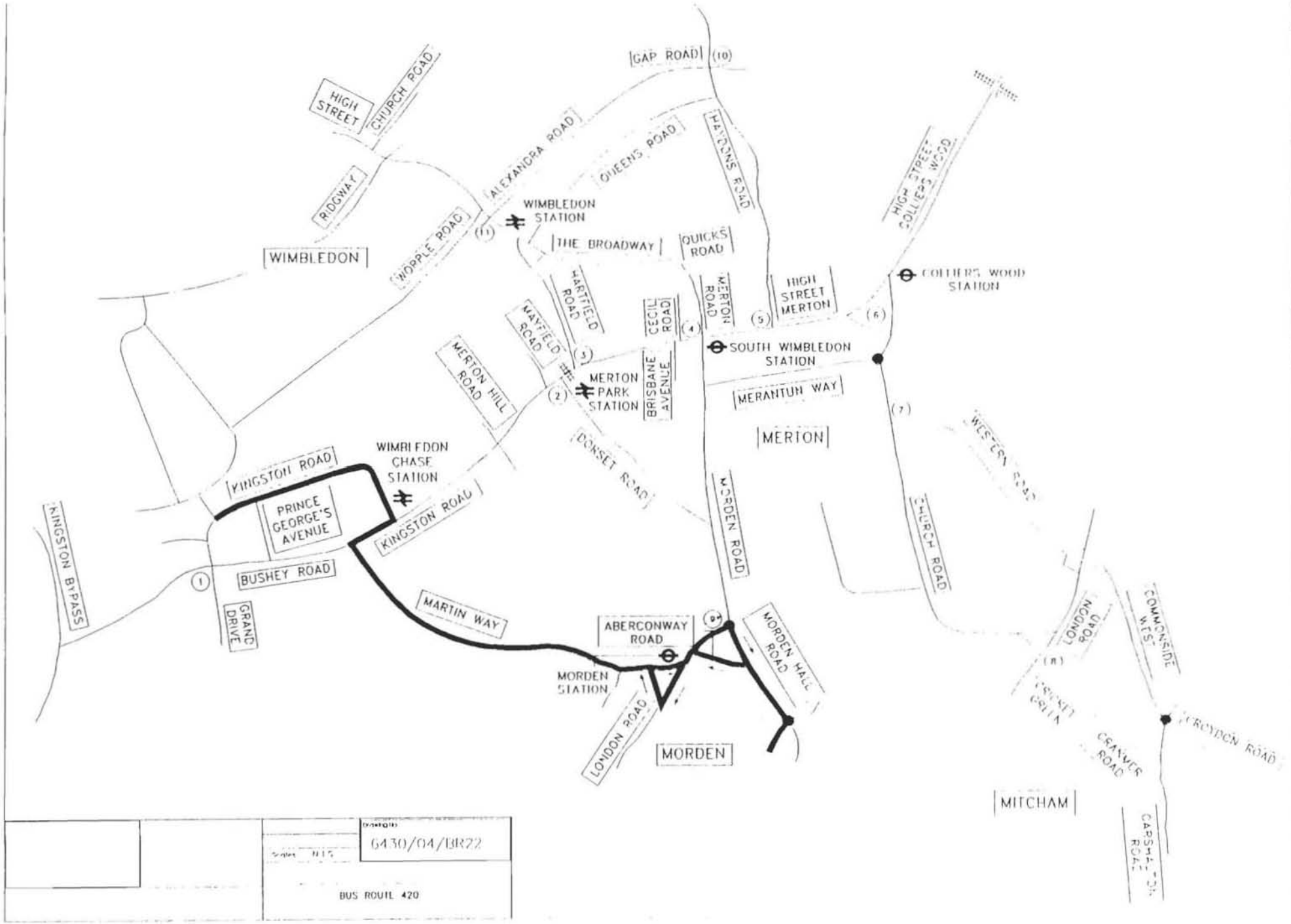
CROYDON ROAD
MITCHAM
CARSHALTON ROAD
64 30/04/BR21
BUS ROUTE 393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WIMBLEDON
WOPPLE ROAD
(11)
THE BROADWAY
QUICKS ROAD
COLLIERS WOOD STATION
HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
(5)
(6)
(4)
(3)
SOUTH WIMBLEDON STATION
MERTON HILL ROAD
MERTON PARK STATION
(2)
BRISBANE AVENUE
MERANTUN WAY
MERTON
(7)
WESTERN ROAD
DORSET ROAD
WIMBLEDON CHASE STATION
KINGSTON ROAD
PRINCE GEORGE'S AVENUE
KINGSTON ROAD
MORDEN ROAD
CHURCH ROAD
KINGSTON BYPASS
(1)
BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
ABERCONWAY ROAD
(9)
MORDEN HALL ROAD
LONDON ROAD
COMMONSIDE WEST
(8)
MORDEN STATION
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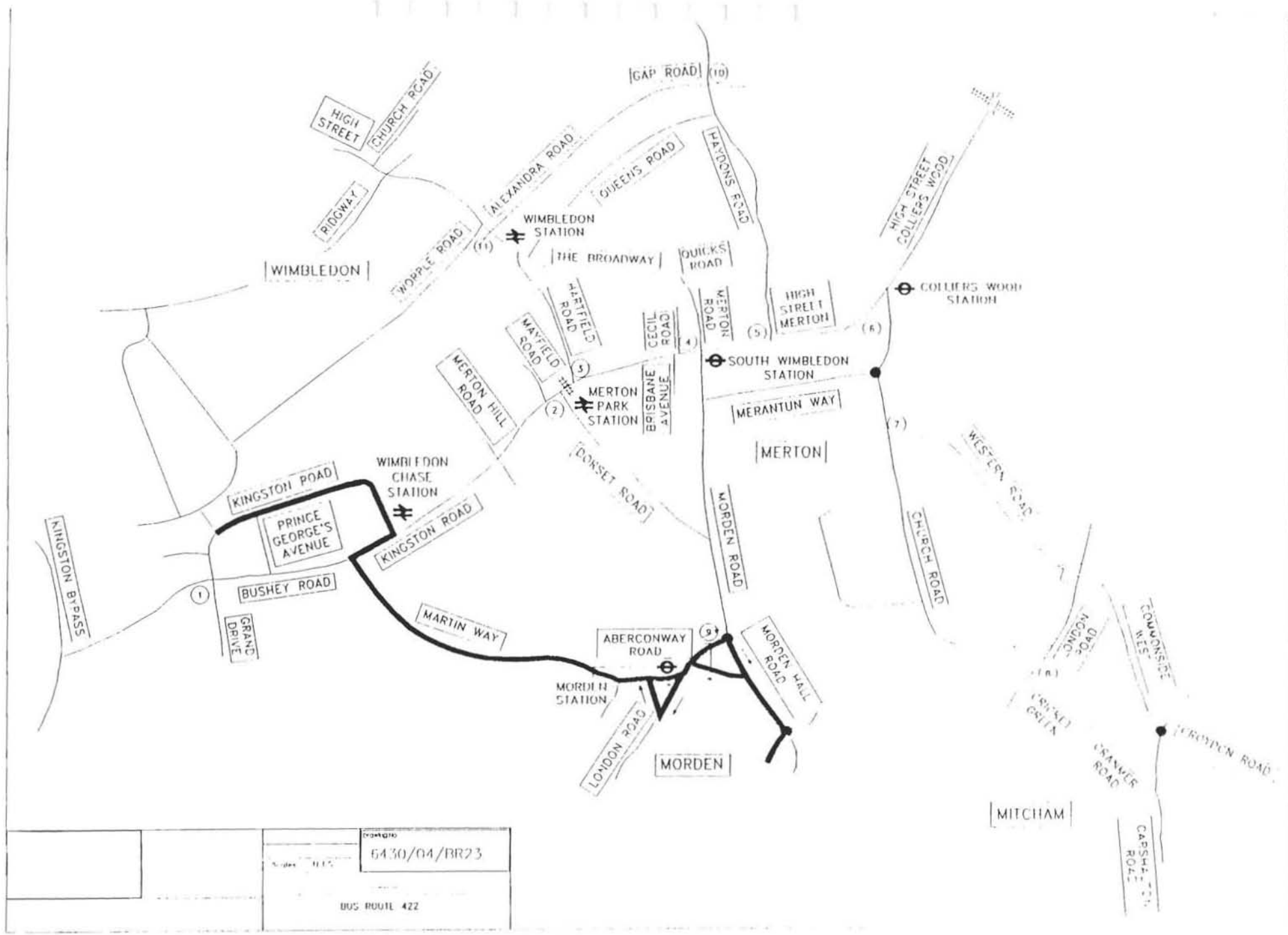
CROYDON ROAD
CRANMER ROAD
MORDEN
MITCHAM
CARSHALTON ROAD
6430/04/BR22
BUS ROUTE 420


GAP ROAD
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HARTFIELD ROAD
MAYFIELD ROAD
CECIL ROAD
MERTON ROAD
HIGH STREET MERTON
SOUTH WIMBLEDON STATION
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WIMBLEDON CHASE STATION
KINGSTON ROAD
PRINCE GEORGE'S AVENUE
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BUSHEY ROAD
GRAND DRIVE
MARTIN WAY
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CHURCH ROAD
ABERCONWAY ROAD
MORDEN HALL ROAD
MORDEN STATION
LONDON ROAD
MORDEN
LONDON ROAD
COMMONSIDE WEST
CROYDON ROAD
CRANMER ROAD
MITCHAM
CARSHALTON ROAD
6430/04/BR23
BUS ROUTE 422

Appendix D

Public Transport Survey

Public Transportation Interview

Instructions: Please take a few minutes to complete this survey. **Mark on the line provided the appropiate answer(s) to each question.** Please feel free to elaborate on any question because your opinions are essential to suggesting improvements to the Merton bus network. The results of this survey will be available from the London Borough of Merton Civic Centre in approxiametely 5 weeks.

Q1: On a daily basis, what is your primary mode of transportation?

Private car ___ Bus ___

Bicycle ___ Tube ___

Other ___ Walking ___
(please elaborate)

Q2: What key factor(s) do you take into account when deciding on the form of transportation marked in Q1?

Accessibility ___ Safety ___

Comfort ___ Speed of Travel ___

Cost ___ Reliability ___

Other ___
(please elaborate)

Q3: Using the mode of transportation marked in Q1, what are your primary destinations?

Recreation ___ Shopping ___

School ___ Work ___

Other ___
(please elaborate)

Q4: What hours do you most often use the mode of transportation marked in Q1?

0600-1000 ___ 1800-2200 ___

1000-1400 ___ 2200-0200 ___

1400-1800 ___ 0200-0600 ___

Q5: How reliable do you think Merton's bus services' are?

Good ___

Average ___

Poor ___

Q6: How accessible do you think Merton's bus services' are?

Very accessible ___

Adequately accessible ___

Poorly accessible ___

Q7: What do you think are the major problem(s) with Merton's bus network?

Accessibility ___ Lack of Information ___

Cost ___ Speed of Travel ___

Other ___ Reliability ___

(please elaborate)

Q8: Would you be willing to pay an increased fare for better bus service?

Yes ___

No ___

(please elaborate)

Your comments are appreciated. Thank you for your time.

ex Ralph Seiger's room
Environmental Services
London Borough of Merton
Merton Civic Centre
London Road,
Morden, Surrey,
SM4 5DX

Appendix E

Private Transport Survey

Private Transportation Interview

Instructions: Please take a few minutes to complete this survey. **Mark on the line provided the appropiate answer(s) to each question.** Please feel free to elaborate on any question because your opinions are essential to suggesting improvements to the Merton bus network. The results of this survey will be available from the London Borough of Merton Civic Centre in approxiametely 5 weeks.

Q1: **On a daily basis, what is your primary mode of transportation?**

Private Car ___ Bus ___

Bicycle ___ Walking ___

Other ___ Tube ___
(please elaborate)

Q2: **What key factor(s) do you take into account when deciding on the form of transportation marked in Q1?**

Accessibility ___ Safety ___

Comfort ___ Speed of Travel ___

Cost ___ Reliability ___

Other ___
(please elaborate)

Q3: **Using the mode of transport marked in Q1, what are your primary destinations?**

Recreation ___ Shopping ___

School ___ Work ___

Other ___
(please elaborate)

Q4: **What hours do you most often use the mode of transportation marked in Q1?**

0600-1000 ___ 1800-2200 ___

1000-1400 ___ 2200-0200 ___

1400-1800 ___ 0200-0600 ___

Q5: **What improvement(s) should be made to the bus service in Merton to increase ridership?**

Accessibility ___ Reliability ___

Comfort ___ Speed of Travel ___

Cost ___ Safety ___

Other ___
(please elaborate)

Q6: **If road space for private vehicles was reduced, and bus priority measures introduced, would you be more likely to use the bus instead of the mode of transport marked in Q1?**

Yes ___

No ___
(please elaborate)

Your comments are appreciated. Thank you for your time.

ex Ralph Seiger's room
Environmental Services
London Borough of Merton
Merton Civic Centre
London Road.
Morden. Surrey.
SM4 5DX