INNER RING ROAD SOUTH and EAST FLANKS

Report for Scheme Justification

STRATHCLYDE REGIONAL COUNCIL
Department of Roads

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1977

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ABSTRACT

1. The 1977 Draft Structure Plan and the 1978-83 TPP both highlight the need for a decision on the requirements of the City and the Central Area relative to the completion of the Inner Ring Road, ie by the construction of the South and East Flanks of the Inner Ring Road, either to motorway or all-purpose at-grade standard. Various issues, including traffic and the environment, have now been analysed in some depth and a report prepared giving justification to the completion of the South and East Flanks to motorway standard, albeit considerably downgraded from previous proposals, agreed by the former Corporation of Glasgow, due to revised population and traffic forecasts.

2. The practical traffic capacity of the North and West Flanks of the existing Inner Ring Road will be significantly exceeded (by about 10%) when the Monkland Motorway is completed in 1980.

3. Using the updated CHS assignments, 1990 traffic was applied to the "Target 1" Road System (the present road system with the completed Monkland Motorway and Dumbreck Road Connection), and "Target 1" Road System plus Hamilton Road Route to Dalmarnock plus Prospecthill Link Road.

In both cases, the physical capacity of the existing road network was overloaded in the vicinity of the Central Area, and the reasonable environmental capacity of the existing road network was grossly overloaded.

4. Assignments of 1990 traffic were made to the strategic highway network including the South and East Flanks with and without Hamilton Road Route, which solved the problems described above.

5. The volumes carried by the proposed South and East Flanks, ranging from 48,000 to 100,000 vehicles per day along the route, justify motorway standards, and rule out a surface level dual carriageway option on traffic operation and environmental grounds.

6. Two specific although tentative preliminary schemes have been developed and presented in the above report. This was done for the following reasons:

(i) To establish in the present circumstances the feasibility of the proposals.

(ii) To make traffic assignments.

(iii) To cost the proposals.

(iv) To assess the tangible benefits arising from the scheme.

(v) To assess the environmental benefits and disbenefits arising from the scheme.

7. The measurable benefits arising from the scheme in respect of 1990 traffic is substantial and the annual benefits can be summarised as follows:

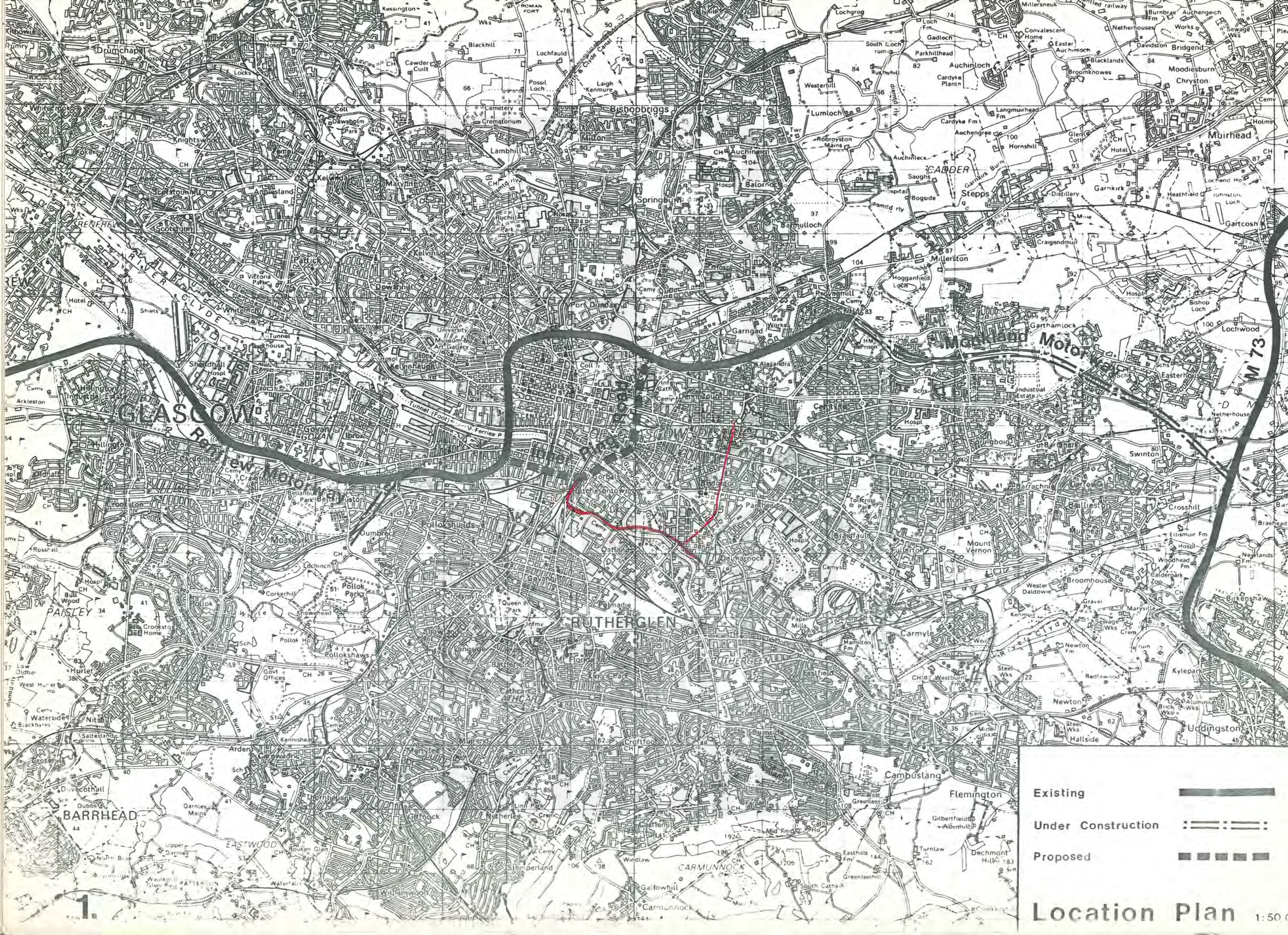
	Annual Value
Road Users' Time Saved - 2,349,000 vehicle hours	£5,367,000
Accident Reduction - 125 Injury Accidents	475,000
Fuel Savings - 728,000 gals	343,000
Working Vehicle Time	486,000
	£6,671,000

The 125 injury accidents are equivalent to 4 fatalities and 150 casualties.

The measurable annual benefit of £6,671,000 (1990 traffic) compares with the capital cost of the scheme, including land, of some £34,000,000. The crude rate of return is therefore about 18%, which is more than ample to justify the proposal on an economic basis.

In addition, there will be net environmental benefits by diverting traffic from environmentally sensitive areas like High Street to the generally less environmentally sensitive location of the proposed new road.

8. The construction of the proposed scheme enables the potential capacity of the existing high capacity sections of the Renfrew and Monkland Motorways to be fully utilised.


GLASGOW
Renfrew Motorway
Inner Ring Motorway
M 73
Maryland Motor
PAISLEY
BARRHEAD
RUTHERGLEN
CARMUNNOCK
CADDER
Bishopbriggs
Cambuslang
Uddingston
Muirhead
Milton
Springburn
Balornock
Barmulloch
Millerston
Stepps
Garnkirk
Lambhill
Kelvindale
Maryhill
Partick
Kelvinside
Dowanhill
Whiteinch
Govan
Pollokshields
Mosspark
Crookston
Pollok
Shawlands
Langside
Battlefield
Mount Florida
Cathcart
Merrylee
Newlands
Croftfoot
Burnside
Carmyle
Newton
Kylepark
Flemington
Dechmont Hill
Gallowhill
Carmunnock
Eastwood
Thornliebank
Giffnock
Clarkston
Netherlee
Stamperland
Williamwood
Darnley
Arden
Carnwadric
Kennishead
Drumchapel
Blackhill
Lochfauld
Cawder Cuilt
Possil Loch
Cemetery
Crematorium
Dawsholm Park
Knightswood
Scotstoun
Anniesland
Victoria Park
Whiteinch
Tunnel
Shieldhall
Hillington
Arkleston
Govan
Ibrox
Tunnel (Foot)
Ferries
Craigton
Cardonald
Bellahouston
Ruchill Park
Possil Park
Port Dundas
Garnhall
Alexandra Park
Queen's Park
Linn Park
Castlemilk
Cathkin
Mid Fm
Easthills Fm
Greenlees
Greenfield
Windlaw
Slamannan
Auchinlea
Auchinleck
Saughs
Bogside
Distillery
Hogganfield Loch
Provanmill
Garthamlock
Easterhouse
Industrial Estate
Springboig
Barmarnock
Swinton
Barrachnie
Tollcross Park
Shettleston
Braidfauld
Fullarton
Mount Vernon
Baillieston
Crosshill
Broomhouse
Wester Daldowie
Broomknowes
Blacklands
Auchinloch
Cardyke Plantn
Cardyke Fm
Langmuirhead Fm
Auchengree
Hornshill
Lochend
Heathfield
Gartcosh
Craigendmuir
Bishop Loch
Lochwood
Moodiesburn
Chryston
Bridgend
Davidston
Netherhouses
Auchengeich
Burnbrae Fm
Sewage Wks
Millersneuk
Convalescent Home
Easter Auchintoch
Gadloch
Loch Fm
Parkhillhead
South Loch
Lochgrog
Lumloch
Robroyston Mains
Westerhill
Rushyhill
Auchinlea
Twr
Ellismuir Fm
Woodhead Fm
Newlands Fm
Calderpark Zoo
Gravel Pit
Maryville
Kenmuir
Paper Mills
Hamilton Fm
Westburn Fm
Steel Wks
Redlawwood
Aluminium Wks
Brick Wks
Hallside
Mine
Existing
Under Construction
Proposed
Location Plan 1:50 0
1.

1. INTRODUCTION

1.1 Extent of Study

This report sets out the traffic, environmental and economic justification for the completion of the Inner Ring Road against the background of the transportation aims of the Regional Development Strategy set out below.

The study area extends from Townhead Interchange south of Cathedral Street to the Interchange with Renfrew Motorway and the Kingston Bridge.

1.2 Regional Development Strategy

Within the framework of the Regional Development Strategy, four major transportation objectives have been identified and these are detailed in the Transport Policies and Programme for the period 1978-83 as follows:

Main Transportation Objectives

1. To maintain and improve the public transport system in order to provide mobility, particularly for the labour force and those without access to a car.
2. To develop the strategic road network by giving priority towards increased benefits for freight, industrial and commercial traffic.
3. To provide necessary connections to the existing strategic networks for preferred areas of development.
4. To utilise and improve the existing transportation system in order to enhance the environment, particularly in Areas of Need.

Other Objectives

In addition, the programme includes schemes justified by the following:

5. To increase transport user benefits by measures which reduce journey times and running costs and improve levels of service.
6. To reduce accidents.
7. To conserve energy by encouraging use of public transport and by reducing congestion.
8. To improve operational efficiency by the improvement and replacement of rolling stock, roads, structures and buildings.
9. To improve bus and rail stations, car parks and other terminal facilities, especially where they encourage interchange.
10. To increase income or reduce revenue expenditure.

The 1977 Draft Structure Plan highlights the need for a decision on the East and South Flanks of the Inner Ring Road and states that the following alternatives will be considered:

Either:

> "A reduced scale East Flank and South Flank of the Inner Ring Road connecting to Hamilton Road Route Reservation."

Or:

> "An improved surface street system to dual carriageway capacity, to replace the East Flank and the South Flank, connected to Hamilton Road Route."

The 1978-83 Transport Policies and Programmes document identifies the East Flank of the Inner Ring Road as a scheme to be considered to take up the Block Allocation expenditure in 1981-83.

1.3 History

An "Interim Report on the Inner Ring Road" dated June 1962 was formally presented to Glasgow Corporation in January 1963, and the proposals contained therein were incorporated in the report "A Highway Plan for Glasgow" published in 1965.

Growing public concern about the adverse environmental effects of the original East Flank proposals led to an examination of alternative lines for the East Flank and a public participation exercise.

Subsequently, a report dated December 1973 was prepared jointly by Scott Wilson Kirkpatrick & Company (Scotland) and William Holford & Associates, which recommended a new scheme for the East Flank - Scheme 4N. This recommendation was accepted by Glasgow Corporation. Further studies led to a modified and improved scheme - Scheme 4U.

Following the reorganisation of local government in May 1975, a draft report on both the South and East Flanks was submitted to the Region in July 1975.

Continuing discussions on the outline design of the South and East Flanks of the Inner Ring Road have been held between the Department of Roads

and Scott Wilson Kirkpatrick. The proposals contained in this report are the results of these discussions.

Since the submission of the report dated December 1973, as well as the draft report dated 1975, a number of major regional planning matters have arisen that affect the original proposals. In particular the revised population and vehicle forecasts and developing transport policies of the Region necessitated a review of the formal proposals.

2. TRAFFIC

2.1 Present Traffic Flows

Present traffic flows (1977) in the Central Area are shown diagrammatically in Fig No 1. The largest traffic flow is over the Kingston Bridge, 89,400 vehicles per day, and the second largest on the dual four-lane section of the North Flank, 65,700 vehicles per day. In June 1978, these flows had risen to 102,000 and 77,300 vehicles per day respectively.

2.2 Capacity of Existing Inner Ring Road

One of the factors that has been examined is the capacity of the various sections of the existing Inner Ring Road. This work is set out in Annex 1.

It is relevant to consider how close the existing Inner Ring Road is to capacity. Fig No 3 shows the measured flows in June 1978 and also the estimated capacity of various critical sections. It will be seen that present flows are not too far short of capacity, which is consistent with observed conditions on the Inner Ring Road at peak hours.

Also shown is the amount of additional traffic which would be diverted onto the Inner Ring Road as a consequence of the opening of Monkland Motorway Stage II. This diverted flow amounts to about 10,000 vehicles per day and, when added to the present flows, appears to bring some sections of the Inner Ring Road up to theoretical capacity. When the general traffic growth of about 10% is added prior to the completion of Monkland Motorway, it would appear that flows on the Inner Ring Road will significantly exceed its desirable design capacity. This is not to say that the results will be calamitous but it does mean that delays and stop-go conditions will prevail on the Inner Ring Road in the peak hours, compelling some motorway traffic to find alternative surface street routes.

2.3 Future Traffic Flows

Recent traffic studies, utilising the Glasgow Highway Plan CHS traffic matrix, have been carried out to more accurately reflect the existing traffic patterns in Glasgow, particularly in the east and the south of the City and the Central Area. In collaboration with the Department of Roads and Physical Planning, predictions of future traffic levels have been made based on current trends in population and car ownership. Details of these studies are contained in Parts 1 to 4 of the "CHS Supplementary Assignment" Reports. A summary has been submitted in advance of this report.

It should be noted at the outset that there is reason to believe that traffic will continue to grow beyond 1990, possibly increasing a further 20% by the year 2000.

The main objectives of the traffic studies in this report are, firstly, to assess the traffic loads on the existing road system in 1990, assuming no South and East Flanks, and secondly, to predict the traffic flows on the road system with the South and East Flanks added, so that the road requirements can be determined and to provide data for an assessment of associated economic benefits.

To elaborate on the first objective, it is necessary first to assign 1990 traffic to the present road network (including the completed Monkland Motorway) and then to assess whether this road network can cope with these future traffic loads. The analysis is complicated by the fact that there are two entirely different standards for determining road capacity. One is the physical capacity of the road, generally termed practical capacity, and the other is the environmental capacity which is a more indeterminate value and is the maximum traffic flow which is considered acceptable from an environmental point of view and is related to the nature of the land use fronting a road and the amount of pedestrian activity along the road.

The overall growth in traffic in Glasgow from 1977 to 1990 inherent in the 1990 traffic assignment is 36%. The problem of accommodating increases of this order is very much related to the existing Inner Ring Road. Since it would be at capacity now, were the Monkland Motorway completed, all increases in traffic will have to be accommodated on the existing city street network so that increases on the street network will be proportionally greater than the overall traffic increase. The crux of this study is therefore to determine whether the street network can cope.

In order to do this, two approaches have been made. The first is to examine the traffic and road capacity in relation to selected screenlines and the second to examine local overloads that the traffic assignments have shown.

For the first approach, screenlines have been drawn through the Central Area and taken as far as the zone of influence can be reasonably expected to extend. These have been located where the combined road capacity on the screenlines appears to be most critical. Two have been selected on a north-south alignment and two on an east-west alignment, and are shown on Fig No 2.

East-West Screenlines (Ref Tables 3 and 4)

Neither of the east-west screenlines shown are a strong case for more road capacity based on practical capacity of the existing roads although, in relation to the desirable environmental capacity of the existing screenline roads, there is a large deficiency (47,900 vehicles per day).

On more careful examination of the network, it was thought that the potential capacity of all the roads on the screenline could not be fully used due to bottlenecks in the network. In particular, it seemed that the traffic arriving at the Townhead area from the east along the Monkland Motorway and from the north along Springburn Road, or a future Springburn Expressway, could not be matched by the existing network capacity in the immediate vicinity to the south and west. To test this hypothesis, a screenline was formed to the south and east of Townhead, as shown on Fig No 2, which was termed the Townhead Screenline.

The results are shown on Table 9 and the significant results summarised below:

Present (1977) actual traffic flows	127,200 veh/day
Practical capacity	148,000
Environmental capacity	122,000
1990 assigned traffic	181,700
Deficiency in practical capacity	33,700
Deficiency in environmental capacity	59,700
Deficiency in practical capacity as percentage of practical capacity	23%
Deficiency in environmental capacity as percentage of practical capacity	49%

It does not appear to be desirable or practical to divert the excess traffic to the existing road network beyond the limits of this screenline. Keppochhill Road to the north would have problems in distributing traffic to the road system both east and west. Cumbernauld Road to the east would not carry sufficient extra traffic to remove the problem but would feed through traffic into the GEAR Area which would have undesirable effects, such as increasing traffic on Duke Street through Dennistoun. Indeed, solving the Townhead capacity problem in this way would be to negate the basic objectives and justification of the Monkland Motorway.

Two separate cases have been considered in these studies. The first assumes the "Target 1" situation; that is, the present road network with the completion of the Monkland Motorway. The second situation is the same system with the addition of the Hamilton Road Route into Dalmarnock, plus the Prospecthill Link Road.

2.4 Traffic Assignments and Analysis - Case 1 (Target 1)

To arrive at the traffic flows relative to Case 1, the 1990 traffic matrix was assigned to Target 1 network. This assignment is described as Run 2.23 and some of the more significant traffic flows are shown in Fig No 3.

This normal unrestrained assignment produced flows on the Inner Ring Road well above its capacity and was thus invalid. To make the assignment valid, assigned speeds on the Inner Ring Road were progressively reduced to bring the assigned flows down to the capacity of the Inner Ring Road. The final run was Run 2.24. Subsequently, more refined capacity studies have shown that this assignment still exceeds the Inner Ring Road capacity by about 12,000 vehicles per day. Due to lack of time, the further restrained assignments required to bring about the necessary balance have not yet been done and, in the subsequent analysis, it should be borne in mind that there are 12,000 excess vehicles per day on the North Flank of the Inner Ring Road.

North-South Screenlines (Ref Tables 1 and 2)

Considering the north-south screenlines, it is apparent that Screenline 2 is the more critical. The theoretical practical capacity on the screenline is 260,000 vehicles per day, compared with a present day (1977) total actual flow of 220,300 vehicles per day (present day assigned 212,400 vehicles per day).

The predicted 1990 flow across the screenline is 306,800 in the unrestrained case and 304,700 in the restrained case. The latter value is 38% higher than the existing total actual flows which agrees with the overall increase in traffic implicit in the 1990 traffic matrix.

The 1990 screenline flow is 44,700 in excess of the maximum practical capacity across the screenline and provides a clear case for additional road capacity, the only practical location for such additional road capacity being through Laurieston-Gorbals.

When the total predicted 1990 flows of 304,700 are compared with the total screenline environmental capacity of 189,500, an even stronger case is made for additional road capacity, the predicted flow being 61% above the environmental capacity.

The conclusion is reached that the future traffic carried on the Monkland Motorway and Springburn Road to Townhead is not matched by the existing road network capacity immediately to the south and west of Townhead. The whole of the North and West Flanks of the Inner Ring Road is reaching capacity more or less simultaneously so that there is no feasible way that the capacity of the existing Inner Ring Road can be increased.

The only reasonable solution to this problem is to provide additional north-south road capacity to the south of Townhead.

2.5 Traffic Assignment and Analysis - Case 2
(Target 1 + Part Hamilton Road Route + Prospecthill Road)

To arrive at the traffic flows relative to the second situation, the 1990 traffic matrix was assigned to the Target 1 network with the addition of the Hamilton Road Route into Dalmarnock and Prospecthill Link Road. This assignment is described in Run 2-25. Some of the more significant traffic flows are shown in Fig No 3.

The analysis which was made of future traffic loads on the Case 1 road system still largely applies to the Case 2 road system. The main difference is that about 7,000 vehicles per day are removed from the north-south screenline (Ref Tables 5 and 6). This minor difference is presumably traffic using the Prospecthill Link Road and proceeding westwards on the network south of Battlefield - Langside Avenue.

On the east-west screenline, the Case 2 1990 traffic volumes are about 10,000 vehicles per day less than Case 1 (Ref Tables 7 and 8). This is due to the Hamilton Road Route diverting some traffic from the Monkland Motorway. However, this effect is possibly spurious in that certain existing roads linking the Hamilton Road Route to the Central Area are assigned traffic volumes well in excess of their capacity. Revised assignments must be done to correct this inconsistency. The net effect will probably be to redirect certain traffic movements back onto the Monkland Motorway.

However, the assignment as it stands has been used in each of the two north-south screenlines, the two east-west screenlines and the special Townhead screenline.

The north-south screenline analysis still makes the same case for additional capacity justifying the South Flank.

In the case of the special Townhead screenline, the 1990 total assigned volumes in Case 2 are 7,100 vehicles per day down on the corresponding Case 1 figures (Ref Table 10). As previously stated, this difference may be spurious and would likely largely disappear in a refined further assignment. But, even taking the predicted traffic flows at face value, they still lead to the same conclusion as in Case 1, that a new road in the vicinity of High Street is required.

3. DESIGN STANDARDS

3.1 Category of Road

The projected traffic volumes on the proposed road range from 45,000 to 100,000 vehicles per day. It must be repeated that the traffic projections relate to the year 1990.

As stated in the Leitch Report, it is current Ministry of Transport practice to make provision for the traffic flows expected to occur 15 years after a road opens. This approach is consistent with accepted highway engineering practice. If it is assumed that the road now considered could be completed about 1985, then a design year of the year 2000 is indicated. On this basis, the traffic flows quoted may be expected to increase by some 20% above 1990 levels.

It is considered impractical to carry traffic volumes of this magnitude on a surface street system, especially in the commercial heart of a city where pedestrian movements are very high. Although the design proposals later presented utilise sections of surface streets combined with traffic management, to maintain a staged solution, a surface level solution throughout the South/East Flank corridor has been rejected on the following grounds:

(a) While a detailed analysis has not been carried out, the traffic flows that would operate on a surface level solution, even with severely limited junction spacing, would necessitate a roads provision ranging from dual three-lane to dual four-lane, with additional capacity provisions at junctions.

(b) The South and East Flanks form an overflow route to the existing east-west M8 motorway route, where the capacity on either side of the City Centre (ie Monkland and Renfrew Motorways) is substantially higher than that of the North and West Flanks, and was designed to serve a ring motorway.

(c) More specifically, a major dual carriageway surface road carrying large traffic flows would be unacceptable in the Cathedral - Strathclyde University area and in High Street. A surface road crossing Glasgow Green would also appear to be unacceptable. Through Laurieston-Gorbals, it would seem that very large traffic volumes carried at ground level with stopping and starting would be less desirable than the alternative proposal of an elevated motorway.

For these reasons, the proposals have been based on the new road being grade separated and to motorway standards.

3.2 Number of Traffic Lanes Required

The lane requirements are determined by two factors - predicted traffic flows and lane balance.

There are four different sections of the proposed motorway that must be separately considered to determine the required number of lanes:

(a) The South Flank has predicted 1990 traffic volumes of some 58,000 vehicles per day. This compares with a practical capacity of dual two lanes of around 51,000 vehicles per day, the precise figure depending upon the two-way traffic split and the extent of weaving which requires further study. Meantime, it appears reasonable to propose dual two lanes.

(b) The next section to be considered is the River Clyde crossing. The traffic flows predicted in the current relevant assignment total 97,000 which compares with a theoretical capacity of about 69,000 to 73,000. However, most of the traffic on this section can readily be re-routed and meantime dual three lanes are proposed.

(c) The section between Greendyke Street and High Street Goods Station has predicted traffic flows of 29,000 vehicles per day. Clearly, the minimum provision of dual two lanes with a capacity of around 51,000 vehicles per day is indicated.

(d) Between High Street Goods Station and Cathedral Street, the assignment shows 45,000 vehicles per day. Although it would appear that dual two lanes would suffice, there are, however, other considerations that point to dual three lanes.

Firstly, the volumes shown on this section in the current assignment are low because the flows on the Hamilton Road Route exceed the capacity of the known road proposals (which would be reflected in an adjusted assignment), so that some traffic would be switched to this section via the Monkland Motorway.

Secondly, lane balance and system requires dual three lanes.

Thirdly, the northbound roadway is on a sustained gradient of 4.5% and the southbound roadway has a major merge which would extend into the tunnel.

Finally, there is no reasonable alternative route in the event that this section becomes overloaded and it would be extremely difficult to increase the capacity of this section at a future date.

3.3 Alignment and Cross Section Standards

Our proposals have been designed to meet the 80 km/hour (50 mph) requirements laid down in "Roads in Urban Areas" amended by the latest Scottish Development Department Circulars and Memoranda. These proposals are consistent with existing standards operating at present on the North and West Flanks of the Inner Ring Road. Table 1 shows the alignment standards.

It is not proposed to provide hard shoulder on the main carriageways of the South and East Flanks. The provision of a hard shoulder is proposed on all single lane motorway slip ramps.

TABLE 1

		Ring Road	Slip Roads*
Design Speed		80 km/hour	60 km/hour
Radius	Desirable	400 m	150 m
	Minimum	230 m	130 m
Maximum Gradient		5%	6%
Minimum Sight Distance		140 m	90 m
Minimum Vertical Curve (K Value)			
	Crest	25	10
	Sag	25	6
Maximum Superelevation		7%	7%

Note: "K" is the length of curve required to effect a 1% change in gradient.

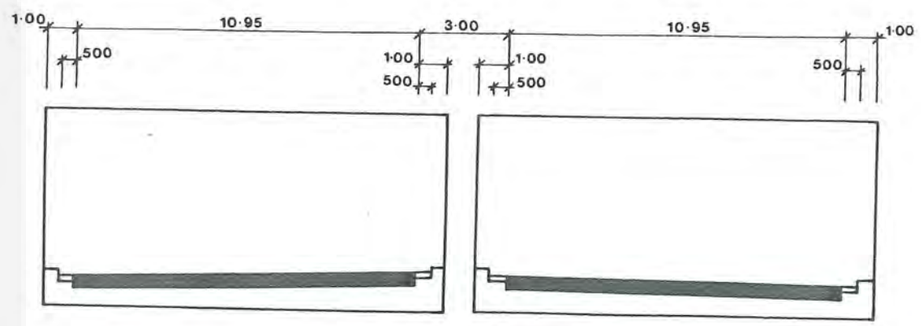
*Loops have been designed to satisfy a speed of 30 km/hour with a minimum radius of 30 m.

3.4 Geology

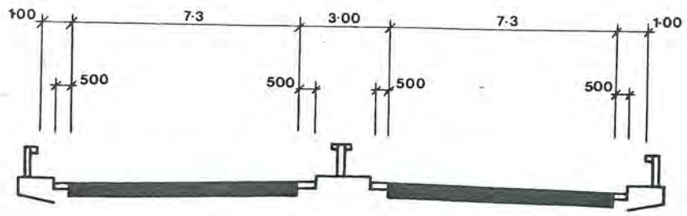
(a) General

The route of the Inner Ring Road is for the most part situated on the flat plain of fresh-water alluvium and raised-beach deposits which extend with varying breadth on either side of the Clyde. On the north side of the river, the ground rises somewhat steeply from the alluvial plain forming smooth rounded ridges. The contours and disposition of these parallel features have been largely determined by glacial action.

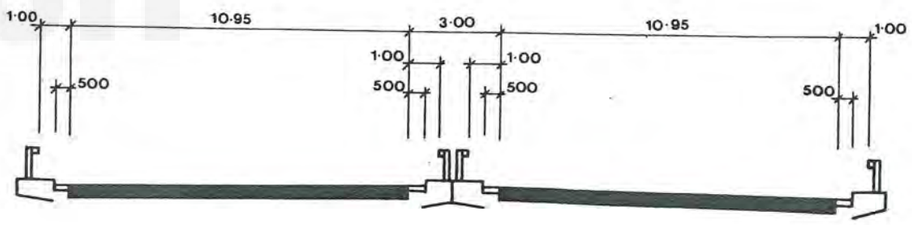
Typical Motorway Cross-sections



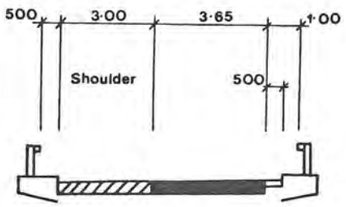
Cut & Cover Section



Dual 2



Dual 3



Slip Road

Most of these ridges contain a core of rock, more or less covered with drift deposits, generally boulder clay.

(b) South Flank

The elevated roadway follows the line of the river alluvium which consists of a silty fine and medium sand with gravel overlying the Upper Limestone Group and Millstone Grit series of rocks. A subsidiary fault enters from the east of Victoria Bridge, its course to the west being concealed beneath the river alluvium.

(c) East Flank

The silty sands continue up as far as College Goods Station, to be replaced by raised beach deposits of silts and silty clays. These overlie the Millstone Grit series of rocks. The area is cut by an east-west fault which downthrows to the north.

To the west of High Street Goods Station, an intrusion of teschenite occurs beneath the superficial deposits. The rock is closely similar in petrological character to that of the adjacent Necropolis hill.

Between Duke Street and Rottenrow, the area is cut by an east-west fault line, downthrown to the south. The teschenite intrusion is replaced by the Upper Limestone Group of rocks. This area also marks the boundary between the raised beach clays and the glacial boulder clays. These boulder clays continue northwards to the existing North Flank and overlie the Upper Limestone Group of rocks.

3.5 Services and Drainage

(a) Services

The proposals contained in this report have been prepared accepting that a major constraint on any scheme for the South and East Flanks is the presence of many existing services.

As it is envisaged that the proposed road is mainly elevated (with the exception of the cut and cover section), service diversions will be kept to a minimum. Generally the proposed motorway slip roads and new surface street distributers tie in to the existing street pattern at existing ground level, thus avoiding major service diversions.

(b) Drainage

South Flank

No new major drainage proposals will be required as the proposed scheme takes the form of a simple dual two-lane elevated structure.

East Flank

The revised design proposals in our view no longer necessitate the construction of a new main sewer for either scheme. Due to the deletion of the previous multi-braided section etc, it is not envisaged that the present proposals will increase the existing run-off in the area.

3.6 Land Use - Existing and Proposed

The section of Glasgow through which the East Flank corridor of the Inner Ring Road passes is one which has very strong historical association with the beginnings of Glasgow. The line of Saltmarket/High Street/Castle Street is still basically the same as the original route but the early building lines have obviously been moved over many years to facilitate road widening. The street pattern has unfortunately no longer the same impact it once had and specific buildings are now very isolated.

The South and East Flank corridor passes through three comprehensive development areas, Townhead, Glasgow Cross and Laurieston-Gorbals, and it is intended that the test maps of the local area plans are adhered to. Consultations have taken place for this interim report with the Planning Department of Glasgow District Council.

Townhead - High Street

This area contains many buildings of significance to Glasgow's present and future well-being, as well as to its historic past. The Royal Infirmary, Strathclyde University, the Cathedral, the housing areas of Cathedral Square and High Street together with the High Street Goods Station form the major groupings of the area. Significant properties within these groupings are indicated on the land use plans. Strathclyde University campus will continue to develop and it is hoped that advantage will be taken by the University to utilise much of the area up to a line west of Castle Street.

The local area plan allows for a development of shelter housing adjacent to Provands Lordship and fronting onto Castle Street and the Cathedral precinct.

British Railways Board's Goods Station at High Street has always been an absolute control on previous East Flank alignments of the Inner Ring Road; however, at this time indications have been given at recent meetings with British Rail that consideration can be given to a route passing over or through High Street Goods Station. Consultations have so far established British Rail acceptance of the route option in as far as their rail operations and long term Goods Station requirements are concerned.

Glasgow Cross - Glasgow Green Area

The present route corridor for the East Flank has moved considerably east of Glasgow Cross, through areas already largely scheduled for demolition as part of the Glasgow Cross CDA. The section includes the former College Goods Station with the substantial warehouse buildings fronting onto Bell Street. The availability of the College Goods Station site as a prestige development fronting onto High Street is presently being given consideration although such a development would have to take into account the proposed roads network in the area. The area directly south of Bell Street to St Andrews Square is substantially commercial and is at present a shopping link between the Barrows and Argyle Street. St Andrews Square, with its Parish Church the centrepiece, is a fine architectural composition on plan, although in reality a great amount of resources are required to be found to restore the buildings to their former condition. The area known as the Barrows is a Glasgow "happening" which creates its own grouping of buildings on certain days of the week, including the St Alphonsus Church. The Electricity Sub-station adjacent to the Barrows has been considered an absolute control due to the disruption and the extremely high cost of relocation.

The local plan allows for the major part of the Calton area to be redeveloped for residential use in association with Glasgow Green. The area of the Barrows would be unaffected and the commercial link between the housing area of Calton and the east end of Argyle Street is encouraged. The area north of Gallowgate is intended for light industry. There are no District Council development proposals for St Andrews Square other than a short-term paint application to the external face of the commercial properties around the square.

Laurieston-Gorbals

The route of the South Flank of the Inner Ring Road was planned in conjunction with the initial planning of the Laurieston-Gorbals CDA and the present alignment corridor agrees in principle with the original line of that route. As a result of this consistency of planning, no major buildings or groupings are affected by this proposal. Significant properties within this area are indicated on the land use drawings.

Local planning proposals for the area east of Bridge Street allow for the development of educational and recreational facilities for the recently constructed multi-storey housing, together with new civic buildings, such as the Sheriff Courts and a mosque, fronting the Clyde. These proposals rely upon a strong pedestrian link across the river to the City Centre. Ability to walk to the town centre with minimum interference from traffic is a matter which the local people are anxious to see implemented.

West of Bridge Street, the South Flank corridor runs between Wallace Street and Cook Street to meet with the existing Ring Road terminal ramps at West Street. A telephone exchange lies on the north side of Cook Street at Centre Street and must be considered as an alignment control. Otherwise, warehousing units occupy much of the route corridor in this area. There are no major planning proposals envisaged though it can be noted that this predominantly commercial area is frustrated in terms of access and parking due to the present scale of through traffic movements emanating from the M8 connections at the southern end of the Kingston Bridge.

3.7 Outline Design

(a) Ultimate Proposals - East Flank - Scheme A

Cathedral Street to Duke Street

To make the East Flank environmentally acceptable in the vicinity of the Cathedral and Strathclyde University, a tunnel or cut and cover section is essential. Its main function will be to reduce noise and visual intrusion in the Cathedral precinct and the University campus, and it will also permit the linking of these areas.

By moving the road further east, Scheme A makes it possible to extend the tunnel under High Street. This saves most of the fine red sandstone tenements north of the junction with Duke Street and considerably reduces the noise and visual intrusion on these properties. Duke Street east of High Street is realigned and regraded to obtain vertical clearance under the East Flank and it is envisaged that the area south of the buildings would be landscaped. In this scheme, High Street is unaffected by the East Flank between Cathedral Street and Glasgow Cross, as is the case with Scheme B.

Duke Street to Gallowgate

This area contains a major intersection between the East Flank and the surface street system, the first one north of Townhead Interchange. The Central Area connections have been restricted to one at Ingram Street in order to reduce the number of junctions on High Street. This interchange also connects to a north-south distributer road which links with existing roads at Gallowgate and in addition connects ultimately with Hamilton Road Route.

Gallowgate to Greendyke Street

By aligning the Ring Road to the east of the Charlotte Street SSEB electricity sub-station, the elevated section is kept sufficiently far from St Andrews Church to avoid any significant environmental intrusion.

The downgrading of the Hamilton Road Route from motorway permits the ultimate connections to the East Flank to be moved out of Glasgow Green to a line north of the Coffee Works. The interchange layout in this scheme allows for the construction of the ultimate East Flank without any major abortive works being required to connect to the Hamilton Road Route. Report Drawing No 9 illustrates this arrangement without Hamilton Road Route.

The ultimate connection between the East Flank and Hamilton Road Route is shown on Report Drawing No 4.

The traffic light controlled circulatory system round the sub-station permits all traffic movements and facilitates the flow of buses and pedestrians through the area. However, further investigation into the capacity of the signal controlled junction will have to be carried out.

Greendyke Street to Hospital Street

The section of Ring Road through Glasgow Green and across the river is reduced to dual three lanes and we feel that with careful design visual intrusion should be reduced to a minimum. The alignment at Crown Street has been located so as to avoid the Child Welfare Clinic in Florence Street; however, it should be noted that the Ring Road passes very close to the back of the Clinic.

The half diamond to Hospital Street has been retained primarily to reduce the amount of traffic passing through the potentially critical circulation system at Gallowgate and to reduce traffic on the Albert and Victoria Bridges.

There will be a certain amount of complex weaving movements on this section of the motorway which requires further study.

(b) Ultimate Proposals - East Flank - Scheme B

Cathedral Street to Duke Street

The comments in Scheme A concerning the Cathedral and Strathclyde University apply also to Scheme B. The main line generally follows that of the earlier Scheme 4U; however, by deleting the braiding it is now possible to retain all the red sandstone tenements in High Street.

Duke Street to Gallowgate

The interchange in this section connects the East Flank to the surface street system from both north and south. The connection to the south, however, is the only one between the interchange at Townhead and Renfrew Motorway. The interchange also connects the north with both the revised surface street system and Hamilton Road Route.

As with Scheme A, the proposals allow for the connection of the Hamilton Road Route to be made at a later stage. It should be noted, however, that in this scheme major abortive works are required, should the East Flank be constructed ahead of Hamilton Road Route.

Gallowgate to Greendyke Street

The elevated Ring Road has been moved close to the west side of the SSEB electricity sub-station to increase the distance from St Andrews Church. Like Scheme A, this proposal also removes the Hamilton Road Route connections from Glasgow Green and retains the Coffee Works buildings, but Greendyke Street remains open.

The remarks in Scheme A concerning the traffic light controlled circulatory system also apply to this scheme.

Greendyke Street to Hospital Street

This section is the same as Scheme A except that the configuration of the Hamilton Road Route connections eliminate most of the weaving movements.

(c) Ultimate Proposals - South Flank

Hospital Street to Renfrew Motorway and Kingston Bridge

The deletion of intermediate connections along the South Flank has simplified the proposed construction difficulties as well as improving the traffic flow characteristics. The elevated structure being of constant width is simpler and cheaper to build and the elimination of additional ramp approaches lessens the visual impact.

The road alignment has been revised to avoid the Coliseum and the proposed surface street distributer has been moved further north of Bedford Street. This allows the future construction of the elevated motorway to be carried out with minimum interference to the existing surface streets.

(d) Staging Proposals

General

An advantage of these proposals is that in both schemes the development of the South and East Flanks can be sub-divided into four stages, each of which produces large immediate traffic benefits at minimal cost. It must be noted, however, that a timetable similar to the construction of the North and West Flanks would minimise the environmental and traffic disbenefits from an extended construction period. The possibility of amalgamating construction stages is presently being considered.

The completion of each stage allows each subsequent stage to be built with minimum interference to traffic operating on completed sections, and with a minimum of abortive work. The staging proposals are diagrammatically shown on Fig No 6.

Scheme A

Stage 1 - Report Drawing No 8A

This scheme connects from Townhead Interchange to the surface street system in the Gallowgate area which, in turn, connects to the one-way pair system crossing the River Clyde. The main line is constructed from Cathedral Street to the ramps just south of Duke Street. The ultimate interchange opposite Ingram Street will be built except for the southbound loop and the complete surface street system constructed as far south as London Road. A one-way pair utilising Greendyke Street and Charlotte Street would then lead to the Victoria and Albert Bridges. A small amount of temporary works are necessary to connect to Townhead Interchange north of Cathedral Street; however, this stage involves no abortive work.

Stage 2 - Report Drawing No 8B

This stage comprises the main line section crossing the River Clyde between London Road and Hospital Street, and their surface connections. Its primary function is to relieve traffic on the surface street system connecting these areas, particularly Greendyke Street and the river bridges. Abortive works are not necessary to construct this stage.

Stage 3 - Report Drawing No 9

Stage 3 completes the Inner Ring Road. It comprises two sections, the first of these being the elevated section of the East Flank between Duke Street and Greendyke Street. The second section is the complete South Flank elevated road from Hospital Street to Renfrew Motorway and the Kingston Bridge.

The main revision to previous schemes is in the connection between the South Flank and Renfrew Motorway. The elevated ramps have been removed and replaced with surface connections. Although this lowers the design speed of the eastbound ramp, there are considerable savings in construction costs.

Stage 3 also contains no appreciable abortive works.

Stage 4

This stage links Hamilton Road Route to the Inner Ring Road.

The construction of the Hamilton Ramps under the existing surface streets will involve temporary movement of these streets but the circulation system is thought flexible enough to accommodate this. These ramps would only be built when the section of the Hamilton Road Route through Glasgow Green is constructed.

Scheme B

Stage 1

The comments contained in Scheme A also apply here, except that the two ramps connecting High Street to the south would not be constructed

and an abortive loop would connect the southbound carriageway to High Street at Ingram Street.

Stage 2

Once again, the majority of the comments on Scheme A applies here; however, the ultimate ramps to Hamilton Road Route are used together with abortive links to connect the motorway to the circulatory system at London Road.

Stage 3

The South Flank is identical in both schemes and is dealt with in the Scheme A proposals.

As in Scheme A, Stage 3 completes the elevated section of the East Flank between High Street and Greendyke Street. However, in this scheme the ultimate motorway connections between High Street and the south are constructed and the abortive loop from Stage 2 removed.

At this stage an undesirable situation exists where the connections between London Road and the main motorway join on the wrong side; however, the lane balance should alleviate the condition. The future construction of Hamilton Road Route overcomes this operational problem.

Stage 4

As in Scheme A, this last stage links the Hamilton Road Route to the Inner Ring Road and is outlined in the Ultimate Proposals.

3.8 Environmental Considerations

(a) Introduction

This report presents two alignments for the South and East Flanks, Scheme A and Scheme B, and attempts to provide initial observations on the benefits and disbenefits that these schemes would impose on the immediate areas through which they pass. The recent extended remit of Holford Associates to study the environmental considerations of this route has allowed little time to study in detail all the implications of the alignment; however, in the time available, consultations have been held with the Glasgow District Planning Department and observations have taken account of the provisions of the local area test plans.

East Flank - Scheme A

This scheme is completely dependent on the successful outcome of negotiations with British Rail to traverse the High Street Goods Station. All previous schemes for the East Flank had to regard this site as an absolute control. The alignment completely avoids the Saltmarket/High Street/Castle Street historic route leading to the Cathedral.

East Flank - Scheme B

This alignment regards High Street Goods Station as an absolute control and, although it shares the benefit of Scheme A in providing a cut and cover section through the University - Cathedral section, the detrimental effect on the environment of High Street and George Street reduces considerably its advantages in relation to Scheme A.

South Flank

The alignment of the South Flank is common to both schemes and in principle has varied little in alignment from that indicated in the Glasgow Highway Plan Report, other than to avoid the Gorbals Welfare Clinic and the Coliseum Cinerama.

(b) East Flank - Scheme A

Scheme A is in cut and cover from St James Road to a point just south of High Street on an alignment that does not affect any significant buildings. The proposal would allow for the retention of the existing line of Cathedral Street with the views of the Cathedral and Castle Street environs from within the City. The properties in Collins Street and Morrin Square would be retained and available for refurbishment. The temporary nurses' homes affected by the route are scheduled by the Hospital Board for replacement elsewhere in 1983.

The cut and cover section does not, in general, encourage above-deck construction though, in the interests of continuity of frontage to Cathedral Street/High Street, building could be permitted in these areas. The remaining area of ground created by this cut and cover section will be landscaped hard and soft in relation to a brief on the function of the area as well as providing a setting for the Barony Church. The profile through High Street Goods Station is subject to further detailed study. Future developers on the east side of High Street would require to be made aware by the Glasgow District Planning Department of the importance of design of frontage, not only onto High Street but onto the landscaped corridor of the East Flank.

Existing pedestrian movements within this area would be unaffected by either scheme, which at any one point would be either in cut and cover or on structure, thereby allowing the pedestrian free movement.

Glasgow Cross - Glasgow Green

Subsequent to crossing High Street Goods Station on structure, Scheme A is located on embankment on the site of the British Railways College Goods Yard prior to crossing the existing elevated railway at Bell Street. This alignment would allow a substantial development on High Street and retain the imposing Bell Street warehouses. The College Goods Yard junction appears imposing on plan; however, the on and off ramps would be in cutting or on embankment and the maximum opportunity would be taken to extensively soft landscape the area and thus reduce much of the visual impact of the junction design.

The alignment crosses the elevated railway and passes over Gallowgate and London Road immediately to the east of the Electricity Substation. It then continues on a line that emerges from between the two Coffee Works buildings fronting Greendyke Street before passing over the Green at approximately tree foliage level. The road crosses the River Clyde between Albert Bridge and the Tidal Weir, passing close to the Gorbals Welfare Clinic, before linking with the South Flank at Ballater Street.

The elevated section of road lies within a corridor of land proposed for redevelopment as part of the comprehensive plan for the Calton area. The proposed phasing of the East Flank through this area requires extensive at-grade through traffic and due consideration must be given to the establishment of clean lines of pedestrian movement through this area, linking the housing of Calton and the commercial interests of the Barrows with Glasgow Cross and Argyle Street. Two major pedestrian thoroughfares are envisaged, one along Gallowgate and the other in London Road, and the recommendation has been made that both these routes be at grade. St Andrews Square has been taken as an absolute control and the elevated section of the road has been located as far east as practical to accommodate the obvious difference in scale between the two elements. The roads marked on the plan in the proximity of the Square are at surface level and will be the subject of further study.

An attempt has been made to simplify the elevated structure over the Green and the design group would be required to give every consideration to the detail of the line of structure and column as well as the landscape restoration of this section of the park. The alignment indicates that the Gorbals Welfare Clinic in Florence Street could in strict engineering terms remain unaffected by the works, though detailed environmental consideration will have to be given to the operation of the Clinic in the daylight shadow imposed by the elevated road.

(c) East Flank - Scheme B

This alignment is in cut and cover from St James Road to Rottenrow before emerging to rise over both George Street and High Street. The depressed section of this alignment, as in Scheme A, does not inhibit the possible expansion of Strathclyde University but the residential buildings in Collins Street and Morrin Square would be affected by this route whereas the temporary nurses' homes would be unaffected by this route. Cathedral Street would require to be realigned to the north with the resultant loss of the through vista to the Cathedral precinct.

Scheme B crosses High Street on structure and the resulting configuration of high and low level ramps also on structure increases the problem of integration of road with the adjoining land uses. The alignment physically affects part of the Bell Street warehouses and inhibits development of the High Street from College Goods Station. Although the remaining section of alignment passes to the west of the Electricity Sub-station, the relationship of elevated structure to St Andrews Square, Glasgow Green, and the Gorbals Welfare Clinic remains as for Scheme A.

(d) South Flank

Laurieston-Gorbals

The alignment of the elevated section of the South Flank route from Ballater Street in the east to the Kingston Bridge in the west is in principle the line of the route that was incorporated into the comprehensive redevelopment plans for the Laurieston-Gorbals area.

The present TPP incorporates a depressed distributer road between Gorbals Street and Eglinton Street. The South Flank would be located on structure immediately to the south of this route at a height of approximately 15 metres (50 feet).

In order that existing pedestrian movements can be retained, it is proposed that at-grade footpaths will cross the partially depressed road, and that the structural works will be integrated through soft and hard landscaping with the proposed land uses of the area. Sections illustrating outline proposals are shown in this report. At present neither the pedestrian movement nor the extent of landscape integration have been studied in detail.

West of Bridge Street

The elevated section spans the railway viaduct before linking with the ramps of Kingston Bridge at West Street. The on and off ramps to the Renfrew Motorway are contained within the present highway Land Take for Renfrew and Kingston.

The elevated structure allows freedom of pedestrian movement through the area; however, study is required to attain the maximum visual and practical benefits of the ground areas made available through the use of an elevated structure.

3.9 Consultations

Strathclyde Regional Council Department of Roads have instigated consultations with the various Regional and District Departments listed below with a view to establishing an acceptable corridor for land reservation. Consultations have also been held with numerous amenity groups.

Strathclyde Regional Departments:
- Physical Planning
- Estates Department
- Police
- Passenger Transport Executive

Glasgow District Council Planning Department
Scottish Development Agency
Scottish Special Housing Association
British Rail
Scottish Civic Trust
Scottish Georgian Society

3.10 Further Studies

It will be necessary to carry out a number of preliminary studies before detailed design considerations are formulated for the proposals. In particular, we would make reference to:

(a) Continuing discussions will be necessary with British Railways to resolve and promote the alignment proposals, particularly with regard to High Street Goods Station and the effect that Scheme A would have on their present operations.

(b) Preliminary soils investigations will require to be carried out.

(c) Further traffic studies will be necessary to establish both the short and long term effects of the staging proposals.

3.11 Costs

The following table of construction costs includes the cost of connecting both East Flank Schemes to Townhead Interchange Stage 2. The Head of Estates has estimated that the land acquisition costs for both schemes will be in the region of £10 million.

TABLE OF COSTS (Estimated at November 1977 prices)

Scheme A	£M	£M
Stage 1 - East Flank - From Townhead Stage 2 to London Road	7.51	
Allowance for Townhead Stage 3	1.58	9.09
Stage 2 - East Flank - From London Road to Hospital Street		6.93
Stage 3 - South Flank - Elevated Road from Hospital Street to Renfrew Motorway	8.20	
- East Flank - Elevated Road from Ingram Street to Greendyke Street	4.09	12.29
Stage 4 - East Flank - Connections to Hamilton Road Route		0.26
		£28.57 M

Scheme B		
Stage 1 - East Flank - From Townhead Stage 2 to London Road (includes approx £90,000 abortive works)	5.81	
Allowance for Townhead Stage 3	1.58	7.39
Stage 2 - East Flank - From London Road to Hospital Street (includes approx £250,000 abortive works)		7.17
Stage 3 - South Flank - Elevated Road from Hospital Street to Renfrew Motorway	8.20	
- East Flank - Elevated Road from Ingram Street to Greendyke Street	4.67	12.87
Stage 4 - East Flank - Connections to Hamilton Road Route		0.34
		£27.77 M

4. ASSESSMENT OF BENEFITS

4.1 Introduction

In this part of the report, estimates are made of the measurable savings that arise from the construction of the South and East Flanks of the Inner Ring Road. These are:

(a) Savings in travel time.

(b) Reduction in accidents.

(c) Reduction in fuel consumption due to the better fuel consumption on urban motorways compared with the conventional urban roads.

(d) Savings in vehicle time (valid only for vehicles used for work).

All of these savings arise because vehicle miles are diverted from conventional urban roads to urban motorway. This is primarily the flows on the South and East Flanks bu' in this particular case the provision of the South and East Flanks per. 'ts additional traffic flows on the Monkland and Renfrew Motorways, which could not otherwise occur. These latter flows are counted in respect of peak hour flows only, since off-peak the Inner Ring Road can cope and no traffic would be diverted off at these times.

The estimated diversion to motorway is 152,500 vehicle miles per day or 50.3 million vehicle miles per year.

4.2 Savings in Travel Time

The first element to be considered is time savings of people in vehicles which is by far the largest benefit when converted to money terms.

The approach adopted is to calculate the number of vehicle miles transferred from the normal streets to the motorway by virtue of the construction of the South and East Flanks.

Knowing the average motorway speed, 50 mph, the average speed on the normal roads (in the inner City area) of 15 mph, and the traffic diverted to the South and East Flanks of 50.3 million vehicle miles per year, it is possible to estimate the savings in vehicle time of 2.34 million vehicle hours per year.

The composite value in 1977 terms of the time of drivers and other occupants, assuming the average mix of vehicles, and using values quoted in the Leitch Report, is £2.29 per vehicle hour. The benefit of time savings by drivers and other occupants' time in one year (1990) is 2,349,000 vehicle hours at £2.29 = £5,367,000.

4.3 Reduction in Accidents

It has been estimated that in 1975 the injury accident rate on all non-motorway roads in Glasgow is 2.7 injury accidents per million vehicle miles, whereas the corresponding rate for motorways in Glasgow is 0.126. To allow for the assumed greater severity of urban motorway accidents, this figure was rounded up to 0.2 so that the reduction in accident rate consequent upon a shift of traffic from normal urban roads to motorways becomes 2.5 injury accidents per million vehicle miles.

For lack of more specific information, it is assumed that the particular existing roads that lose traffic to the proposed motorway have an average accident rate. In reality, the actual rate may be higher or lower.

The cost per injury accident is given in the Leitch Report as £2,300 for urban roads in 1964. Correcting for inflation, this becomes £3,800 in 1977.

∴ No of injury accidents saved in one year = 50.3 x 2.5 = 125
This corresponds to 150 casualties and 4 fatalities.

The cost of accidents in one year (1990) is 125 x £3,800 = £475,000.

4.4 Reduction in Fuel Consumption

Recent tests in Glasgow using a standard car have shown a petrol consumption on motorways of 38 miles per gallon and a petrol consumption of 26 miles per gallon on other roads. This results in a saving of 0.0384 gallons per vehicle mile transferred. To allow for the proportion of commercial vehicles, this has been increased by 20% = .0145 gallons/vehicle mile. Fuel saved is thus:

50,300,000 x .0145 = 729,000 gallons

at 47p per gallon net of tax = £343,000

4.5 Savings in Vehicle Time

The composite time value of vehicles used in the course of work is calculated to be £0.21 per vehicle hour in 1977. The benefit of reduced vehicle time in one year (1990) is 2,349,000 vehicle hours at £0.21 = £486,000. There appears to be little published on this subject which is both clear and authoritative, and further work on this topic is desirable.

4.6 Summary of Benefits

The measurable benefits are as follows:

Savings in Drivers' and Other Vehicle Occupants' Time:	
2,349,000 vehicle hours at £2.29	£5,367,000
Accident Cost Savings:	
125 injury accidents at £3,800	475,000
Fuel Cost Savings:	
728,000 gallons at 47p/gallon	343,000
Savings in Vehicle Time:	
2,349,000 vehicle hours at £0.21	486,000
	£6,671,000

5. SCHEME JUSTIFICATION

5.1 Objectives

Justification for the South and East Flanks of the Inner Ring Road must be judged against the objectives of Strathclyde Regional Council, established in the document "Transport Policies and Programmes 1978-83", and set out in the Introduction to this report.

The main transportation objectives which are relevant to this report are:

A. To develop the strategic road network by giving priority towards increased benefits for freight, industrial and commercial traffic.

B. To utilise and improve the existing transportation system in order to enhance the environment, particularly in Areas of Need.

The more specific objectives listed under "Other Objectives" which are especially relevant to this study are:

C. To increase transport user benefits by measures which reduce journey times and running costs and improve levels of service.

D. To reduce accidents.

E. To conserve energy by encouraging use of public transport and by reducing congestion.

The assessment of justification falls into two main parts. The first part deals with implications for traffic flows on the existing road network in the absence of the South and East Flanks. These implications relate to the physical capacity of the road network and to the environmental consequences of the projected traffic flows on the existing roads, in the absence of the South and East Flanks.

The second part relates to the measurable savings arising from the South and East Flanks of the Inner Ring Road, as follows:

1. Savings in travel time of drivers and other vehicles' occupants.

2. Reduction in accidents.

3. Reduction in fuel consumption arising from the better fuel consumption achieved on urban motorways as compared with conventional roads.

4. Savings of vehicle time.

5.2 Traffic Considerations

The first part of the justification is dealt with in Section 2 - Traffic. The conclusion is reached that the physical capacity of the existing road network will be exceeded by 1990 traffic and that the environmental effect of traffic on certain roads will be most unpleasant; High Street, Saltmarket, and roads through Laurieston-Gorbals being worst affected.

5.3 Economic Benefits

The measurable benefits are calculated in Section 4 - Assessment of Benefits. The total annual savings that would flow from the construction of the South and East Flanks in terms of 1990 traffic measured in 1977 values amount to £6,671,000. This compares with a capital cost, including property acquisition of about £38,000,000, producing a simple rate of return of 17.6%. This is more than sufficient to justify the construction of the project. Moreover, it does not include certain real benefits:

(i) In assessing time savings, it has been assumed that present day average road speeds will continue. In reality, the average speeds on the road system will fall as traffic increases, if the Inner Ring Road is not completed, so that the actual time related benefits will be higher than shown.

(ii) The measured benefits do not include any allowance for driver comfort due to the generally more pleasant driving conditions prevailing on the motorway as against the stop-go driving on the city streets.

(iii) A further benefit which is difficult to assess but is likely to be real relates to the utilities in the city streets. All the utilities which service the City are in the city streets - sewers, water, gas, electricity and GPO. The cost of maintaining these services and effecting repairs must inevitably be greater in streets that are running to capacity.

(iv) The other benefit not included is the benefit to buses. When congestion reaches a certain level on city streets, buses are delayed and fall behind schedule. This problem is likely to arise especially in High Street, although most, if not all, bus routes in the vicinity of the Central Area are likely to be affected.

(v) Urban motorway travel undoubtedly involves less wear and tear on brakes, clutch and gear box. There is little doubt that real benefits accrue but it has not proved possible to evaluate these benefits in this report.

5.4 Justification in Relation to Policy

To summarise the justification, in terms of the Region's objectives as set out at the beginning of this section:

A. To develop the strategic road network by giving priority towards increased benefits for freight, industrial and commercial traffic.

The proposed project would develop the strategic road network by removing a bottleneck which will otherwise arise at the focal point of the Region's strategic road network involving large volumes of freight and industrial and commercial traffic.

B. To utilise and improve the existing transportation system in order to enhance the environment, particularly in Areas of Need.

The proposed project would enhance the environment, especially in the area of the Cathedral and Strathclyde University, around Glasgow Cross - Saltmarket, and in the Laurieston-Gorbals CDA.

C. To increase transport user benefits by measures which reduce journey times and running costs and improve levels of service.

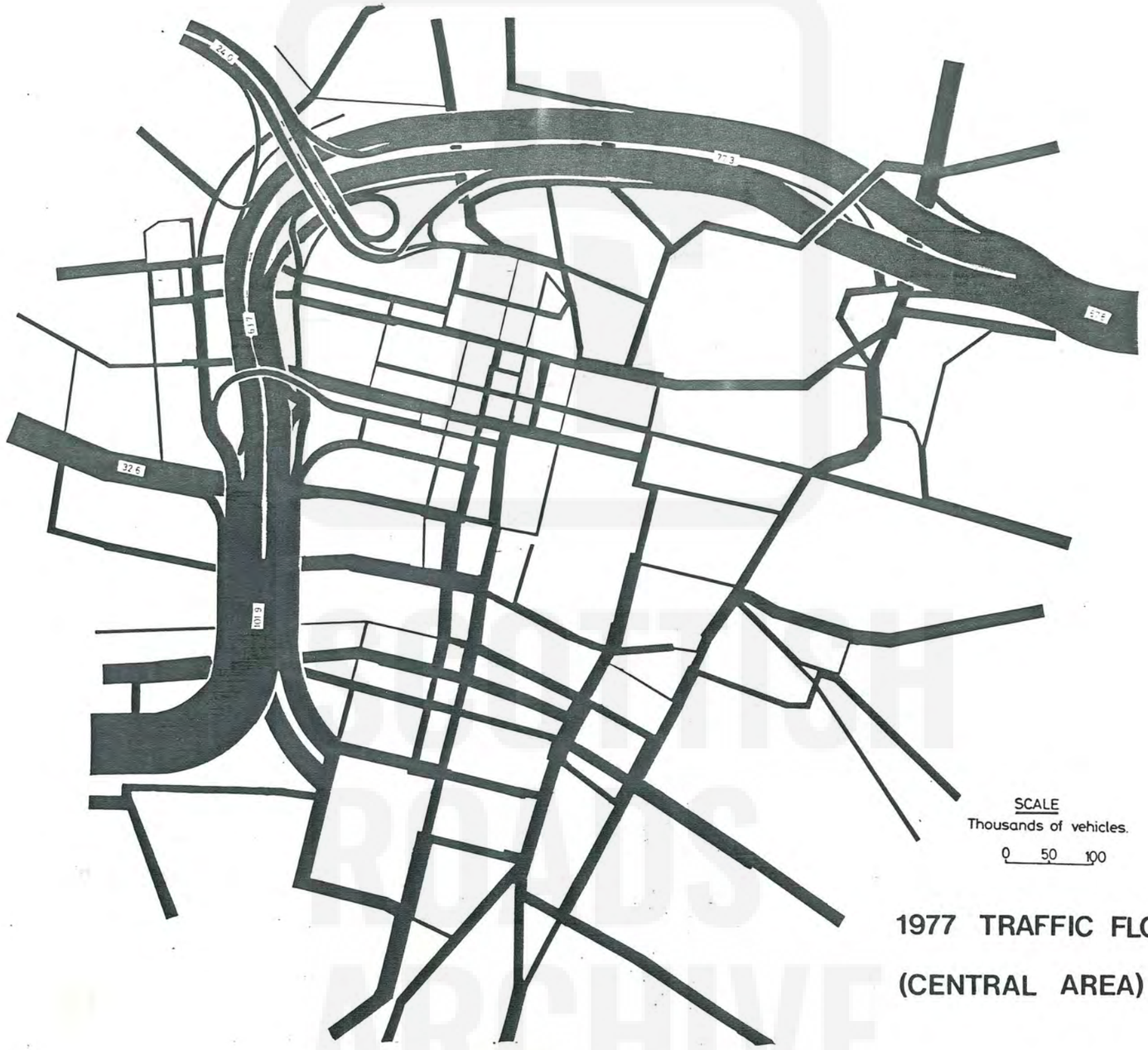
It has been demonstrated that the proposals substantially reduce journey times and running costs, especially as regards fuel consumption. The level of service of the existing North and West Flanks of the Inner Ring Road would be greatly improved, as would be many city streets.

D. To reduce accidents.

The proposed scheme is estimated to produce reduction of about four fatalities and 150 casualties per year.

E. To conserve energy by encouraging use of public transport and by reducing congestion.

As already stated, a substantial fuel savings is produced by the proposed scheme, which has been calculated. A further saving in fuel would follow from the reduction in congestion in many city streets.



SCALE
Thousands of vehicles.
0 50 100

1977 TRAFFIC FLOWS

(CENTRAL AREA)

FIG No1

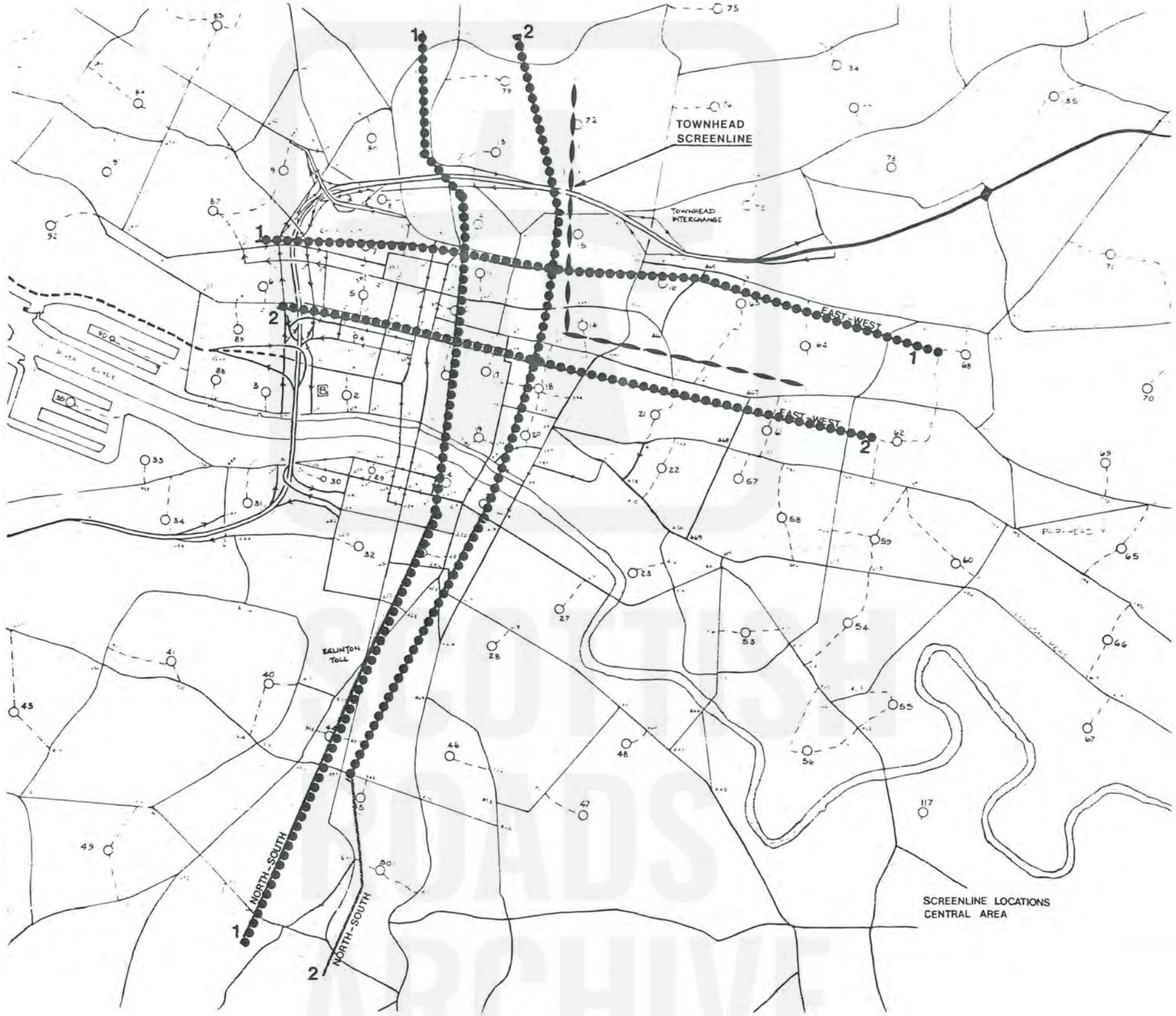


FIG No2

CHARING X

TOWNHEAD INTERCHANGE

57.0	Capacity
51.0	1978 Flow
72.7	1990 Target.1 Flow
55.1	1990 Target.1 - Restrained Flow
59.2	1990 Target.1 + Hamilton Road Route Flow
+5.0	+ Monkland.2

73.0	Capacity
65.7	1978 Flow
100.2	1990 Target.1 Flow
78.2	1990 Target.1 - Restrained Flow
85.3	1990 Target.1 + Hamilton Road Route Flow
+10.2	+ Monkland.2

92.0	Capacity
77.3	1978 Flow
115.8	1990 Target.1 Flow
92.2	1990 Target.1 - Restrained Flow
100.9	1990 Target.1 + Hamilton Road Route Flow
+11.7	+ Monkland.2

63.0	Capacity
60.4	1978 Flow
90.1	1990 Target.1 Flow
80.9	1990 Target.1 Restrained Flow
75.3	1990 Target.1 + Hamilton Road Route Flow
+6.8	+ Monkland.2

115.0	Capacity
102.0	1978 Flow
128.4	1990 Target.1 Flow
114.3	1990 Target.1 - Restrained Flow
116.3	1990 Target.1 + Hamilton Road Route Flow
+1.8	+ Monkland.2

SCALE:-

150.0

100.0

50.0

thou. veh/day

NOTE:

* Traffic induced by Monkland Stgs.2 and Dumbreck Road Connection.

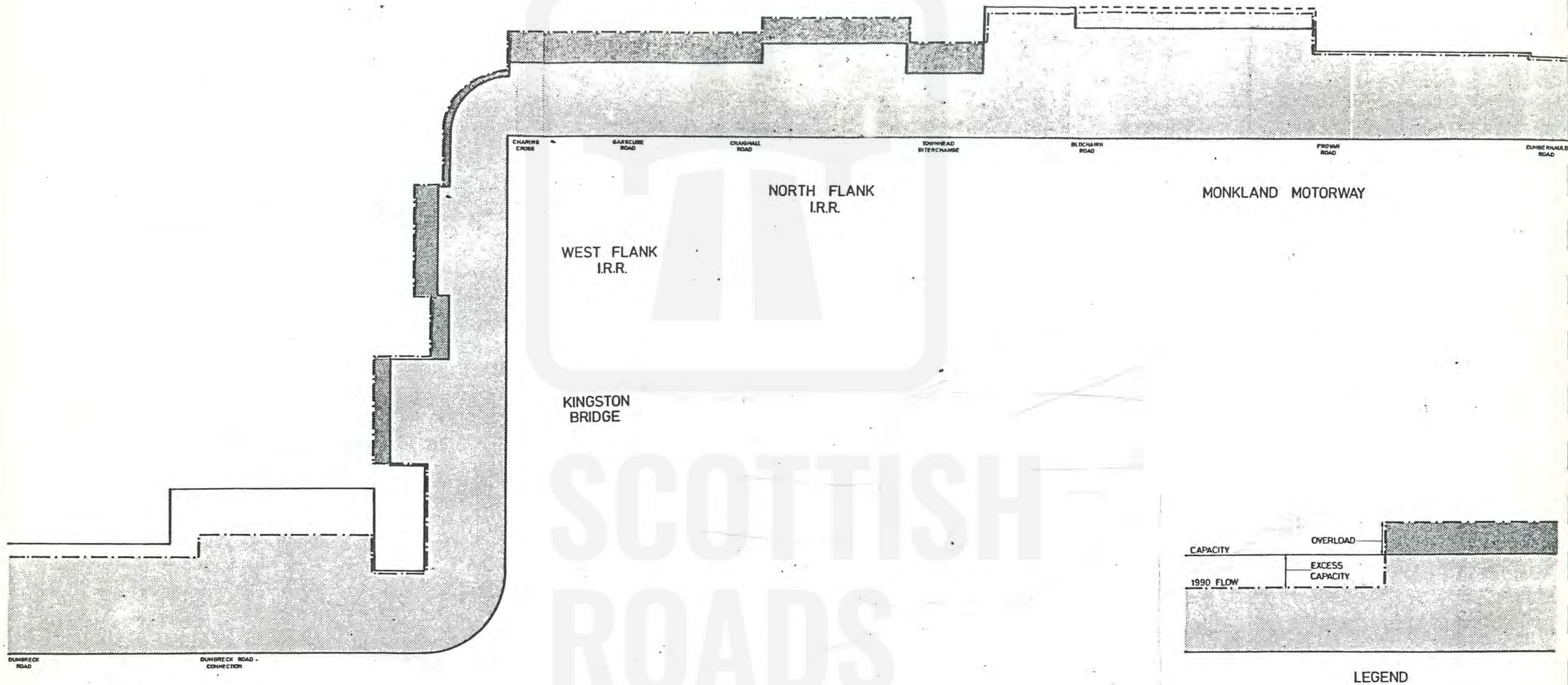
OUTER GLASGOW AREA STUDY

TARGET 1 NETWORK

CAPACITY OF NORTH AND WEST FLANKS_ IRR

FIG No3

SCOTT WILSON KIRKPATRICK & COMPANY (SCOTLAND



LEGEND

M8 CAPACITY FLOW DIAGRAM

FIG No4

Manually re-assigned Traffic Flows on Ring Road in Thousands of Vehicles per day

eg 32·9 = 32,900

32·9
37·2
47·1
47·3
52·9
53·6
30·0
26·5
43·4
44·9
53·1
60·8
56·6
59·3
28·6
29·6
46·5
50·9
24·4
20·6
14·7
14·7
33·0
35·4

CHARING X

TOWNHEAD INTERCHANGE

78501

1074

OUTER GLASGOW AREA STUDY

STRATEGIC HIGHWAY NETWORK

(Preferred)

CENTRAL AREA

RUN 2·31

1990 TRAFFIC FLOWS

FIG No 5

TOWNHEAD INTERCHANGE
COMMITTED SCHEME

STAGE 1

STAGE 2

STAGE 3

STAGE 3

STAGE 4 – CONNECTIONS TO
HAMILTON ROAD ROUTE

STAGING PROPOSALS

FIG No 6

355/146 = 2.43 376/146 = 2.57

CHANGES IN DAILY TRAFFIC FLOW
– TWO WAY RIVER CROSSINGS –

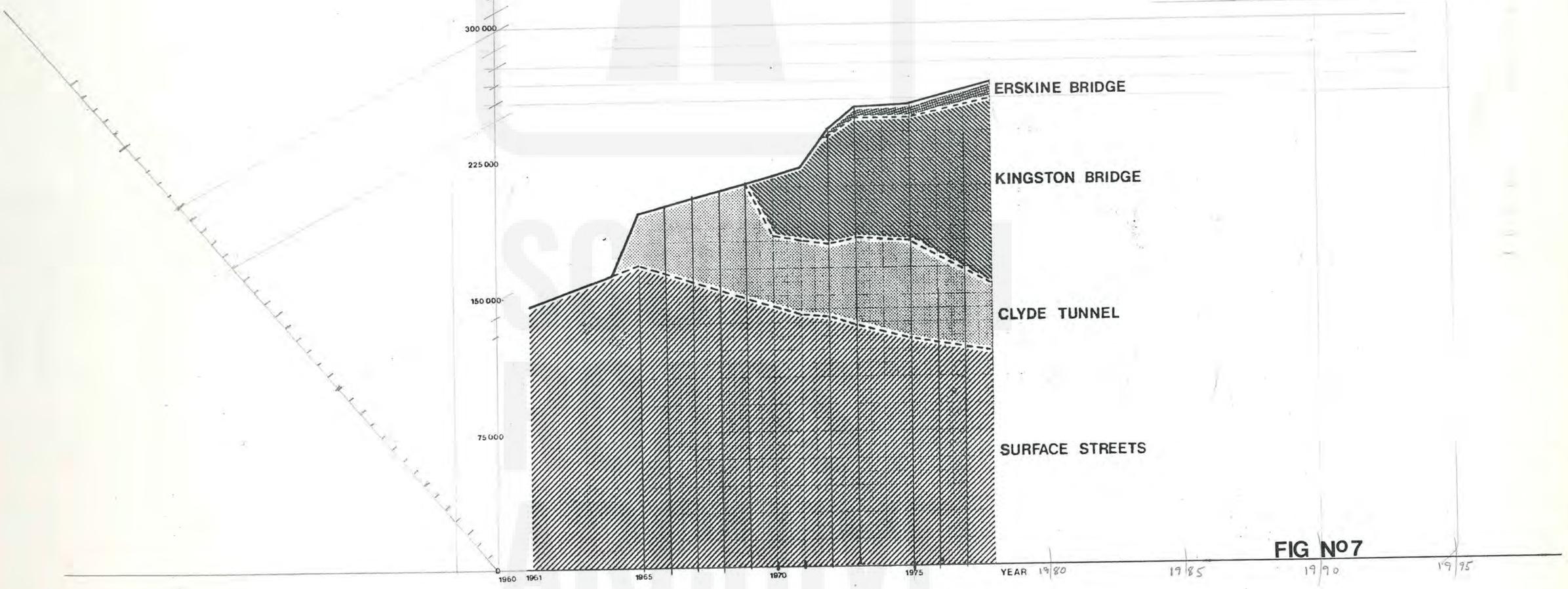
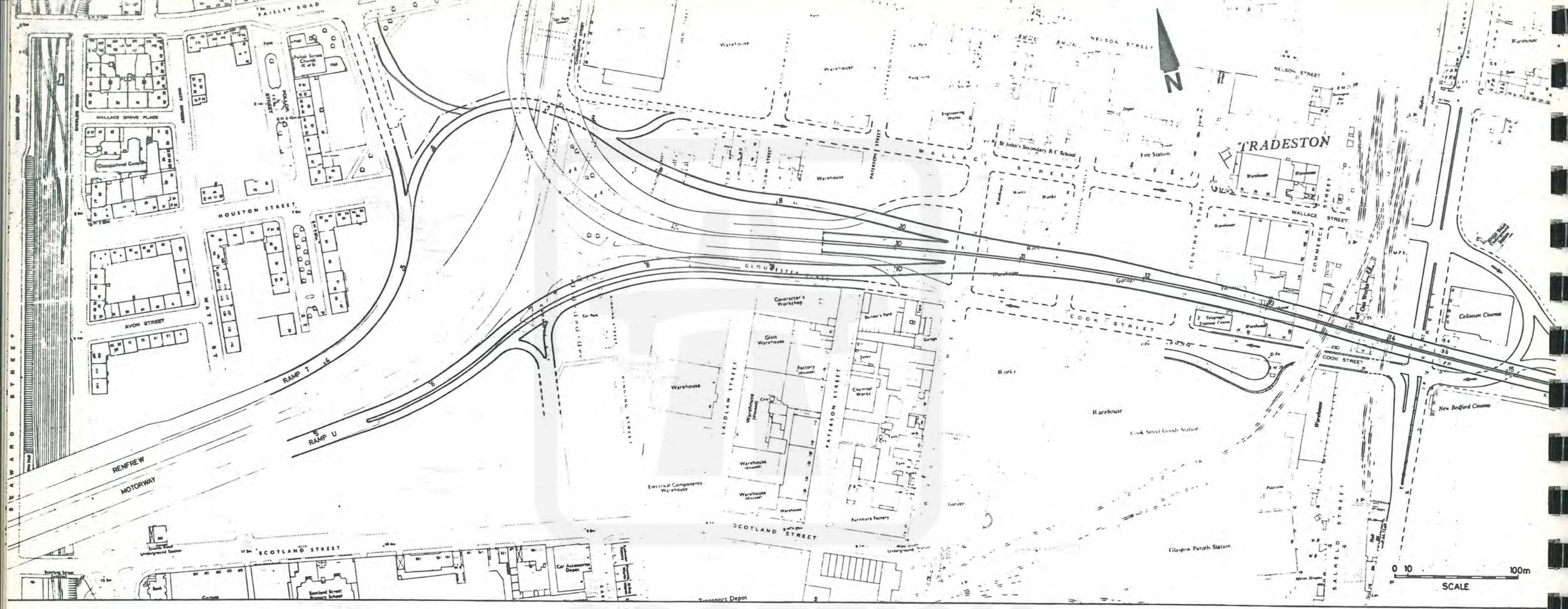
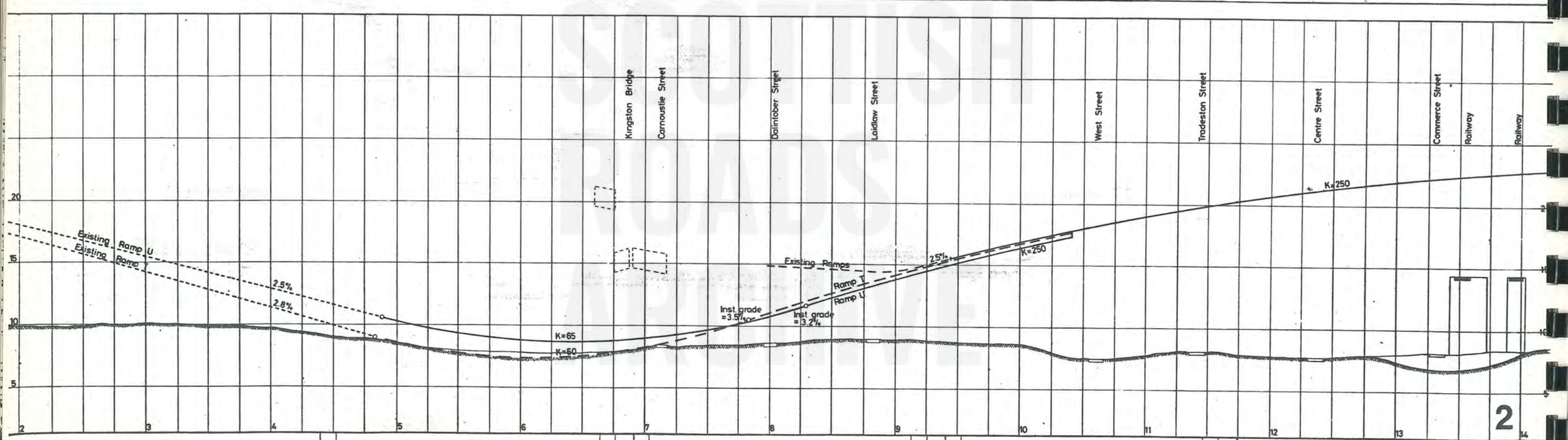


FIG No 7





STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

GLASGOW INNER RING ROAD

77501
462

Scale
Date Mar 78 Initials SMC
Checked Approved
Revisions

ULTIMATE SOUTH FLANK
SHEET 1

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)

TRADESTON

LAURIESTON

NELSON PLACE

St John's Secondary R C School

Fire Station

Gas Works

Coliseum Cinema

St John's R C Church

Public Baths & Wash Houses

Garage

COOK STREET

New Bedford Cinema

Works

Warehouse

Cook Street Goods Station

Glasgow Power Station

ABBOTSFORD PLACE

HORSLEY STREET

Realigned Hospital Street

RAMP

0 10 100m
SCALE

N

Paterson Street
Centre Street
Commerce Street
Railway
Railway
Eglinton Street
Coburg Street
Abbotsford Place
FOOTBRIDGE
Nicholson Street
Portugal Street
Gorbals Street
Hospital Street
Thistle Street
Old Rutherglen Road
Crown Street
Ballater Street

Inst. grade = 0.75%

K=250
K=200
K=20
K=10
K=20
K=10
K=10
K=10

5% RAMP M
6% RAMP L
3.5%
0.5%

30
25
20
15
10
5

11 12 13 14 15 16 17 18 19 20 21 22

3

STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

GLASGOW INNER RING ROAD

77501
463

Scale

Date Mar. 78 Initials SM*

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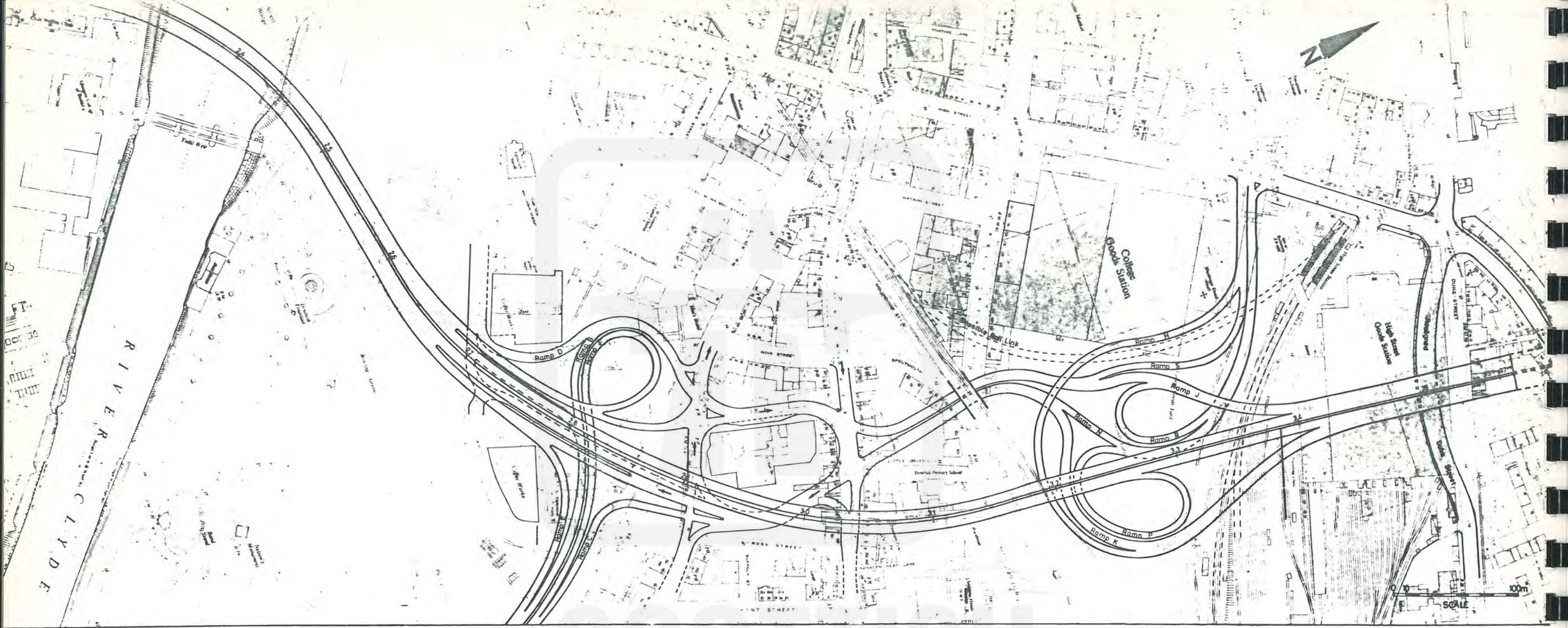
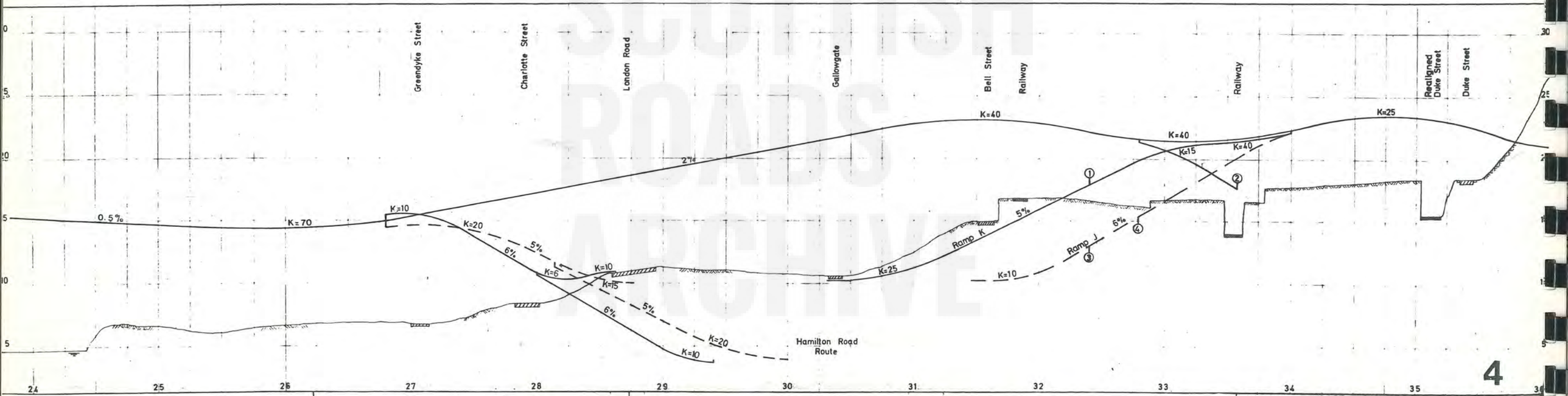
ULTIMATE SOUTH FLANK
SHEET 2





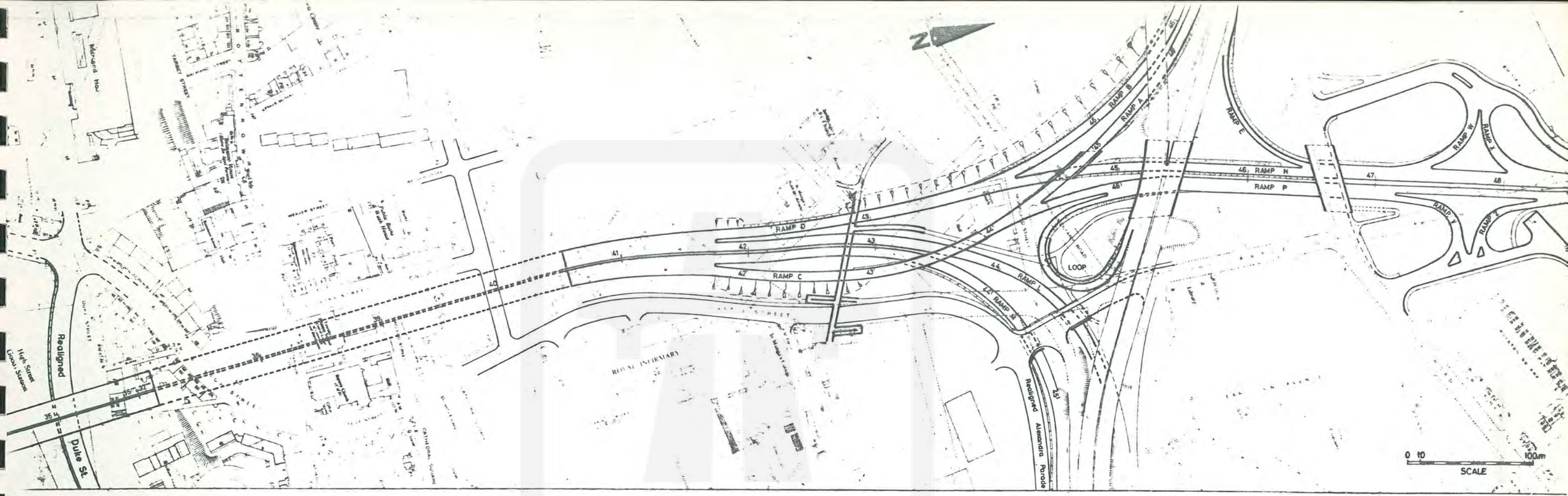
4

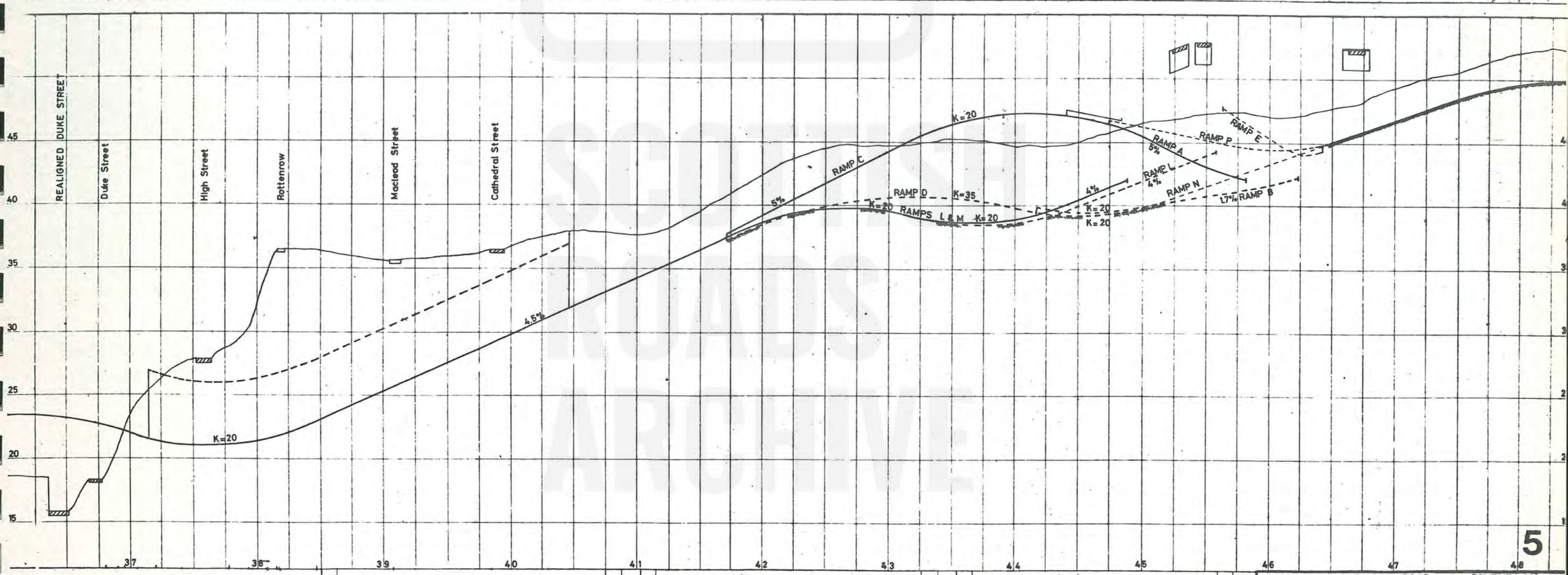
STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

GLASGOW INNER RING ROAD - SCHEME 'A'

78501 / 481	Scale	EAST FLANK ULTIMATE SHEET 1
	Date AUG '78 Initials GJB	
	Checked Approved	

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)





5

STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

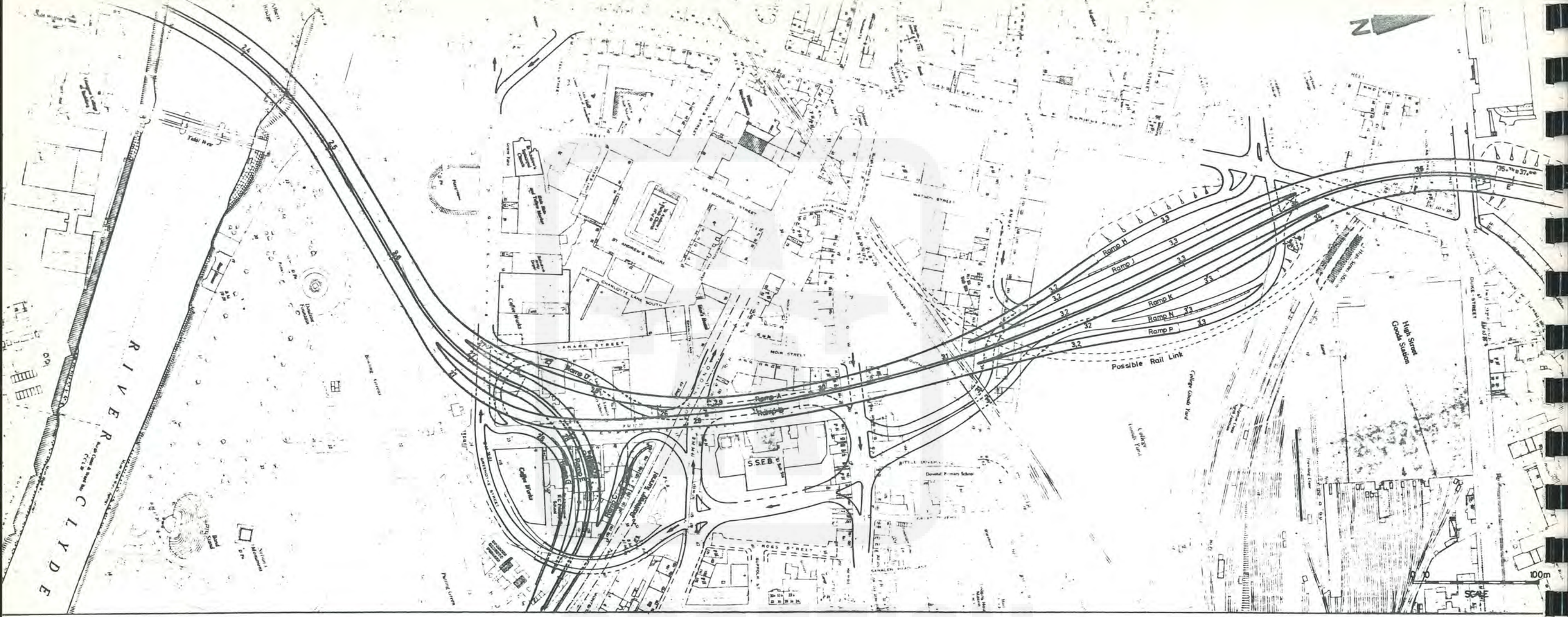
GLASGOW INNER RING ROAD - SCHEME 'A'

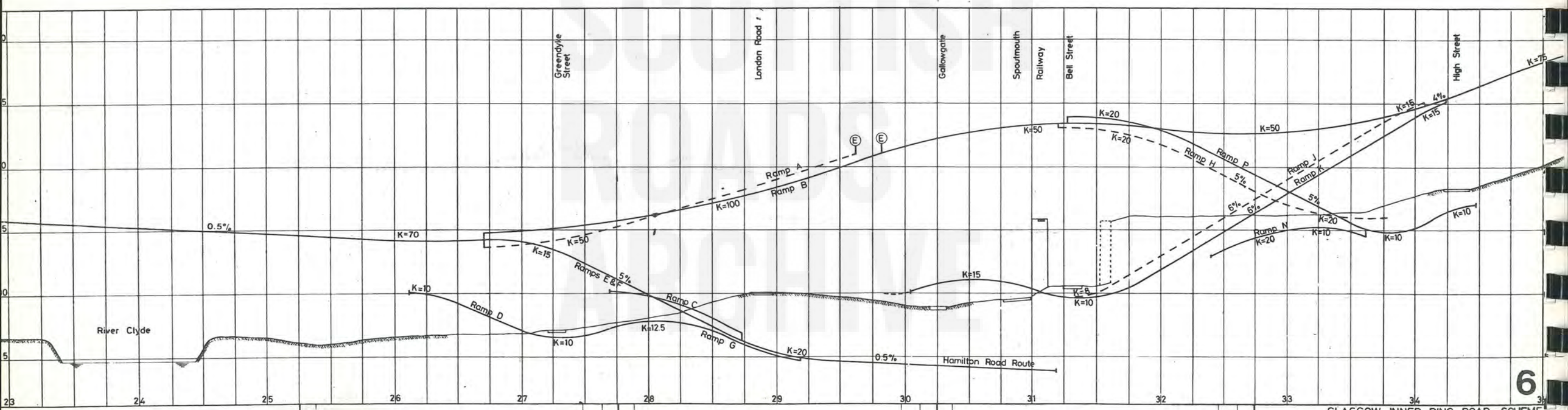
78501
482

Scale
Date AUG 78 Initials GR
Checked
Approved
Revisions

EAST FLANK ULTIMATE
SHEET 2

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)





6

STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

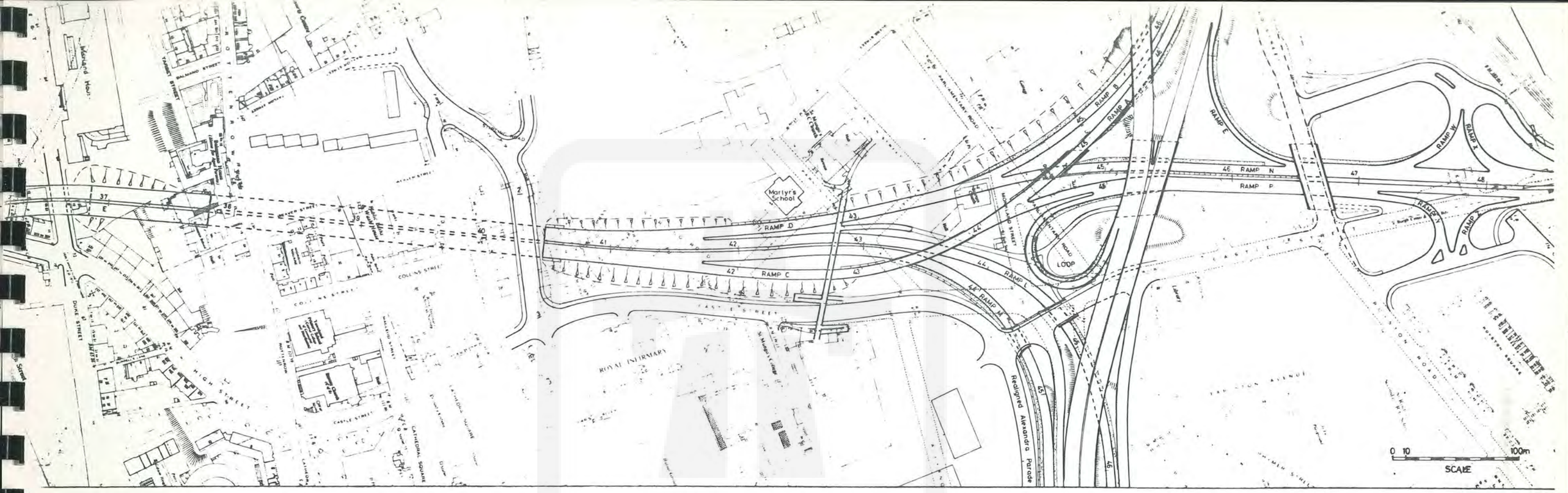
GLASGOW INNER RING ROAD - SCHEME D

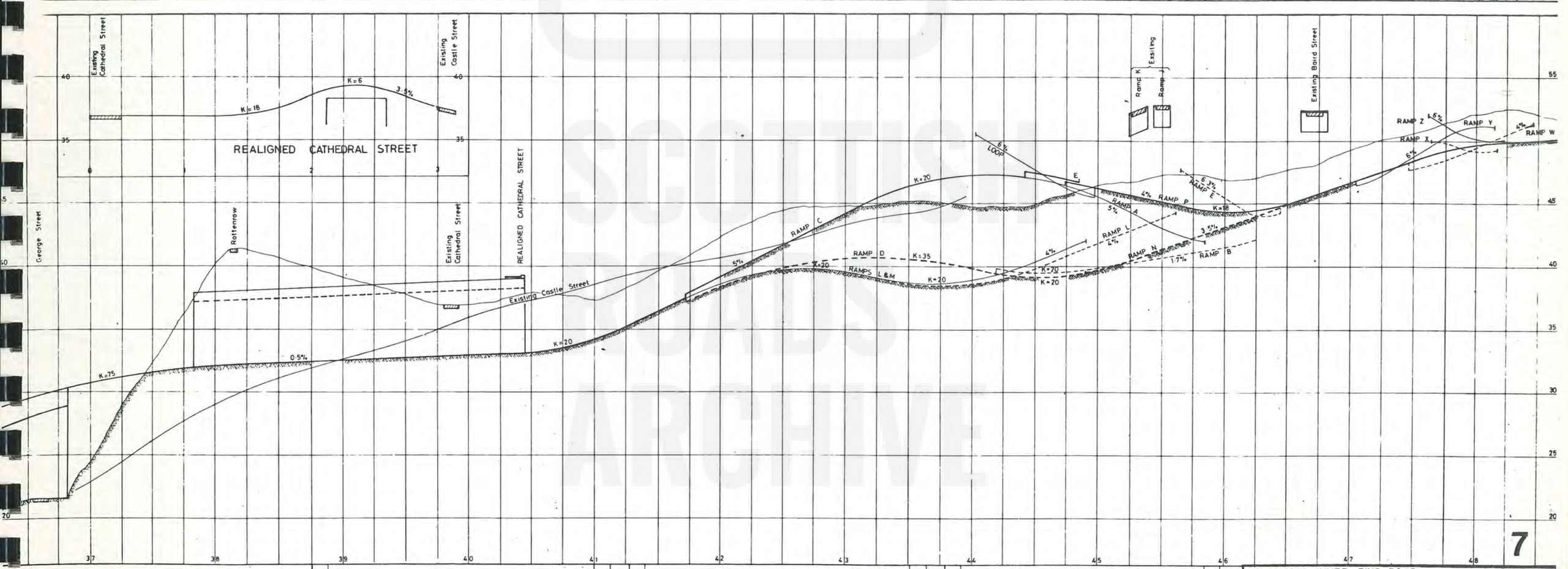
77501
461
Revisions

Scale
Date Mar 78 Initials SMC
Checked Approved

ULTIMATE EAST FLANK
SHEET 1

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)





7

STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

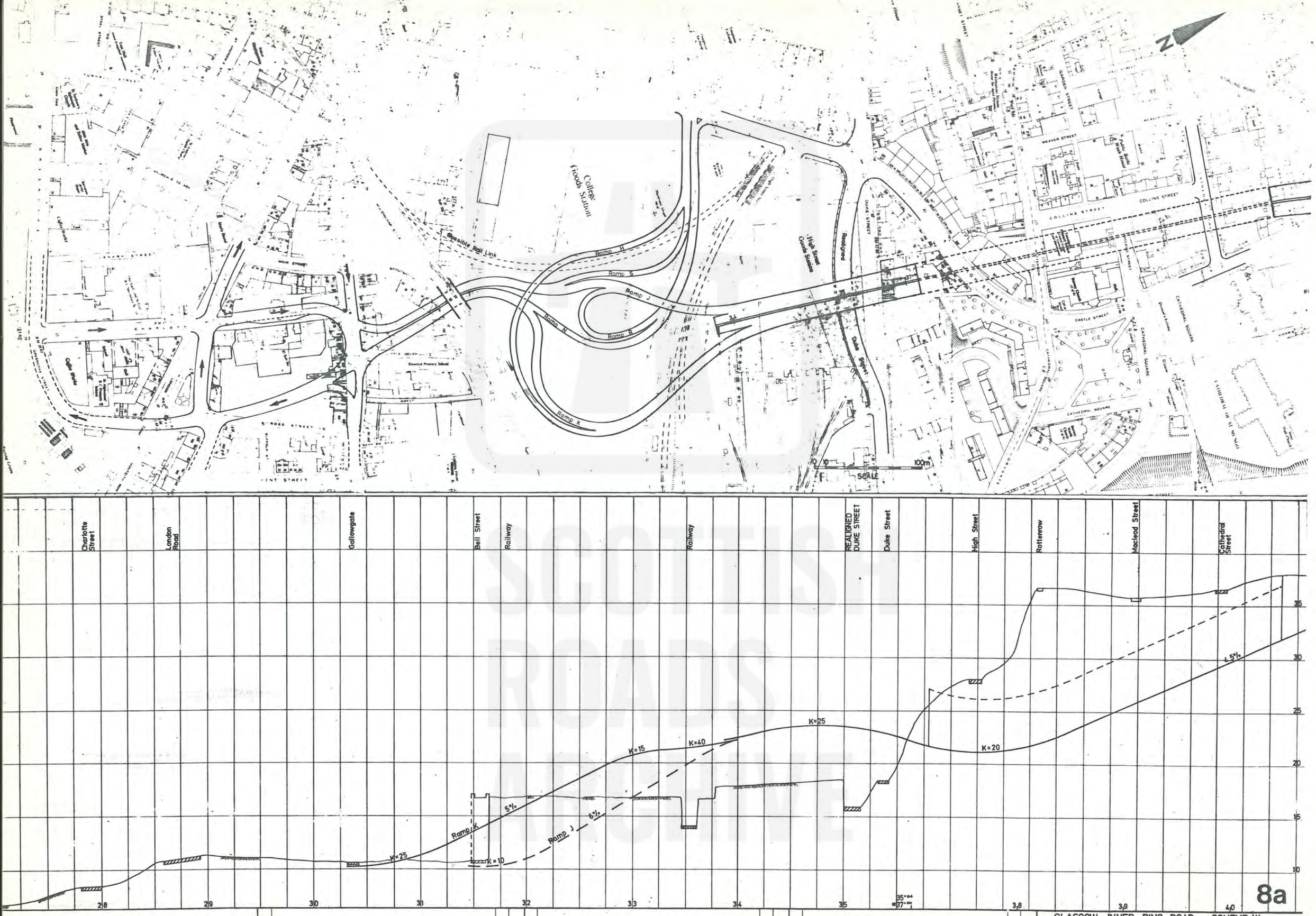
GLASGOW INNER RING ROAD SCHEME 'B'

78501
460

Scale
Date JUN 78 Initials W.H.
Checked Approved
Revisions

ULTIMATE EAST FLANK
SHEET 2

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)



STRATHCLYDE REGIONAL COUNCIL

DEPARTMENT OF ROADS

GLASGOW INNER RING ROAD – SCHEME 'A'

78501
487

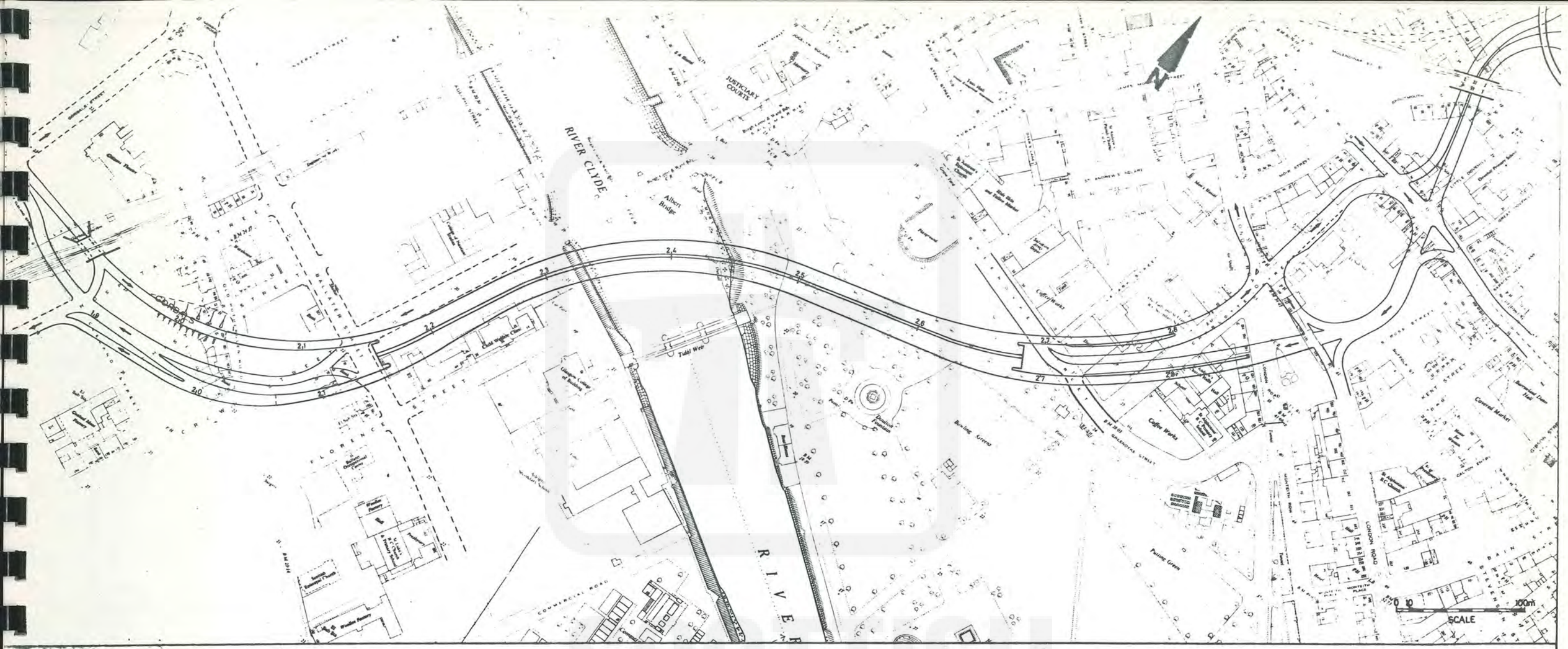
Scale 1:1250 1:125

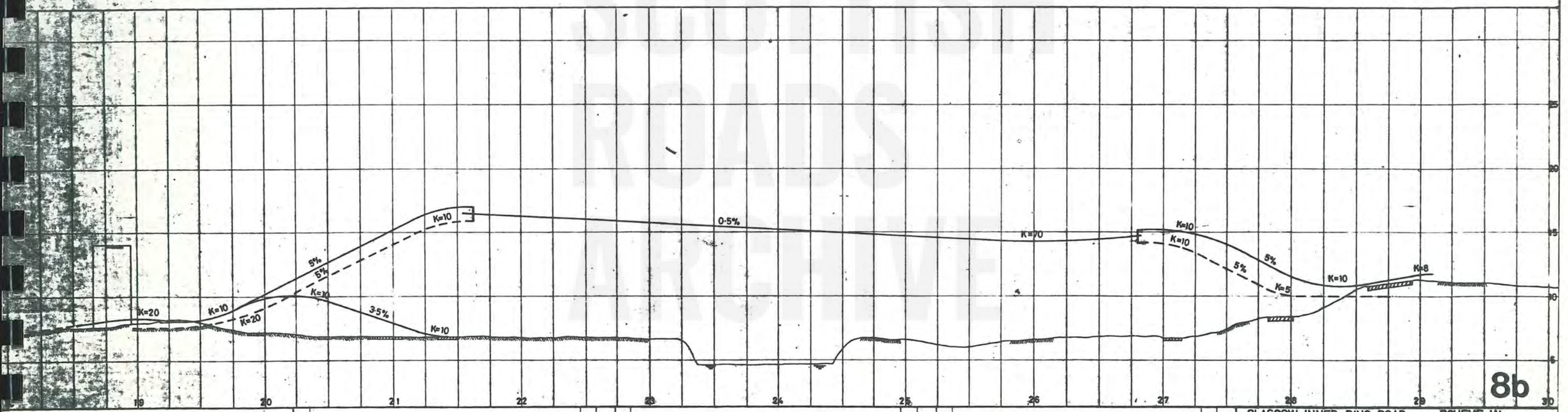
Date Oct. 78 Initials

Checked Approved

EAST FLANK – STAGE 1

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)





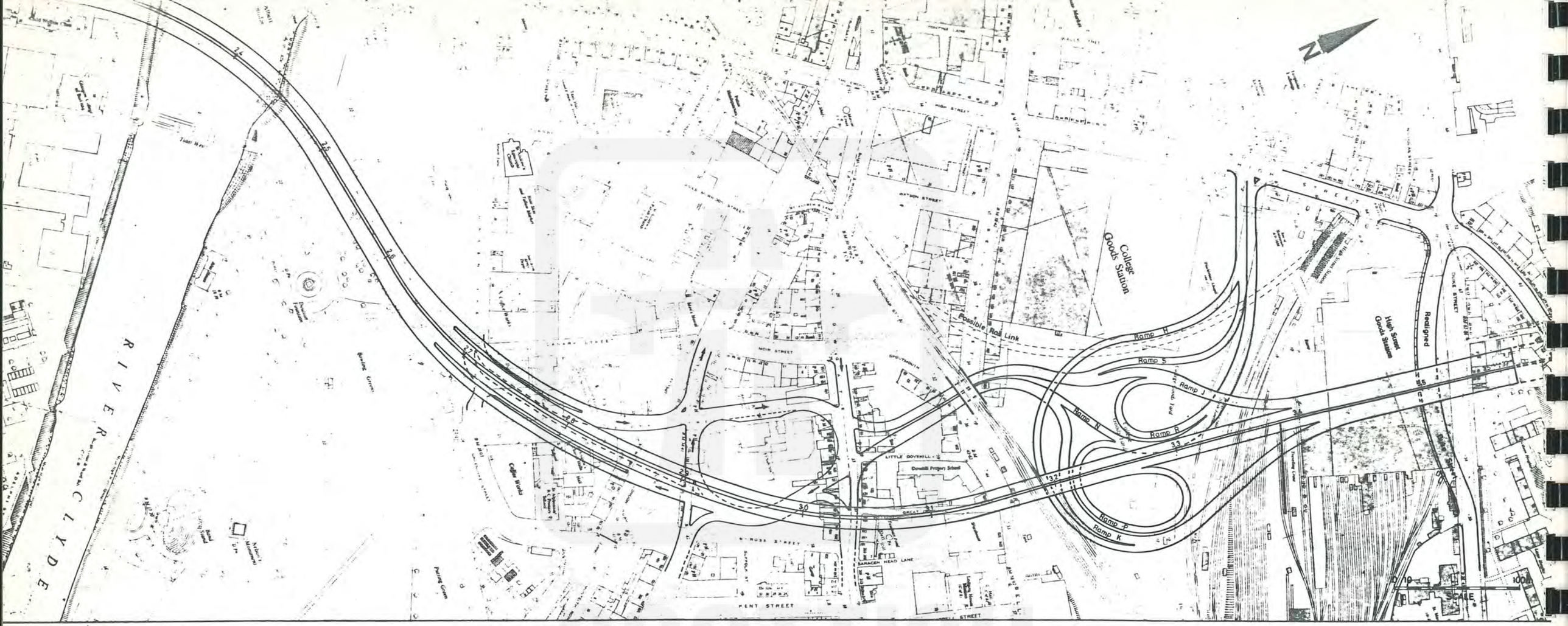
STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

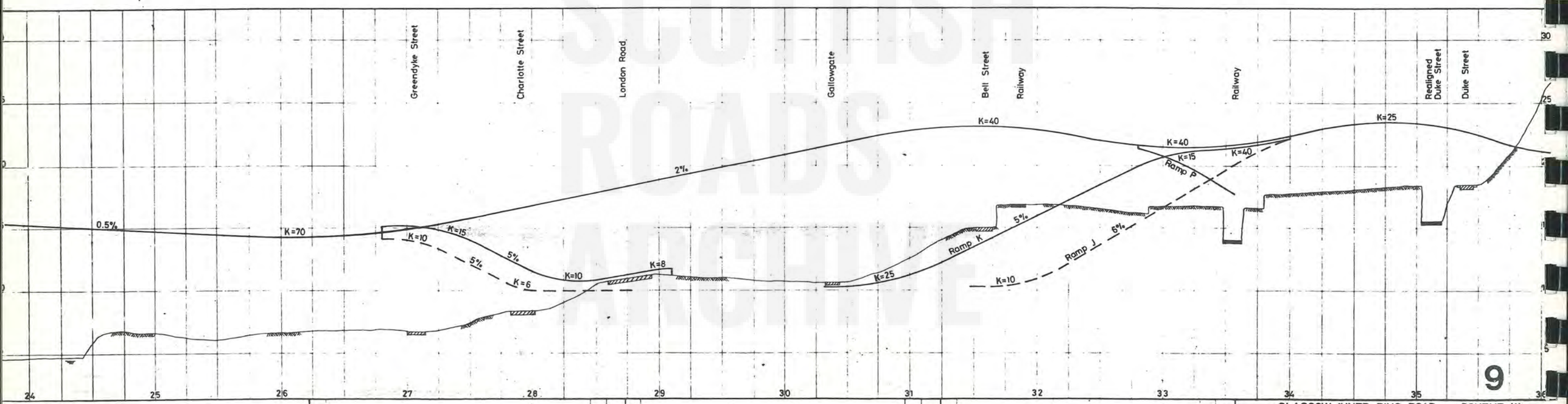
GLASGOW INNER RING ROAD - SCHEME 'A'

78501
486

Scale
Date
Checked
Initials
Approved

EAST FLANK - STAGE 2





STRATHCLYDE REGIONAL COUNCIL
DEPARTMENT OF ROADS

GLASGOW INNER RING ROAD – SCHEME 'A'

78501/485

Scale

Date AUG 78 Initials WH

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EAST FLANK - STAGE 3
PART PLAN

SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)

TOWNHEAD INTERCHANGE
COMMITTED SCHEME

STAGE 1

STAGE 2

STAGE 3

STAGE 3

STAGE 4 – CONNECTIONS TO
HAMILTON ROAD ROUTE

HAMILTON ROAD ROUTE

STAGING PROPOSALS

FIG No 6

SIGNIFICANT PROPERTIES:

1 Royal Infirmary
2 Glasgow Cathedral
3 Provand's Lordship
4 Barony Church
5 Barony North Church
6 Prisoners Aid Society Bldg.
7 Residential - Collins St.
8 Residential - Morrin Square
9 Residential - High St.
10 Residential - High St./Duke St.
11 High St. Goods Station
12 Oakfield Insurance Bldg.
13 Telephone Exchange
14 Bell St. Warehouses
15 Warehouse Bell St.
16 Warehouse Watson St.
17 Tolbooth Steeple
18 Mercat Building
19 Lift Pump House
20 Central Police Station
21 Fishers Store
22 St. Andrews Church
23 St. Andrews by the Green
24 Skin and Hide Works
25 Coffee Works
26 Our Lady & St. Francis' Sch.
27 Justiciary Courts
28 McLennan Arch
29 Doulton Fountain
30 Nelson's Monument
31 People's Palace
32 Electricity Sub Station
33 The Barrows
34 Barrowland Ballroom
35 St. Alphonsus' Church
36 St. Luke's Church
37 Nautical College
38 Health Clinic
39 College of Building
40 Adelphi Secondary Sch.

EAST FLANK A

POTENTIAL LAND USE:

- Residential
- Commercial
- Industrial
- Educational
- Public Buildings
- Landscaped space hard / soft
- Main pedestrian routes
- Parking (P)

RIVER CLYDE

CALTON

EAST FLANK A

SIGNIFICANT PROPERTIES:

1 Royal Infirmary
2 Glasgow Cathedral
3 Provand's Lordship
4 Barony Church
5 Barony North Church
6 Prisoners Aid Society Bldg.
7 Residential - Collins St.
8 Residential - Morrin Square
9 Residential - High St.
10 Residential - High St./Duke St.
11 High St. Goods Station
12 Oakfield Insurance Bldg.
13 Telephone Exchange
14 Bell St. Warehouses
15 Warehouse Bell St.
16 Warehouse Watson St.
17 Tolbooth Steeple
18 Mercat Building
19 Lift Pump House
20 Central Police Station
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22 St. Andrews Church
23 St. Andrews by the Green
24 Skin and Hide Works
25 Coffee Works
26 Our Lady & St. Francis' Sch.
27 Justiciary Courts
28 McLennan Arch
29 Doulton Fountain
30 Nelson's Monument
31 Student Residences
32 Electricity Sub Station
33 The Barrows
34 Barrowland Ballroom
35 St. Alphonsus' Church
36 Malvern House
37 Nautical College
38 Health Clinic
39 College of Building
40 Adelphi Secondary Sch.

EAST FLANK B

RIVER CLYDE

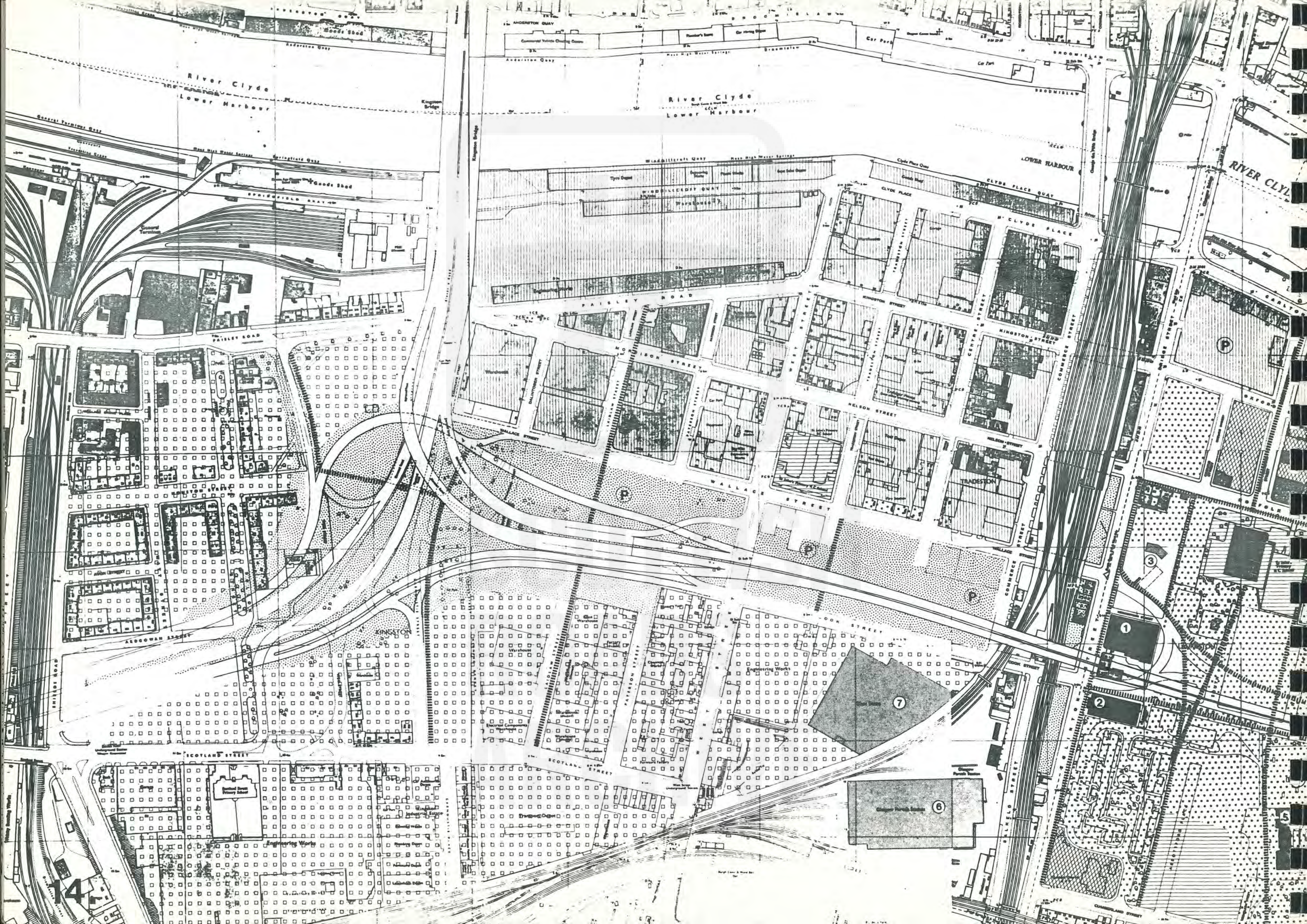
RIVER CLYDE

CALTON

POTENTIAL LAND USE:

- Residential
- Commercial
- Industrial
- Educational
- Public Buildings
- Landscaped space hard/soft
- Main pedestrian routes
- Parking (P)

EAST FLANK B


River Clyde
Lower Harbour
River Clyde
Lower Harbour
LOWER HARBOUR
RIVER CLYD
ANDERSTON QUAY
BROOMIELAW
CLYDE PLACE QUAY
CLYDE PLACE
PAISLEY ROAD
KINGSTON STREET
NELSON STREET
WALLACE STREET
SCOTLAND STREET
KINGSTON
TRADESTON
Engineering Works
P
P
P
P
1
2
3
5
6
7

PROPERTIES OF SIGNIFICANCE:

1 Coliseum cinema
2 Bedford social club
3 Bridge st. underground sta.
4 St John's R.C. Church and presbytery
5 22 storey res. tower
6 Glasgow parcels sta.
7 Glass store
8 Citizens' theatre
9 Listed bldg.

POTENTIAL LAND USE:

Residential
Commercial
Industrial
Educational
Public Bldgs
Landscaped open space hard/soft
Main ped. routes
Motorway landscaping
Primary surface rds.
Motorway

Perspective viewpoint
Parking (P)

SOUTH FLANK

SIGNIFICANT PROPERTIES:

1 Royal Infirmary
2 Glasgow Cathedral
3 Provand's Lordship
4 Barony Church
5 Barony North Church
6 Prisoners Aid Society Bldg.
7 Residential - Collins St.
8 Residential - Morrin Square
9 Residential - High St.
10 Residential - High St./Duke St.
11 High St. Goods Station
12 Oakfield Insurance Bldg.
13 Telephone Exchange
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15 Warehouse Bell St.
16 Warehouse Watson St.
17 Tolbooth Steeple
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25 Coffee Works
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27 Justiciary Courts
28 McLennan Arch
29 Doulton Fountain
30 Nelson's Monument
31 People's Palace
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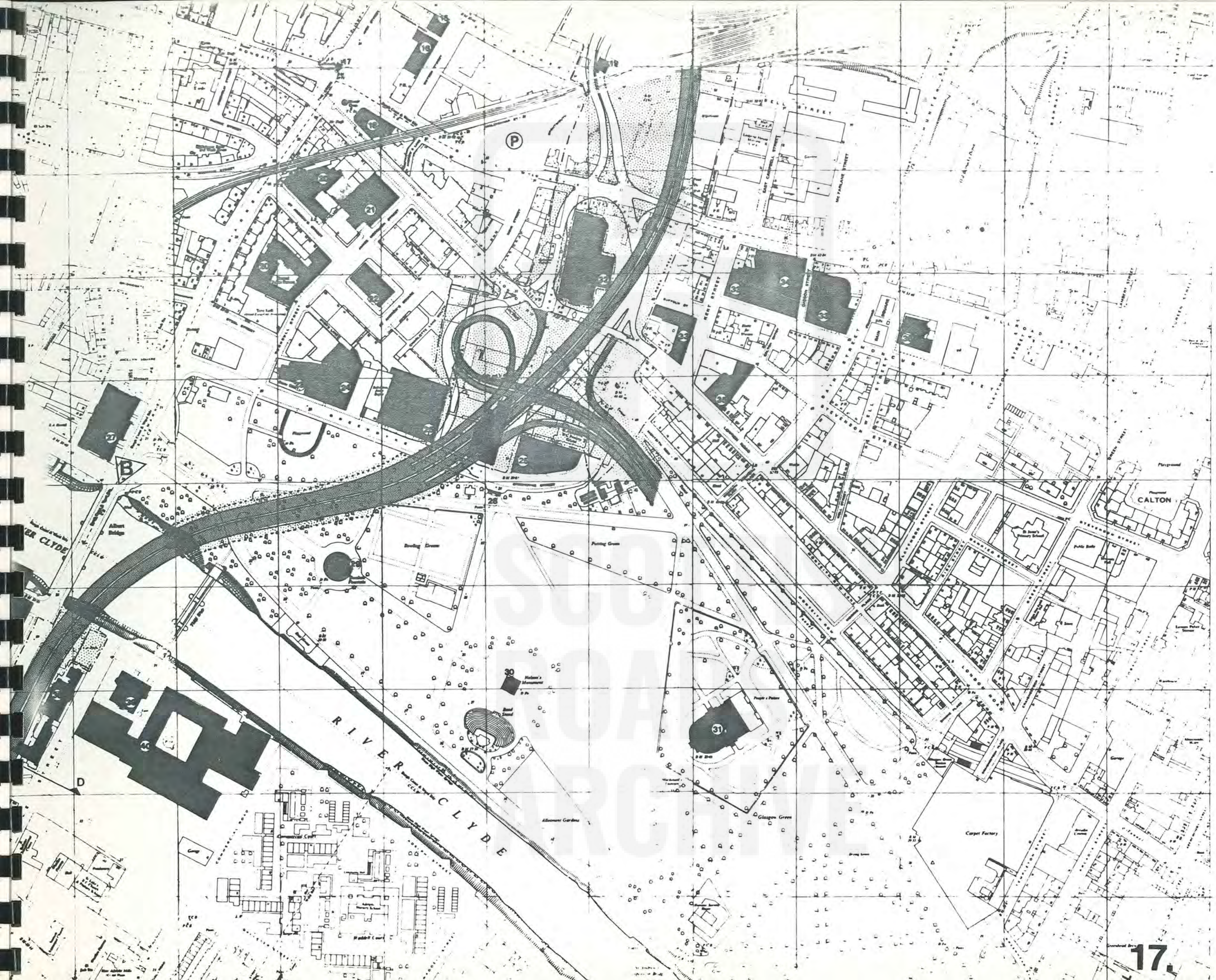
33 The Barrows
34 Barrowland Ballroom
35 St. Alphonsus' Church
36 St. Luke's Church
37 Nautical College
38 Health Clinic
39 College of Building
40 Adelphi Secondary Sch.

EAST FLANK A



Acquisition line

Temp. acquisition line

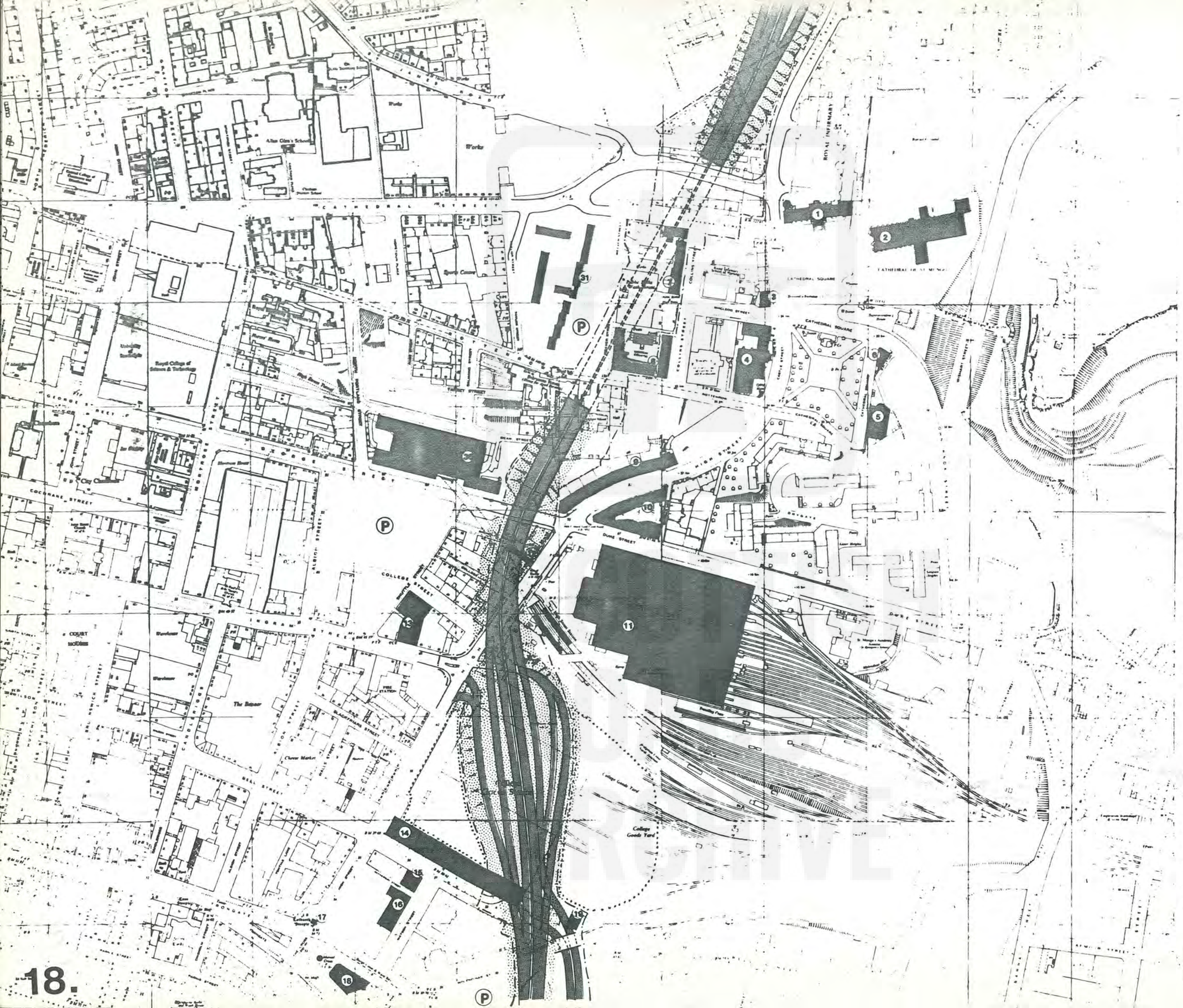
Motorway

Primary surface rds.

Motorway landscaping

Perspective viewpoint

EAST FLANK A



SIGNIFICANT PROPERTIES:

1 Royal Infirmary
2 Glasgow Cathedral
3 Provand's Lordship
4 Barony Church
5 Barony North Church
6 Prisoners Aid Society Bldg.
7 Residential - Collins St.
8 Residential - Morrin Square
9 Residential - High St.
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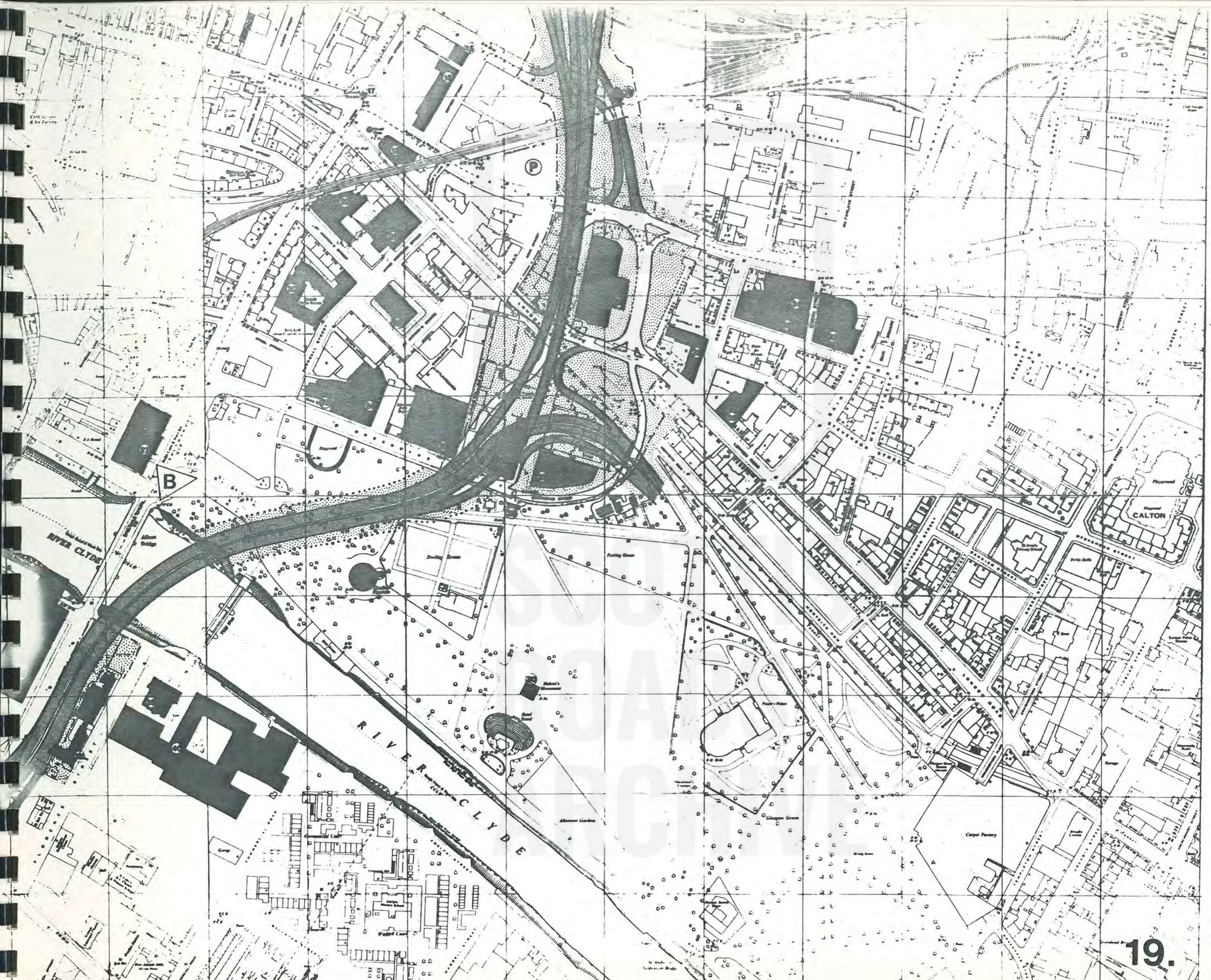
26 Our Lady & St. Francis' Sch.
27 Justiciary Courts
28 McLennan Arch
29 Doulton Fountain
30 Nelson's Monument
31 Student Residences
32 Electricity Sub Station
33 The Barrows
34 Barrowland Ballroom
35 St. Alphonsus' Church
36 Malvern House
37 Nautical College
38 Health Clinic
39 College of Building
40 Adelphi Secondary Sch.

EAST FLANK B



Acquisition line

Temp. acquisition line

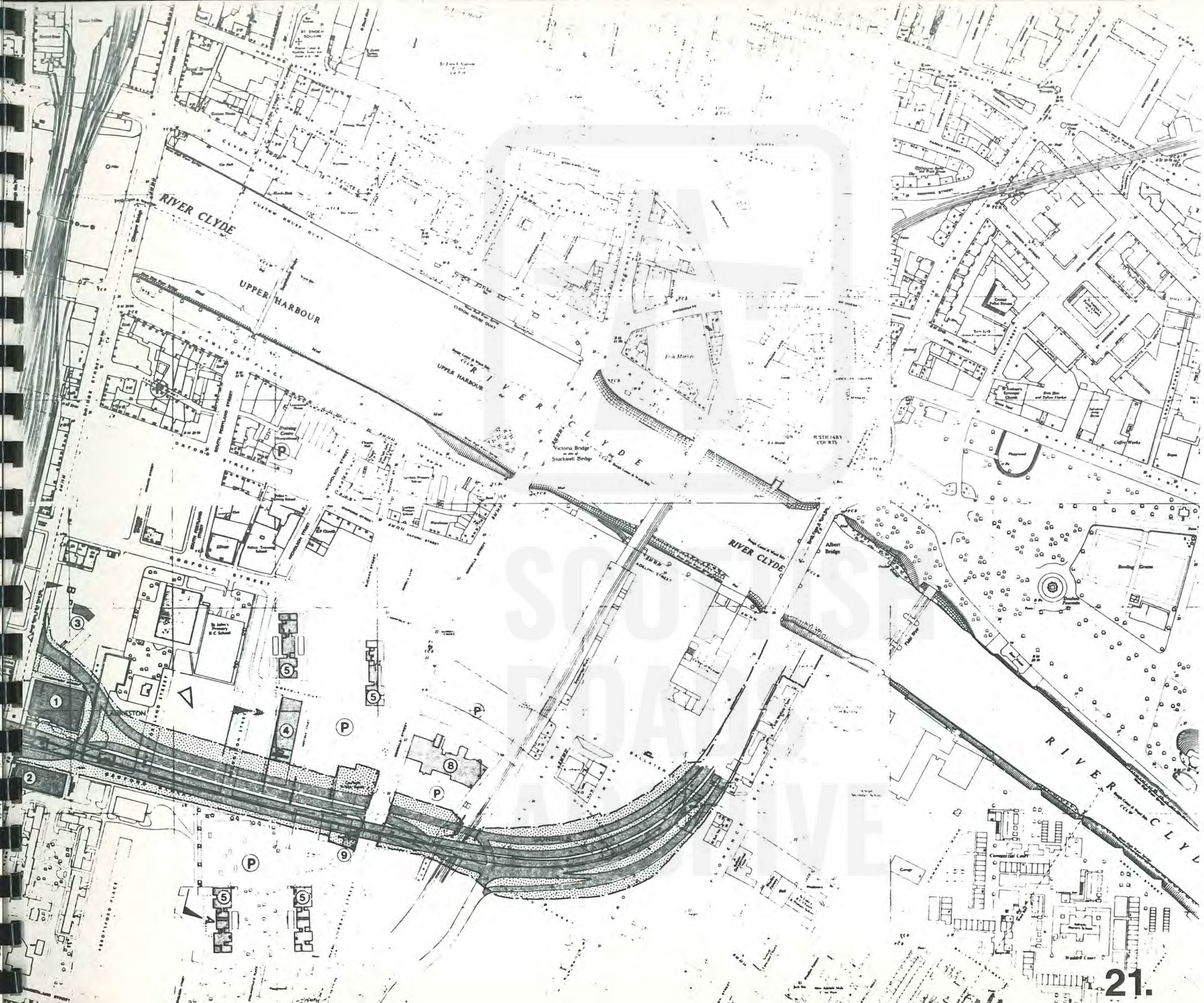
Motorway

Primary surface rds.

Motorway landscaping

Perspective viewpoint

EAST FLANK B



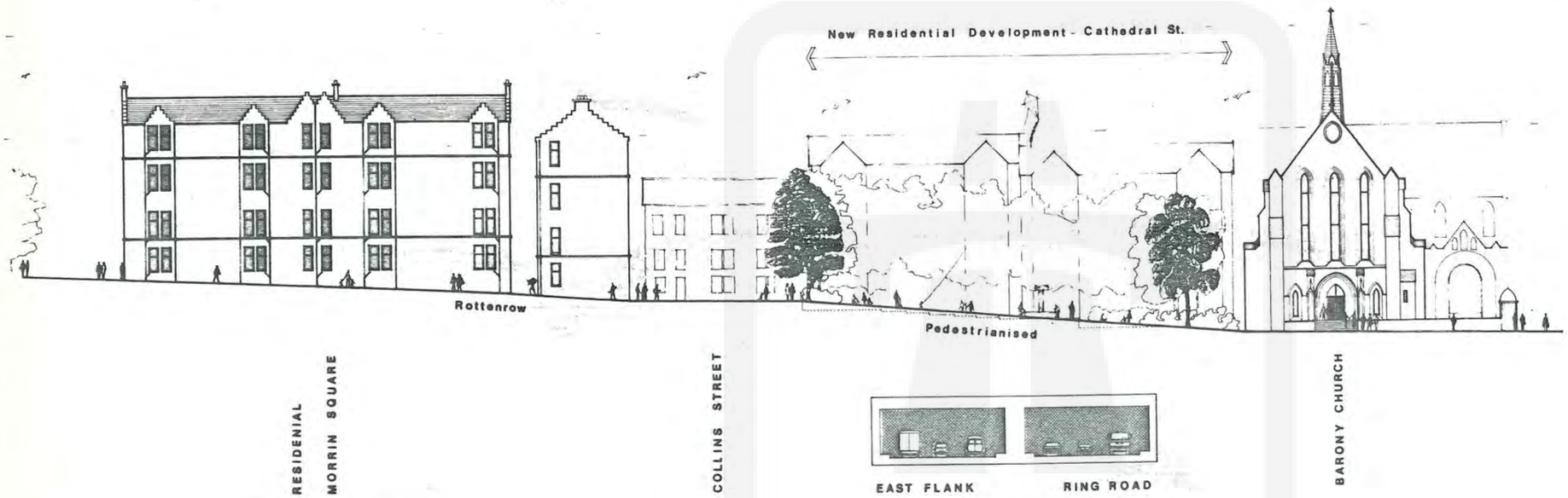
PROPERTIES OF SIGNIFICANCE:

1 Coliseum cinema
2 Bedford social club
3 Bridge st. underground sta.
4 St John's R.C. Church and presbytery
5 22 storey res. tower
6 Glasgow parcels sta.
7 Glass store
8 Citizens' theatre
9 Listed bldg.

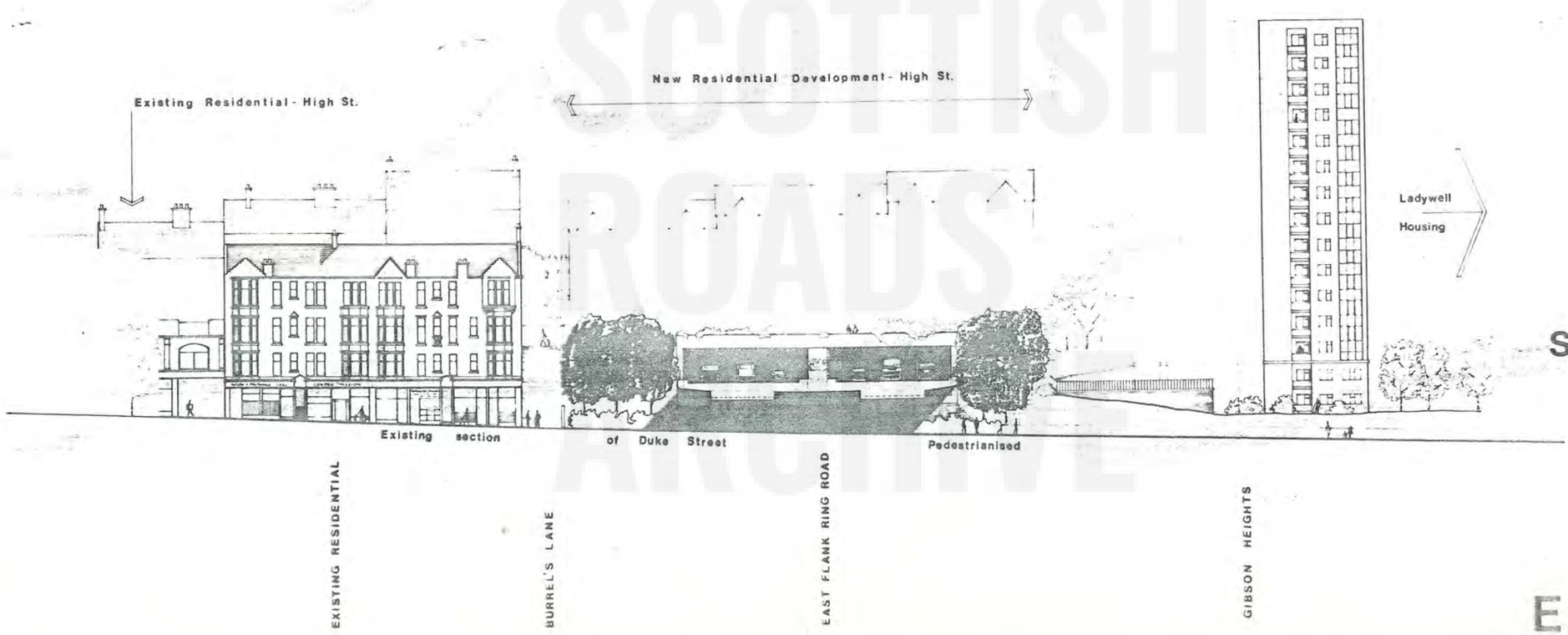
POTENTIAL LAND USE:

Residential
Commercial
Industrial
Educational
Public Bldgs
Landscaped open space hard/soft
Main ped. routes
Motorway landscaping
Motorway
Aquisition line
Perspective viewpoint
Parking (P)

SOUTH FLANK



SECTION AA



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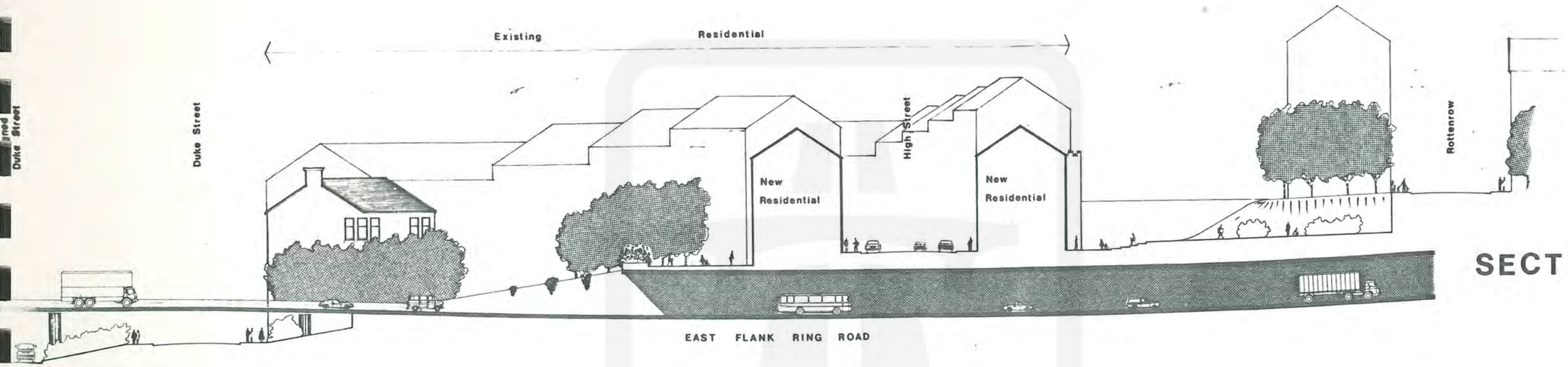

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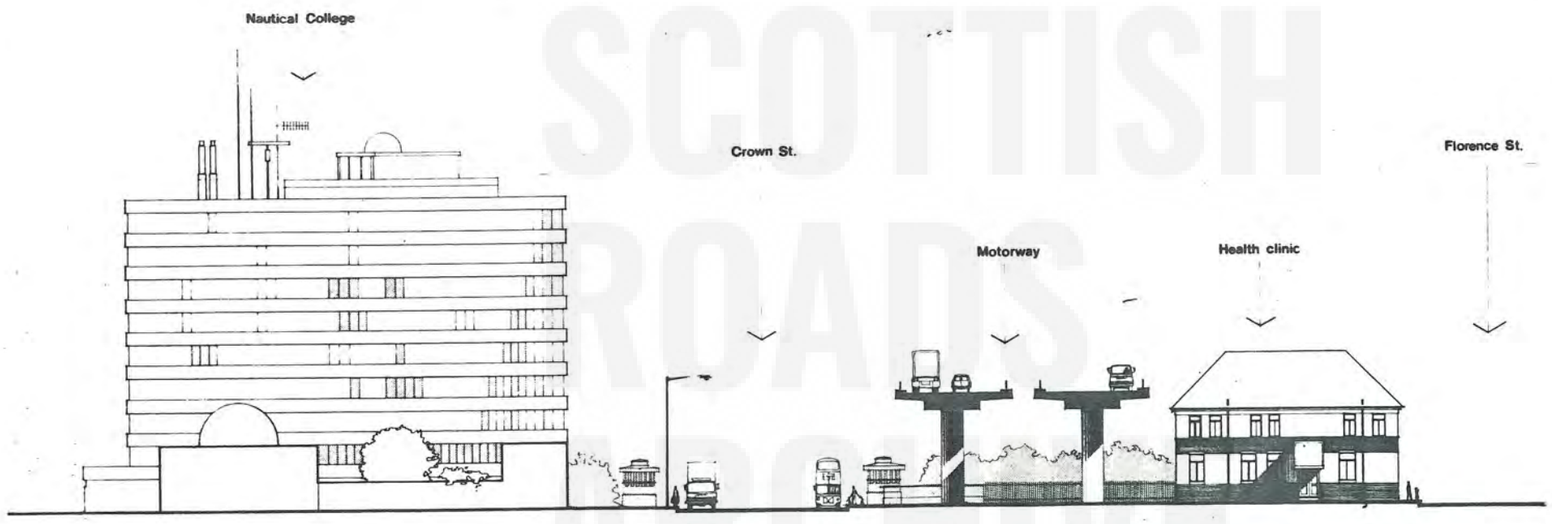

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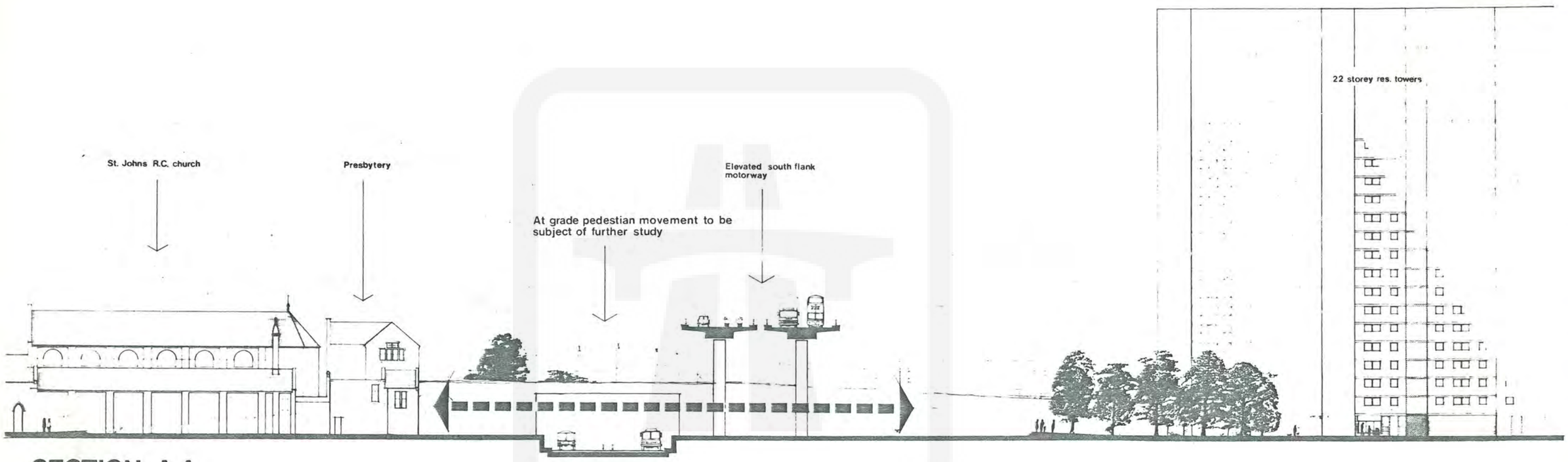
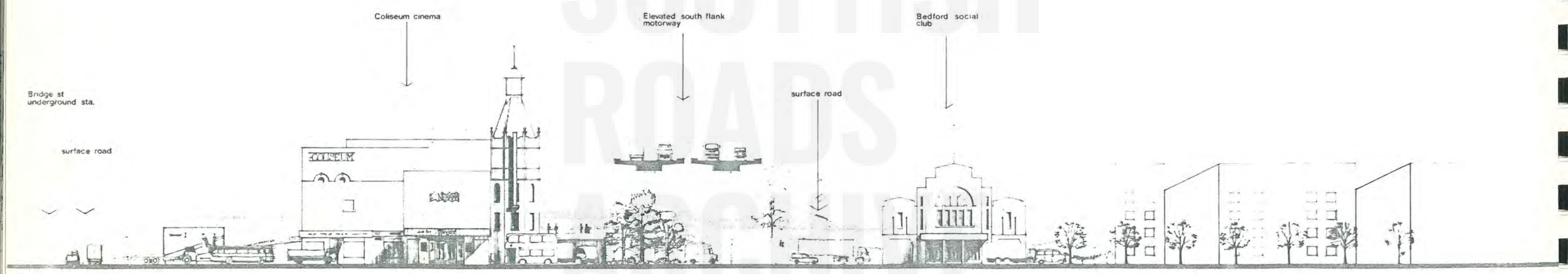


SECTION A-A



SECTION B-B

SOUTH FLANK

ANNEX 1

NOTES ON MOTORWAY CAPACITY

Glasgow Motorways other than the Ring Road

The most recent official guide to urban motorway capacity is contained in DoE Technical Memorandum H9/76, repeated in SDD Technical Memorandum SH9/76.

The relevant figures are:

	Mixed Vehicles per Hour - One-way
Dual 2-lane	3,600
Dual 3-lane	5,700

We understand that these proposed values derive from observations in the London Area. We believe that these values may not be strictly applicable to Glasgow for the following reasons:

(i) Being based on observations in the London Area, they reflect Peak Hour Factors close to unity, resulting from the greater spread of traffic flows over the peak hours due to the size of the Metropolitan Area as well as traffic congestion.

(ii) We believe that driving habits in the London Area are generally tighter than in Glasgow.

(iii) They may not sufficiently reflect the effects of gradient.

(iv) They may not sufficiently reflect adverse weather conditions.

(v) The MOT capacities are applied in relation to traffic projections for the busiest month of the year rather than the average yearly traffic, as in Glasgow.

Referring back to (i), we would accept that the flows quoted are in general reasonable as maximum rates of flow, but a city of the size of Glasgow does not achieve fully sustained flows over a period of a full hour. To convert from the short term flow rate to the total flow over one hour, we believe that a Peak Hour Factor should be applied, as recommended in the "Highway Capacity Manual" of 1965, published by the US Highway Research Board - Special Report 87.

In the USA, a typical Peak Hour Factor for a metropolitan area the size of the Glasgow area would be 0.85. A recent survey of traffic on the Renfrew Bypass produced a similar figure and we have accepted 0.85 as the Peak Hour Factor for Glasgow. It could be argued that the use of this factor is possibly an over-generous design and, if it is accepted that some congestion should be accepted during the peak hour, then a Peak Hour Factor of 0.90 would be a reasonable design figure. However, to allow for the other factors listed under (ii) to (v), the factor of 0.90 should be revised to 0.85.

For a 4-lane section, it is reasonable to assume that the total flow is proportional to that of the 3-lane section.

These DoE figures allow for up to 15% of heavy vehicles. The roads under consideration nowhere appreciably exceed this value, especially in the peak hour, and heavy vehicles can be expected to grow more slowly than other vehicles so we consider that no adjustment need be made on this account.

Ring Road

We believe these figures are generally applicable to the motorways in Glasgow but we believe that the Ring Road is a special case and requires that these figures should be further adjusted.

For this purpose, the Ring Road is defined as extending from the south side of the Kingston Bridge where the West Street connections join the Renfrew Motorway to the point where the Ring Road joins the Monkland Motorway.

There are two ways in which the capacity of the Ring Road differs from the other motorways. Firstly, the continuous fast lane, with comparatively few lane changes and occupied wholly or almost wholly by cars which presumably accounts for the implied high lane capacity of 2100 vph of this lane (the difference between 5,700 and 3,600 given by DoE), does not apply.

Secondly, there is on nearly all sections sufficient weaving to reduce the effective lane capacity. The only exception to this qualification might be the 2-lane sections south of St Vincent Street, and at Charing Cross - St George's Cross. The general reduction in capacity due to weaving we believe to be about 5 to 10 per cent, depending on the circumstances prevailing in any particular section.

It has been usual in past Glasgow motorway calculations to assume a 2-way peak hour split of 60/40 and to assume that the 2-way peak hour flow is 10% of the 2-way daily (24 hour) flow. This produces a ratio

of 2-way daily to one-way hourly of

$$\left(1 + \frac{40}{60}\right) \times \frac{100}{10} = 16.67$$

Recent traffic flow observations on the Ring Road and adjacent motorway sections produce values close enough to this value to justify its continued use, with the exception of the Ring Road at St Vincent Street where the actual ratio is 18.7. This higher value is due to the nearly equal 2-way peak hour split and occurs where the predominant peak hour flow changes from one direction to the other, which is as expected. It is therefore suggested that a factor of 18.7 be used at this location.

The results of all of these factors may be tabulated as follows:

Normal Motorway

	DOE Flows	"Glasgow Factor"	Glasgow Normal Motorway	Factor $\frac{\text{2-way ADT}}{\text{1-way PH}}$	Glasgow Normal Motorway 2-way ADT
2-lane	3,600	0.85	3,060	16.67	51,000
3-lane	5,700	0.85	4,845	16.67	81,000
4-lane	7,600*	0.85	6,460	16.67	108,000

*Pro rata with 3-lane

Ring Road

	DoE Flows 1-way Hourly Rates	"Glasgow Factor"	Glasgow 1-way Hourly Rates	$\frac{\text{2-way ADT}}{\text{1-way PH}}$	2-way ADT where no Weaving	Weaving Factor	Capacity 2-way ADT
2-lane	3,600	0.85	3,060	18.7	57,000		
	3,600	0.85	3,060	16.67	51,000		
3-lane	5,400*	0.85	4,590	16.67	76,500	0.95	73,000
						0.90	69,000
4-lane	7,200*	0.85	6,120	16.67	102,000	0.95	97,000
						0.90	92,000
5-lane	9,000*	0.85	7,650	16.67	127,500	0.95	121,000
						0.90	115,000

*Taken pro rata to 2-lane value

ANNEX 2

NOTES ON BENEFIT ASSESSMENT

1. Savings in Travel Time

1.1 General

Saving in travel time has been computed from the total vehicle miles transferred from surface streets to the motorway network.

Due to the central location alignment of the proposed South and East Flanks of the Inner Ring Road, overall travel distances will generally remain unchanged and consequently no correction has been applied for excess travel.

1.2 Vehicle Miles Transferred

(a) To the proposed South and East Flanks of the Inner Ring Road:

Assigned Flow = 50,000 vehicles/day

Vehicle Miles = 50,000 x 2.5 miles = 125,000 vehicle miles/day

(b) Additional Flow on Monkland and Renfrew Motorways:

Only the proportion of the flow occurring during the peak periods may be considered since this additional traffic could be accommodated during off-peak periods without the inclusion of the new route.

It is, however, reasonable to assume that 25% is directly related to the new route.

Additional Flow on Monkland Motorway = 15,000 ADT

∴ Vehicle miles transferred to Monkland Motorway =
0.25 x 15,000 x 6* = 22,500/day

Additional Flow on Renfrew Motorway = 10,000 ADT

∴ Vehicle miles transferred to Renfrew Motorway =
0.25 x 10,000 x 2* = 5,000/day

(c) Total Vehicle Miles transferred to Motorway Network =
152,500/day
= 152,500 x 330 vehicle miles/year
= 50.325 million vehicle miles/year

*Average distance travelled by transferred flow.

1.3 Benefit of Saving in Travel Time

From an average journey speed survey in Glasgow (September 1978):

Average speed on surface streets = 15 mph
Average speed on motorways = 50 mph

$$\text{Total time saved} = 50.325 \times \left(\frac{1}{15} - \frac{1}{50} \right)$$

= 2.349 million vehicle hours/year
(based on 1990 flows)

2. Composite Time Cost of Vehicular Occupants (including Drivers)

2.1 To calculate this cost on an hourly basis, information was obtained from the following sources:

(a) Strathclyde Regional Council - Traffic Counts

The distribution of vehicle types on the existing sections of the Inner Ring Road is approximately:

Cars	75%
Light Goods Vehicles	10%
Other Goods Vehicles	15%

The proportion of Buses and Motorcycles is negligible.

(b) Mathematic Advisory Unit - MAU Paper No 179 (Revised)

The national average occupancy for different vehicle types, as found in Table 2 of the MAU Paper:

Cars - in course of work	1.12
- leisure trips	1.92
Light Goods Vehicles	1.30
Heavy Goods Vehicles	1.20

The figures for cars are derived from the 1972/3 National Travel Survey. There is no evidence regarding goods vehicle occupancy and the figures quoted are educated guesses. Surveyed data would be preferable.

The journey purpose split from Table 4 of the MAU Paper is as follows:

In course of work	18%
Non-work mileage	82%

(c) The Leitch Report on Trunk Road Assessment

The Value of Working Time (pence per hour; 1976 prices) from Table 4.2 of the Report:

All Workers*	333
Car Drivers	379
Car Passengers	332
HGV Occupants	178
LGV Occupants	158

*All workers includes drivers of commercial vehicles.

2.2 Composite time cost of vehicle occupants including drivers (pence per hour; 1976 prices) was derived using the following tabulated calculation:

	Time Value of Driver	Time Value of Passengers	Average No of Passengers	Time Value of All Occupants	Distribution of Vehicle Type	Proportional Time Value of All Occupants
Cars - Leisure	36	36	0.92	69	0.615	42
Cars - Work	379	332	0.12	419	0.135	57
Light Goods Vehicles	333	158	0.30	380	0.100	38
Other Goods Vehicles	333	178	0.20	369	0.150	55
Composite time cost of vehicle occupants						192 p
At November 1977 prices						229 p

2.3 The benefit of reduced driver and other occupants time in one year, 1990, is 2,349,000 vehicle hours at 192 p.

= £4,510,080 (1976 prices)

= £5,367,000 (November 1977 prices)

3. Vehicle Costs per Hour (Vehicle Depreciation and Capital Saving)

3.1 As stated in the TRRL Laboratory Report 661 on vehicle operating costs in 1973:

"Vehicle capital savings arise in situations where the total travel time on a network changes due to an improvement in the system. If it is assumed that commercial vehicles are used for a constant number of hours per year, then a change in total travel time implies a change in the required vehicle stock. This is a once and for all change and to incorporate it conveniently into the cost relationships means that the capital value of a vehicle has to be annuitized to yield an equivalent hourly cost. No such calculations are made for private cars since it is not thought likely that the total stock of private vehicles would be responsive to changes in the road network.

"Depreciation due to the passage of time is ignored except when vehicle capital savings occur. If the level of this vehicle stock changes, then the level of non-use related depreciation will change. This effect has to be accounted alongside the costs quoted for vehicle capital savings."

3.2 The following values for cost per hour (1977) have been assumed for vehicles, in course of work:

Cars	20 pence
Light Goods Vehicles	30
Heavy Goods Vehicles	100

These values are estimates and further study, and discussion with the motor trade, is necessary to establish their validity.

3.3 The composite cost of vehicle time was calculated as follows: (pence per hour)

	Cost	Proportion of Vehicle Classification	Proportional Cost
Cars - Leisure	0	0.615	0
Cars - Work	20	0.135	2.7
Light Goods Vehicles	30	0.100	3.0
Other Goods Vehicles	100	0.150	15.0
Composite Cost of Vehicle Time			20.7

3.4 The benefit of reduced vehicle time in one year (1990) is 2,349,000 vehicle hours at 20.7 p per hour

= £486,243 (November 1977 prices)

4. Accidents

4.1 Vehicle Mileage

In order to assess the accident savings, it was necessary to estimate the total vehicle mileage in Glasgow. From the CHS traffic assignments (1977 flows), the total vehicle miles on the existing network within the City of Glasgow boundary is 1,336.6 million vehicle miles per year. This total includes a 25% increase on surface street vehicle mileage to account for the absence of local trips in the assignment procedure. From counted volumes (1977), the vehicle mileage on the existing motorway network is 210.6 million vehicle miles per year.

4.2 Accident Rate - Motorways

Based on recorded accident statistics, and vehicle mileage for each section of the motorway network, the following accident rates were calculated:

Motorway Injury Accident Rates (per million vehicle miles)

	1975	1976	1977
Inner Ring Road	0.052	0.161	0.164
Clydeside Expressway	0.175	0.207	0.266
Renfrew Motorway	-	-	0.017
Monkland Motorway	0.308	0.032	0.068
Glasgow Average	0.134	0.135	0.114
National Average	0.290	0.240	-

Average for Glasgow (1975, 1976, 1977) = 0.126

4.3 Accident Rate - Surface Streets

The total number of injury accidents in Glasgow District on surface streets during 1977 was 3,416. However, as vehicle mileage was known for the City of Glasgow only, it was necessary to adjust the values to cover the same area before calculating the accident rate. The total number of injury accidents was reduced by 12%, this percentage being an approximation to the difference in population between the City of Glasgow and Glasgow District.

Accident Rate for the City of Glasgow (Injury only):

$$\frac{3416 \times 0.88}{(1336.6 - 210.6) \times 10^6} \text{ accidents vehicle miles}$$

= 2.67 Injury Accidents/million vehicle miles

4.4 Benefits of Reduced Accidents for One Year, 1990

Total vehicle miles transferred x difference in accident rate:

$$50.325 \times (2.67 - 0.19^*)$$

= 125 Injury Accidents/million vehicle miles per year

*The value for motorways has been increased by 50% to allow for the assumed greater severity of motorway accidents.

The cost per injury accident is given in the Leitch Report as £2,300 per urban road in 1974. Correcting for inflation, this becomes £3,800 in 1977.

The total saving from reduced accidents in one year (1990) is:

125 x £3,800 = £475,000

ANNEX 3 - SCREENLINE COMPARISON TABLES

Case 1

North-South Screenline 1

TABLE 1

Year				1977	1990	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 Restrain Network	Target 1 Network	Strategic Highway Network Preferred
					Run 2-24	Run 2-23	Run 2-31
Possil Rd	665-684	18.0	7.5	13.1	19.8	15.1	14.1
North Flank	1139-1118 1134-1133	73.0	73.0	65.7	78.2	100.2	70.1
Dobbie's Loan	404-452	22.0	20.0	10.7	19.7	17.7	23.4
Cowcaddens	376-377	20.0	10.0	11.7	9.1	9.0	9.5
Bath St	349-348	17.0	7.5	9.6	32.6	27.3	11.6
W George St	345-344	13.0	7.5	4.8	6.4	5.8	6.1
St Vincent St	341-340	17.0	7.5	16.8	15.0	14.4	15.5
Clyde St	305-304	20.0	15.0	21.0	17.2	16.6	11.0
Norfolk St	426-427	20.0	10.0	13.5	40.2	35.9	5.4
Bedford St	430-420	12.0	10.0	8.2	10.6	10.0	38.2
Cumberland St	431-422 -(421)	15.0	7.5	6.4	24.0	25.8	4.1
Devon St	432-425	15.0	7.5	9.9	23.2	20.2	5.5
Calder St	899-889	12.0	7.5	5.6	11.1	11.0	7.3
Langside Ave	893-892	18.0	7.5	14.3	5.7	5.7	4.8
Comparison		292.0	198.0	211.3	312.8	314.7	
South Flank	1166-1163 1164-1165	57.0	57.0				45.0
Ramps	1068-1190 1050-1011	35.0	35.0				51.2
Comparison		384.0	290.0				322.8

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	211.3	292.0	80.7 (27.6%)	198.0	-13.3 (-6.7%)
Target 1	1990	314.7	292.0	-22.7 * (-7.8%)	198.0	-116.7 (-58.9%)
SHN (P)	1990	322.8	384.0	61.2 (15.9%)	290.0	-32.8 (-11.3%)

* Capacity deficiency of Target 1 Network by 1990

Case 1

North-South Screenline 2

TABLE 2

Year				1977	1990	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 Restrain Network	Target 1 Network	Strategic Highway Network Preferred
					Run 2-24	Run 2-23	Run 2-31
Keppochhill Rd	684-705	12.0	7.5	4.2	14.7	8.0	7.2
North Flank	1118-1119 1134-1148	92.0	92.0	77.3	92.2	115.8	94.4
Baird Street	403-402	15.0	10.0	12.0	10.9	8.8	9.7
Cathedral St	347-399	18.0	7.5	18.9	38.0	32.6	10.5
George St	343-397	18.0	7.5	7.0	11.8	11.2	17.3
Bridgegate	302-390	14.0	10.0	12.7	24.7	22.0	6.2
Clyde St	301-302	4.0	10.0	6.9	3.0	2.6	2.5
Ballater St	419-453	22.0	10.0	18.9	33.9	30.3	11.0
Caledonia Rd	422-417	20.0	10.0	18.3	31.1	31.2	4.5
Cathcart Rd	423-424	18.0	10.0	19.8	18.3	18.3	16.9
Calder St	889-888	10.0	7.5	6.0	12.7	12.6	8.8
Battlefield Rd	891-873	17.0	7.5	18.3	13.4	13.4	9.7
		260.0	189.5	220.3	304.7	306.8	
South Flank	1192-1191 1189-1190	57.0	57.0				58.2
Ramps	1068-1190 1050-1011	35.0	35.0				51.2
Comparison		352.0	281.5				308.1

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	220.3	260.0	39.7 (15.3%)	189.5	-30.8 (-16.3%)
Target 1	1990	306.8	260.0	-46.8 (-18.0%)	189.5	-117.3 (-61.9%)
SHN (P)	1990	308.1	352.0	43.9 (12.5%)	281.5	-26.6 (-9.5%)

Case 1
East-West Screenline 1

TABLE 3

Year				1977	1990	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 Restrain Network	Target 1 Network	Strategic Highway Network Preferred
					Run 2-24	Run 2-23	Run 2-31
Charing Cross Northbound	363-366	15.0	15.0	13.9	11.3	9.0	8.6
West Flank	1115-1116 1131-1130	69.0	69.0	63.7	68.9	89.4	56.5
Charing Cross Southbound	365-362	15.0	15.0	12.9	25.4	25.2	23.6
Cambridge St	358-379	15.0	7.5	9.0	11.8	10.6	17.3
Hope St	357-378	15.0	7.5	6.2	1.5	1.5	1.5
W Nile St	356-377	15.0	7.5	10.4	10.4	9.1	12.2
N Hanover St	347-375	14.0	7.5	8.5	10.1	9.4	9.3
Castle St	398-400	20.0	7.5	25.6	38.0	36.2	23.6
Wishart St	466-465	5.0	7.5	4.6	0.9	0.6	1.0
Cumbernauld Rd	738-751	15.0	15.0	7.0	6.4	6.2	3.9
Comparison		198.0	159.0	162.2	184.7	197.2	
East Flank	1164-1165 1166-1163	69.0	69.0				45.0
		267.0	228.0				202.5

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	162.2	198.0	35.8 (18.1%)	159.0	-3.2 (-2.0%)
Target 1	1990	197.2	198.0	0.8 (0.4%)	159.0	-38.2 (-24.0%)
SHN (P)	1990	202.5	267.0	64.5 (24.2%)	228.0	25.5 (11.2%)

Case 1
East-West Screenline 2

TABLE 4

Year				1977	1990	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 Restrain Network	Target 1 Network	Strategic Highway Network Preferred
					Run 2-24	Run 2-23	Run 2-31
Northbound Ramp	319-334	12.0	12.0	10.5	10.8	8.3	9.2
West Flank	1115-1116 1131-1130	69.0	69.0	63.7	68.9	89.4	56.5
Southbound Ramp	333-317	14.0	14.0	11.4	25.2	24.0	28.4
Wellington St	325-329	10.0	7.5	3.6	4.5	4.2	4.1
Hope St	324-328	18.0	7.5	18.6	20.7	16.1	15.0
Renfield St	342-460	15.0	7.5	10.0	11.1	9.3	4.4
Stockwell St	339-338	12.0	7.5	11.1	8.0	7.1	5.7
High St	395-394	18.0	7.5	15.1	32.7	30.6	20.3
Belgrove St	468-467	10.0	7.5	7.9	8.9	8.1	5.3
Millerston St	789-751	18.0	15.0	4.5	12.1	11.7	5.1
Comparison		196.0	155.0	156.4	202.9	208.8	
East Flank	1164-1165 1166-1163	69.0	69.0				45.0
Comparison		265.0	222.2				199.0

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	156.4	196.0	39.6 (20.2%)	155.5	-0.9 (-0.6%)
Target 1	1990	208.8	196.0	-12.8 (-6.5%)	155.5	-53.3 (-34.3%)
SHN (P)	1990	199.0	265.0	66.0 (24.9%)	222.2	23.2 (10.5%)

Case 2

North-South Screenline 1

TABLE 5

Year				1977	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 + HRR	Strategic Highway Network Preferred
					Run 2-25	Run 2-31
Possil Rd	665-684	18.0	7.5	13.1	15.1	14.1
North Flank	1139-1118 1134-1133	73.0	73.0	65.7	85.3	70.1
Dobbie's Loan	404-452	22.0	20.0	10.7	17.7	23.4
Cowcaddens	376-377	20.0	10.0	11.7	9.0	9.5
Bath St	349-348	17.0	7.5	9.6	26.8	11.6
W George St	345-344	13.0	7.5	4.8	6.0	6.1
St Vincent St	341-340	17.0	7.5	16.8	14.4	15.5
Clyde St	305-304	20.0	15.0	21.0	16.3	11.0
Norfolk St	426-427	20.0	10.0	13.5	37.4	5.4
Bedford St	430-420	12.0	10.0	8.2	9.4	38.2
Cumberland St	431-422 -(421)	15.0	7.5	6.4	35.7	4.1
Devon St	432-425	15.0	7.5	9.9	19.9	5.5
Calder St	899-889	12.0	7.5	5.6	9.9	7.3
Langside Ave	893-892	18.0	7.5	14.3	6.6	4.8
Comparison		292.0	198.0	211.3	309.5	
South Flank	1166-1163 1164-1165	57.0	57.0			45.0
Ramps	1068-1190 1050-1011	35.0	35.0			51.2
Comparison		384.0	290.0			322.8

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	211.3	292.0	80.7 (27.6%)	198.0	-13.3 (- 6.7%)
Target 1 + HRR	1990	309.5	292.0	-17.5 (-6.0%)	198.0	-111.5 (-56.3%)
SHN (P)	1990	322.8	384.0	61.2 (15.9%)	290.0	-32.8 (-11.3%)

Case 2

North-South Screenline 2

TABLE 6

Year				1977	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 + HRR	Strategic Highway Network Preferred
					Run 2-25	Run 2-31
Keppochhill Rd	684-705	12.0	7.5	4.2	8.0	7.2
North Flank	1118-1119 1134-1148	92.0	92.0	77.3	100.9	94.4
Baird St	403-402	15.0	10.0	12.0	8.8	9.7
Cathedral St	347-399	18.0	7.5	18.9	32.0	10.5
George St	343-397	18.0	7.5	7.0	11.6	17.3
Bridgegate	302-390	14.0	10.0	12.7	18.5	6.2
Clyde St	301-302	4.0	10.0	6.9	2.5	2.5
Ballater St	419-453	22.0	10.0	18.9	27.4	11.0
Caledonia Rd	422-417	20.0	10.0	18.3	43.0	4.5
Cathcart Rd	423-424	18.0	10.0	19.8	18.0	16.9
Calder St	889-888	10.0	7.5	6.0	11.5	8.8
Battlefield Rd	891-873	17.0	7.5	18.3	13.3	9.7
Comparison		260.0	189.5	220.3	295.5	
South Flank	1192-1191 1189-1190	57.0	57.0			58.2
Ramps	1068-1190 1050-1011	35.0	35.0			51.2
Comparison		352.0	281.5			308.1

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	220.3	260.0	39.7 (15.3%)	189.5	-30.8 (-16.3%)
Target 1 + HRR	1990	295.5	260.0	-35.5 (-13.7%)	189.5	-106.0 (-55.9%)
SHN (P)	1990	308.1	352.0	43.9 (12.5%)	281.5	-26.6 (-9.5%)

Case 2
East-West Screenline 1

TABLE 7

Year				1977	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 + HRR Network	Strategic Highway Network Preferred
					Run 2-25	Run 2-31
Charing Cross Northbound	363-366	15.0	15.0	13.9	8.7	8.6
West Flank	1115-1116 1131-1130	69.0	69.0	63.7	75.3	56.5
Charing Cross Southbound	365-362	15.0	15.0	12.9	24.7	23.6
Cambridge St	358-379	15.0	7.5	9.0	10.6	17.3
Hope St	357-378	15.0	7.5	6.2	1.5	1.5
W Nile St	356-377	15.0	7.5	10.4	9.1	12.2
N Hanover St	347-375	14.0	7.5	8.5	9.4	9.3
Castle St	398-400	20.0	7.5	25.6	30.5	23.6
Wishart St	466-465	5.0	7.5	5.0	0.6	1.0
Cumbernauld Rd	738-751	15.0	15.0	7.0	6.2	3.9
Comparison		198.0	159.0	162.2	176.6	
East Flank	1164-1165 1166-1163	69.0	69.0			45.0
Comparison		267.0	228.0			202.5

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	162.2	198.0	35.8 (18.1%)	159.0	-3.2 (-2.0%)
Target 1 + HRR	1990	176.6	198.0	21.4 (10.8%)	159.0	-27.6 (-11.1%)
SHN (P)	1990	202.5	267.0	64.5 (24.2%)	228.0	25.5 (11.2%)

Case 2
East-West Screenline 2

TABLE 8

Year				1977	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 + HRR Network	Strategic Highway Network Preferred
					Run 2-25	Run 2-31
Northbound Ramp	319-334	12.0	12.0	10.5	8.6	9.2
West Flank	1115-1116 1131-1130	69.0	69.0	63.7	75.3	56.5
Southbound Ramp	333-317	14.0	14.0	11.4	24.3	28.4
Wellington St	325-329	10.0	7.5	3.6	4.2	4.1
Hope St	324-328	18.0	7.5	18.6	15.9	15.0
Renfield St	342-460	15.0	7.5	10.0	9.3	4.4
Stockwell St	339-338	12.0	7.5	11.1	7.1	5.7
High St	395-394	18.0	7.5	15.1	25.0	20.3
Belgrove St	468-467	10.0	7.5	7.9	7.5	5.3
Millerston St	789-751	18.0	15.0	4.5	12.9	5.1
Comparison		196.0	155.0	156.4	190.1	
East Flank	1164-1165 1166-1163	69.0	69.0			45.0
Comparison		265.0	224.0			199.0

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	156.4	196.0	39.6 (20.2%)	155.0	-1.4 (-0.9%)
Target 1 + HRR	1990	190.1	196.0	5.9 (3.0%)	155.0	-35.1 (-22.6%)
SHN (P)	1990	199.0	265.0	66.0 (24.9%)	224.0	25.0 (11.2%)

Case 1

Townhead Screenline

TABLE 9

Year				1977	1990	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flows	Target 1 Restrain Network	Target 1 Network	Strategic Highway Network Preferred
					Run 2-24	Run 2-23	Run 2-31
North Flank	1118-1119 1134-1148	92.0	92.0	77.3	92.2	115.8	94.4
Baird St	403-402	15.0	10.0	12.0	10.9	8.8	9.7
Cathedral St	347-399	18.0	7.5	18.9	38.0	32.6	10.5
High St	398-395	18.0	7.5	11.0	26.3	24.2	11.5
John Knox St	412-466	5.0	5.0	8.0	14.3	14.3	5.6
Comparison		148.0	122.0	127.2	181.7	195.7	
East Flank	1164-1165 1166-1163	69.0	69.0				45.0
Comparison		217.0	191.0				176.7

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	127.2	148.0	20.8 (14.1%)	122.0	-5.2 (-4.3%)
Target 1	1990	195.7	148.0	-47.7 (-32.2%)	122.0	-73.7 (-60.4%)
SHN (P)		176.7	217.0	40.3 (18.6%)	191.0	14.3 (7.5%)

Case 2

Townhead Screenline

TABLE 10

Year				1977	1990	1990
Street	Node Ref	Practical Capacity	Desirable Environ'l Capacity	Present Day Flow	Target 1 + HRR Network	Strategic Highway Network Preferred
					Run 2-25	Run 2-31
North Flank	1118-1119 1134-1143	92.0	92.0	77.3	100.9	94.4
Baird St	403-402	15.0	10.0	12.0	8.8	9.7
Cathedral St	347-399	18.0	7.5	18.9	32.0	10.5
High St	398-395	18.0	7.5	11.0	18.6	11.5
John Knox St	412-466	5.0	5.0	8.0	14.3	5.6
Comparison		148.0	122.0	127.2	174.6	
East Flank	1164-1165 1166-1163	69.0	69.0			45.0
Comparison		217.0	191.0			176.7

Summary

		Flow	Prac. Cap.	Res. Cap.	Envir. Cap.	Res. Cap.
Present Day	1977	127.2	148.0	20.8 (14.1%)	122.0	-5.2 (-4.3%)
Target 1 + HRR	1990	174.6	148.0	-26.6 (-18.0%)	122.0	-52.6 (-43.1%)
SHN (P)	1990	176.7	217.0	40.3 (18.6%)	191.0	14.3 (7.5%)

LEGEND

Motorways within Limits of Study

Surface Streets within Limits of Study

SIGNIFICANT PROPERTIES

1a	Saint Andrews by the Green Church
1b	Saint Andrews Parish Church
1c	Skin and Hide Works
1d	Our Lady and Saint Francis School
1e(1)&(2)	Coffee Works
2a	SSEB Substation
3a	Barrowland Ballroom
3b(1)&(2)&(3)	The Barrows
3c	Saint Alphonsus R C Church
3d	Site for Men's Hostel (not shown)
3e	College Goods Station
3f	High Street Goods Station
4a(1)&(2)	Templeton's Carpet Factory
4b	Dunn & Moore Ltd
4c	East Kilbride Dairy Farmers (not shown)
4d	Brownlie Scanchett & Graham Ltd
4e	Thomas Graham & Sons Ltd
5a	John Street School
6a	Glasgow Green
6b	People's Palace
6c	Sports Pavilion
7	Court Buildings
8(1)&(2)	Central Police Station
9	Fishers Store
10	Mercat Cross Buildings
11	Watson Street Warehouse
12(1)&(2)	Telephone Exchange
13	Barony Church
14	Provand's Lordship

Limit of Estimate

Limit of Estimate

Limit of Estimate

Proposed new railway line.

GORBALS WARD

CALTON WARD

TOWNHEAD WARD

RIVER CLYDE

HUTCHESONTOWN

RAMP 1

RAMP 2

RAMP 3

RAMP 4

Recommended Scheme 4N

Drawing No 1