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Title and Subtitle

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS
Report on Heavy Vehicle Black Spot Investigations - Melbourne

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Project Officer

K B Smith

Abstract

Research into the types, severity and causes of crashes involving heavy vehicles in urban Australia was carried out and countermeasures were recommended to reduce the incidence and severity of such crashes. The project included literature review, mass data analysis, detailed post-crash analysis of fatal crashes, analysis of accident black spots and in-depth investigation. The study found significant deficiencies in driver, rider and pedestrian behaviour which directly relate to the causation of severe crashes. The critical importance of the traffic engineering design of controlled and uncontrolled intersections has been highlighted The design of heavy vehicles for operation in urban areas also needs improvement and measures to reduce heavy vehicle aggressivity and to redress deficiencies in the driver's field of view are needed

This report is one of two covering site investigations as part of the Black Spots Analysis, and covers the fifteen sites investigated in Melbourne.

Keywords
Safety, Accident, Injury, Heavy Vehicle, Design, Motorcyclist, Pedestrian, Cyclist, Roads, Accident Black Spots

HEAVY VEHICLE CRASHES IN URBAN AREAS

INTRODUCTION

One component of the study of heavy vehicle crashes in urban areas performed for the Federal Office of Road Safety (CR 155, FORS, 1995) was a detailed examination of intersections in Sydney and Melbourne. These intersections were selected for study because data analysis showed that they were highly involved in heavy vehicle casualty crashes.

Fifteen sites were investigated in Sydney and fifteen in Melbourne. This report represents the outcome of the detailed investigation of the Melbourne sites. It outlines site information, crash history, factors contributing to crashes and countermeasure options in a common format for all sites. The findings of this part of the study are summarised in Chapter 5 of the main report* .

The full set of sites examined in this study is as follows:

M1 South Eastern Arterial/Warrigal Road, Chadstone
M2 Barry Road/Hume Highway, Campbellfield
M3 Boundary Road/Flemington Road/Mt Alexander Road/Tullamarine Freeway, North Melbourne
M4 Francis Street/Williamstown Road, Yarraville
M5 Dandenong-Hastings Road/Thompsons Road, Lyndhurst
M6 Anderson Road/McIntyre Road/Western Highway, Sunshine
M7 Balckburn Road/Doncaster Road, Doncaster East
M8 Burke Road/South Eastern Arterial, Glen Iris
M9 Cooper Street/Hume Highway/Somerton Road, Campbellfield
M10 Doncaster Road/Elgar Road/Tram Road/Williamson's Road, Doncaster
M11 Geelong Road/Roberts Street/Somerville Road, Footscray West
M12 Napier Street/Whitehall Street, Footscray
M13 Stud Road/Brady Road, Dandenong North
M14 Centre Road/Police Road/Princes Highway/Springvale Road, Springvale
M15 Dandenong-Frankston Road/Healey Road, Dandenong South
S1 Cumberland Highway/Copeland Road/Pennant Hills Road, West Pennant Hills
S2 George Street/Market Street, Sydney
S3 George Street/King Street, Sydney
S4 Great Western Highway/Centenary Road/Station Street, Wentworthville South
S5 Hume Highway/Elizabeth Drive, Liverpool
S6 Great Western Highway/Jones Street/Berith Road, Pendle Hill
S7 Newbridge Road/Governor Macquarie Drive, Moorebank
S8 New Canterbury Road/Livingstone Road/Gordon Street, Petersham
S9 Adelaide Street/Hollywood Avenue/Oxford Street, Bondi Junction
S10 Alfred Street/Loftus Street, Circular Quay
S11 Great Western Highway/Wallgrove Road, Eastern Creek
S12 The Horsley Drive/Cowpasture Road, Bossley Park
S13 Hume Highway/Glenfield Road, Glenfield
S14 Broadway/Harris Street/Regent Street, Chippendale
S15 Chalmers Street/Eddy Avenue/Elizabeth Street/Foveaux Street, Surry Hills

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* Sweatman, P.F., Ogden, K.W., Haworth, N., Corben, B., Rechnitzer, G. and Diamantopoulou, K., *Heavy Vehicle Crashes in Urban Areas*, FORS Report CR155, 1995

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M5 Dandenong-Hastings Road/Thompson Road, Lyndhurst

M6 Anderson Road/McIntyre Road/Western Highway, Sunshine

M7 Blackburn Road/Doncaster Road, Doncaster East

M8 Burke Road/South Eastern Arteial, Glen Iris

M9 Cooper Street/Hume Highway/Somerton Road, Campbellfield

M10 Doncaster Road/Elgar Road/Tram Road/Williamson's Road, Doncaster

M11 Geelong Road/Roberts Street/Somerville Road, Footscay West

M12 Napier Street/Whitehall Street, Footscray

M13 Stud Road/Brady Road, Dandenong North

M14 Centre Road/Police Road/Princes Highway/Springvale Road, Springvale

M15 Dandenong-Frankston Road/Healey Road, Dandenong South

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: South Eastern Arterial/Warrigal Road, Chadstone

Case No: M1

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 3 June 1994 **Case No: M1**

1. Location Details

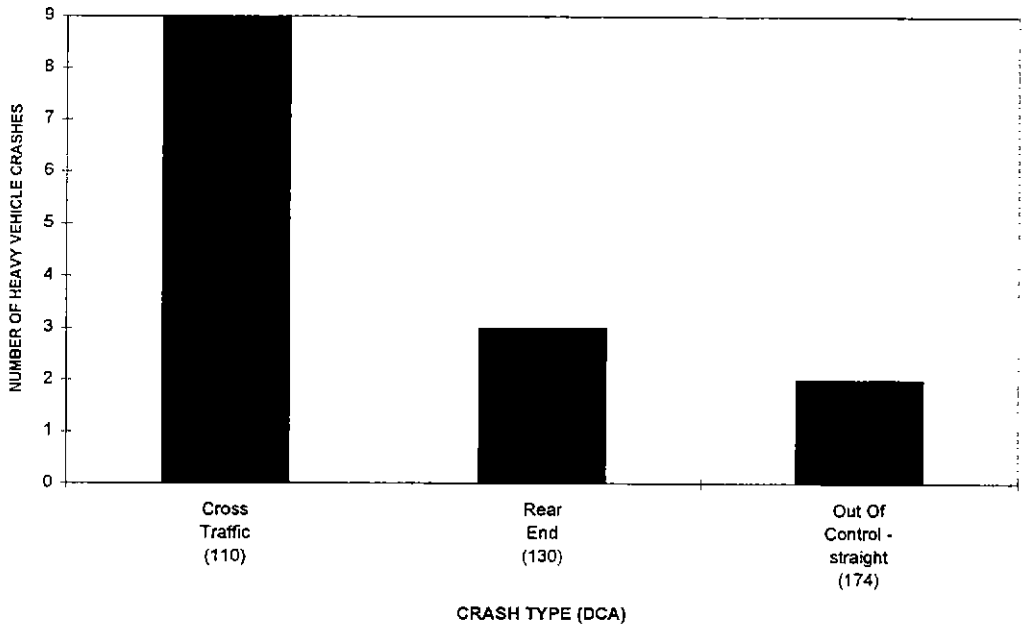
Street Names: South Eastern Arterial/Warrigal Road
Suburb and Local Government Area: Chadstone, Cities of Malvern and Oakleigh
Melway Map Reference: 69 F3
Road Functional Classification: Both primary arterials.
Alignment/Topography: Generally flat, with slight uphill grade from east to west and downhill from south to north.
Intersection Geometry (if applicable): Cross intersection, with wide separation between the east and west bound carriageways.
Traffic Control Type: Intersection signals.
Surrounding Land Use: Residential/open space.
Designated Heavy Vehicle Route: South Eastern Arterial carries very high volumes of heavy vehicles.
Speed Zone: South Eastern Arterial: 60 km/h (roadworks speed limit) to 100 km/h; Warrigal Rd: 60 km/h to 70 km/h.
Number of Traffic Lanes: Multi-lane approaches - refer attached plan.
Pedestrian (or other vulnerable road user) Activity: Low pedestrian volumes
Characteristics of Traffic (Control) Operation: Vehicle speeds along both roads are high, especially along the SEA. Signal phasing for Warrigal Rd traffic is such that a clearance period operates between the adjacent signalised intersections. Heavy vehicle volumes on SEA are high.

Treatment History: Signalised intersection with major grade separation works currently underway.
Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: The first of only a few signalised intersections for Melbourne bound traffic along a route that is otherwise of freeway standard and function.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 2 **Serious Injury** - 22 **Other Injury** - 59 **Total** - 83
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 4 **Other Injury** - 10 **Total** - 14
Percentage of Heavy Vehicle to All Casualty Crashes: 16.9% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 7 **Rigid** - 9 **Bus** - 0

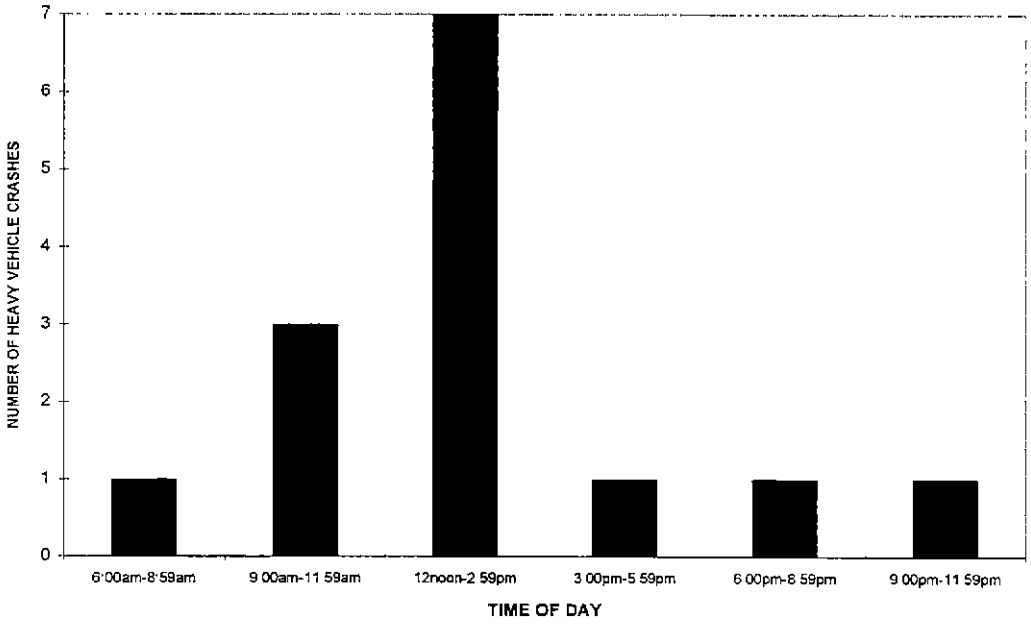
Predominant Heavy Vehicle Crash Types (DCA):



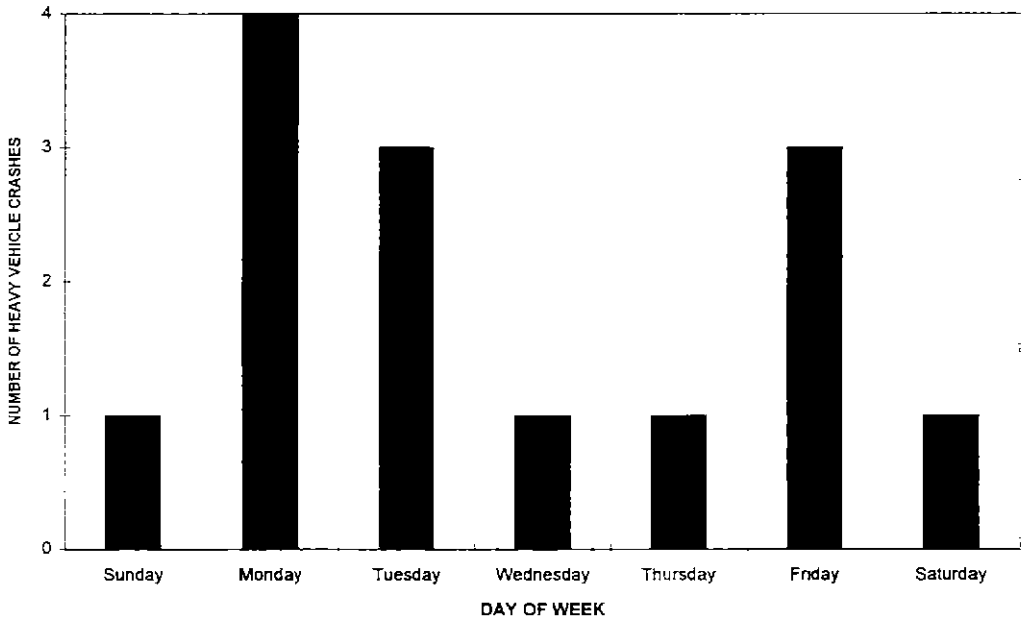
Predominant Heavy Vehicle Movements by DCA:

Cross Traffic - 64%
Rear End - 22%
Out of Control on Straight Carriageway - 14%

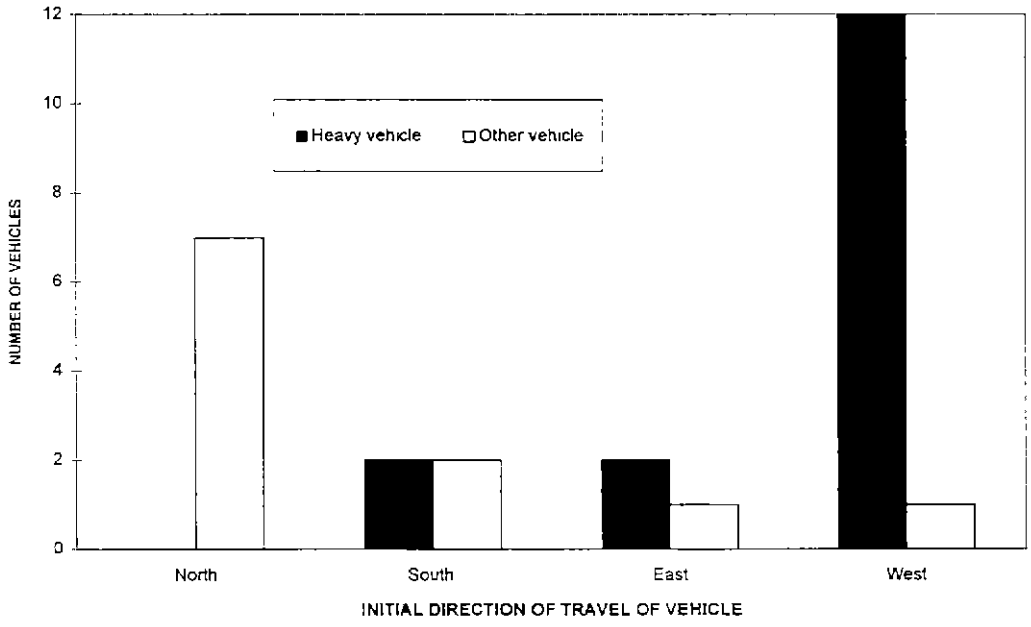
Time of Day Crash Patterns:



Day of Week Crash Patterns:



Initial Direction of Travel Crash Patterns



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
The crash problem for heavy vehicles is predominantly for Melbourne traffic.

3. Road Environment Factors Contributing to Crash Occurrence

Speed: Probably - for many Melbourne bound motorists on the South Eastern Arterial, the intersection is the first signalised intersection (and one of only a few along the SEA) to be encountered after a relatively long period of driving at high speeds under freeway conditions. Responding appropriately to the signalised control in this high speed environment presents difficulties for motorists in general, and for drivers of heavy vehicles in particular.
Alignment/Topography: Unlikely.
Intersection Geometry (if applicable): Unlikely.
Intersection Control (if applicable): Inter-green periods appear to be set to minimum times, namely 3 secs yellow and 2 secs all-red. Longer inter-green periods may be appropriate along routes with high heavy vehicle volumes, given the added difficulty drivers of heavy vehicles seem to experience in stopping when traffic signals change from green to red. The standard of signal displays appears adequate.
Road Surface (friction and roughness): Unlikely.
Roadside Features/Hazards: Unlikely.
Land Use: Unlikely.
Traffic Operation: There is a tendency for vehicles travelling along the SEA to "run the red". This is particularly so for heavy vehicles and is consistent with the presence of a red light camera for west bound vehicles.
Delineation: Unlikely.
Street lighting: Unlikely.
Sight Distance: Unlikely.
Road Divided/Undivided: Unlikely - both roads fully divided.
Lane Configuration (e.g. lane drop/merge, etc.): Unlikely.
Lane Provision for Turning: Unlikely.
Road works: Currently underway but unlikely to be a factor in crash occurrence.

Shoulder Condition:
No.

Other:
North bound and south bound vehicles are subject to clearance periods which create a short term situation whereby the signals change to red where Warrigal Road intersects with the first carriageway of the SEA while the signals at the intersection with the second carriageway remain green for some seconds, before changing to red. Inattentive motorists could be drawn through the first carriageway red signal if they are observing and responding to the second carriageway green.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Cross-Traffic Crashes

- **high vehicle speeds** on both roads but especially the SEA;
- a tendency for motorists in general, and heavy vehicle drivers in particular, to **"run the red"** (heavy vehicles were exclusively involved on the SEA). In seven of the nine cross-traffic crashes, the heavy vehicle entered on a red signal or just as the signals were changing to red. In five of these cases, **heavy vehicle brake failure or poor braking performance** was mentioned in Police reports as factors. In two instances Police considered the **signal inter-green times to be too short** for the circumstances.

Rear-End Crashes

- **high vehicle speeds and congested traffic conditions** - for many Melbourne bound motorists on the South Eastern Arterial, the intersection is the first signalised intersection (and one of only a few along the SEA) to be encountered after a relatively long period of driving at high speeds under freeway conditions.;
- the drivers of heavy vehicles being unable to stop in time to avoid colliding with stationary or near-stationary vehicles (rear-end collisions are characteristic of traffic signal crash patterns generally). **Brake failure of heavy vehicles** was cited in one of the three cases, while in other cases the cause may be the **inferior braking performance** of heavy vehicles compared to lighter vehicles and/or to **poor decision-making** by drivers of heavy vehicles faced with a red or changing signal display.

5. Countermeasure Options

With the recent grade-separation of this intersection under the Victorian Transport Accident Commission's Accident Black Spot Program, most of the potential for crashes of the type found here has been eliminated. However, it is recommended that the signal all-red periods be checked to ensure that adequate safety exists for traffic leaving the SEA to turn right into Warrigal Road.

ATTACHMENTS

CONTROLLER OPERATIONS SHEETS - C PERSONALITY

INTERSECTION SOUTH EASTERN ARTERIAL / WARRIGAL ROAD No 3681

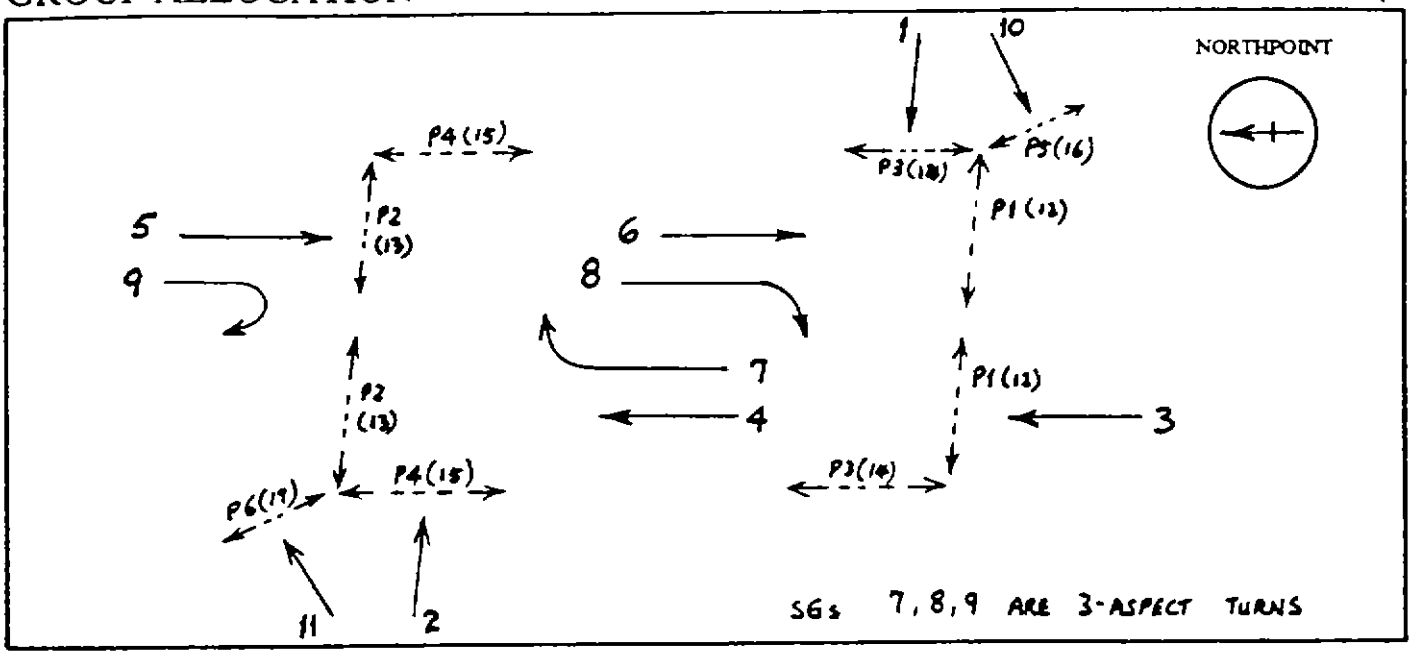
MUNICIPALITY MALVERN / OAKLEIGH RE DESIGNER HOAN NGO C. EER DATE 10/8/94 10/3/93

CONTROLLER CAPACITY 17 GROUPS RE DESIGN CHECKED Francis J. Woollard DATE 17/8/94

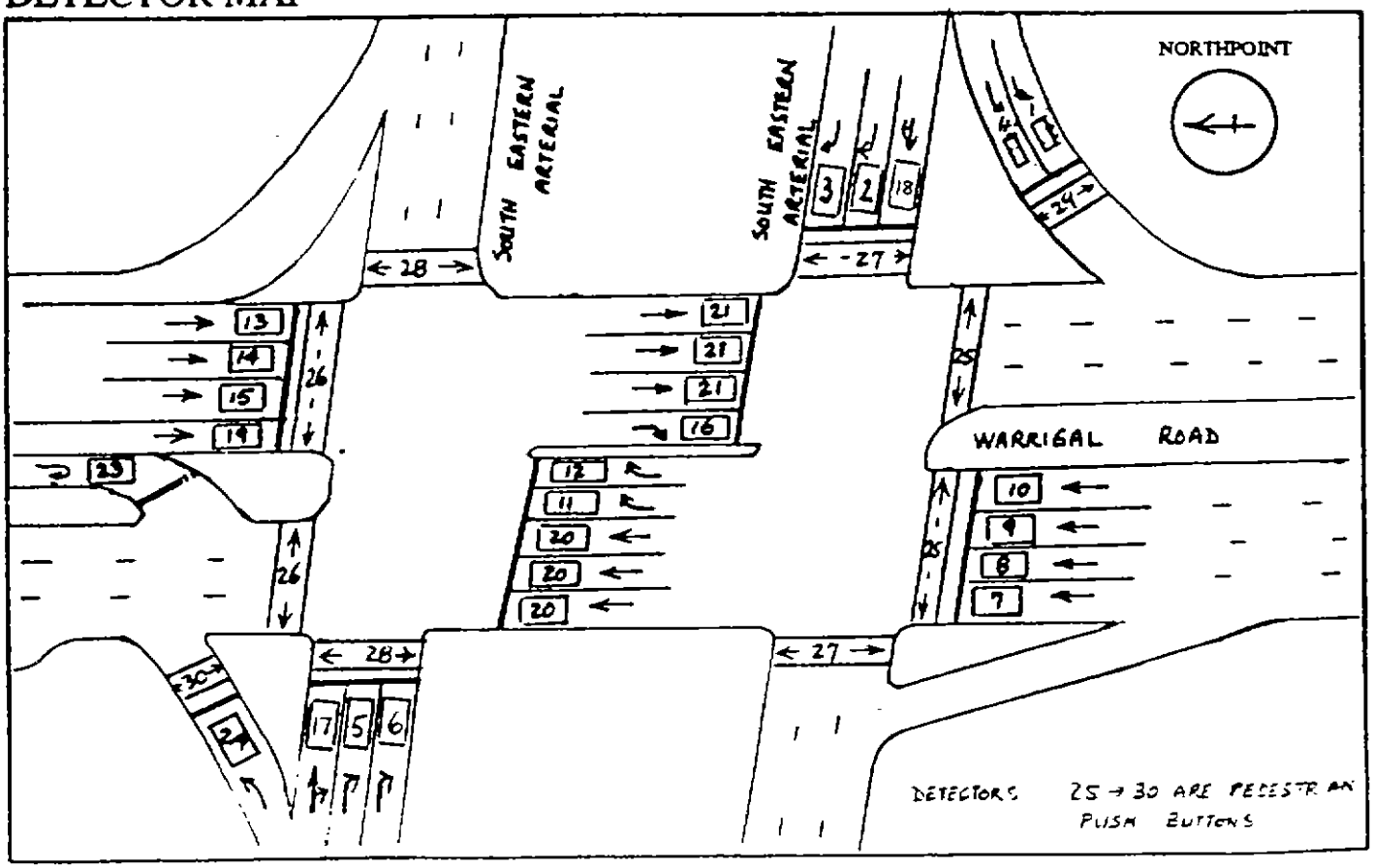
PLAN No 409190A, 882014 PROGRAM CHECKED Chris Lee DATE 13/5/93

RE-PROGRAM CHECKED Hanhorth 24/8/94

GROUP ALLOCATION

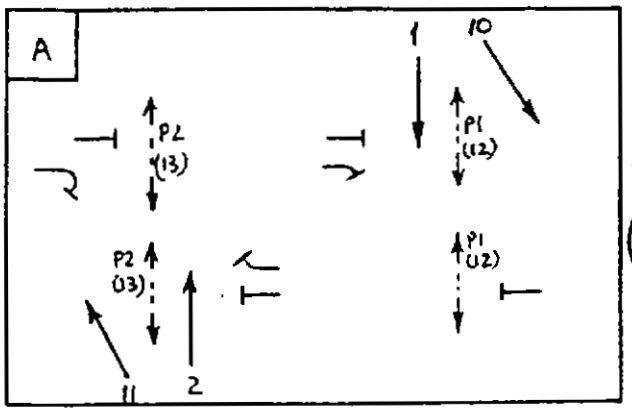


DETECTOR MAP



INTERSECTION SOUTH EASTERN ARTERIAL / WARRIGAL ROAD No 3681

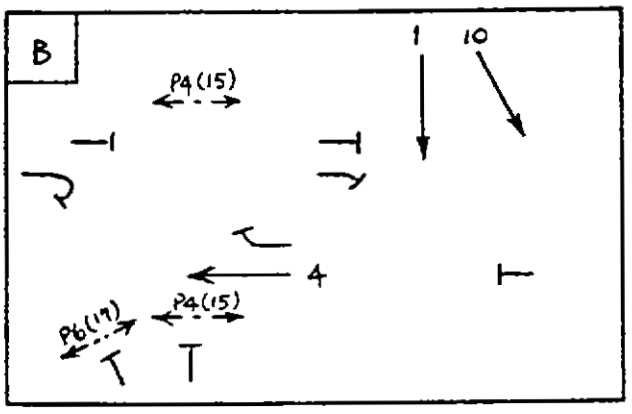
A



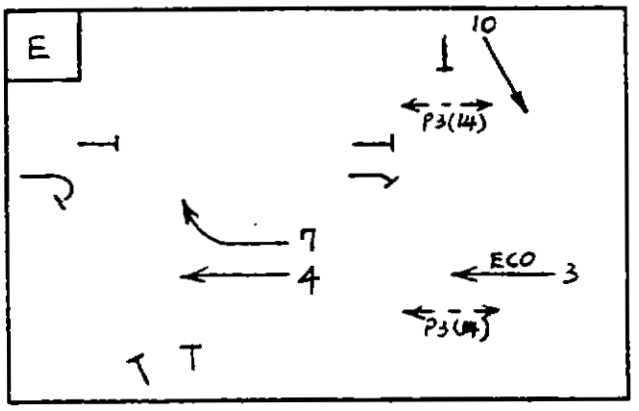
NORTHPOINT

PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION

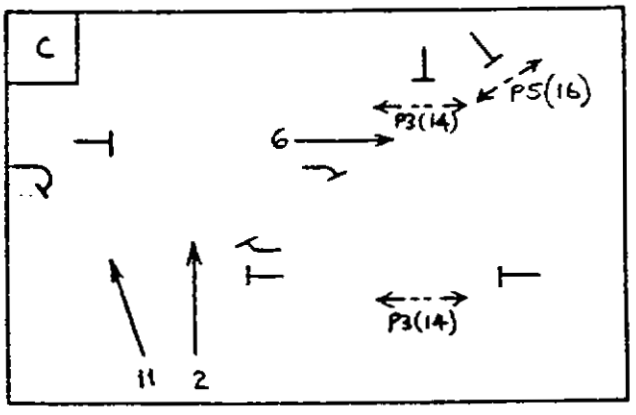
B



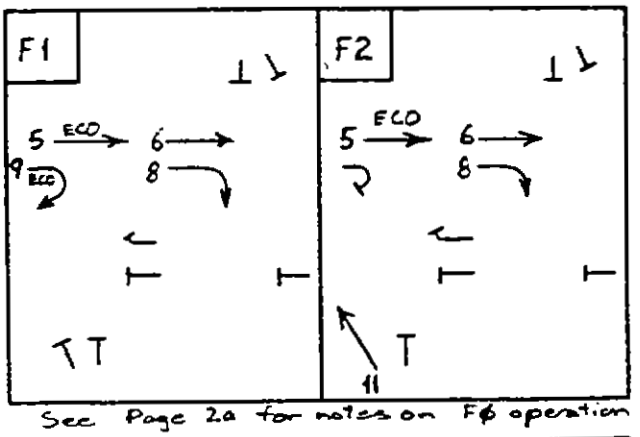
E



C

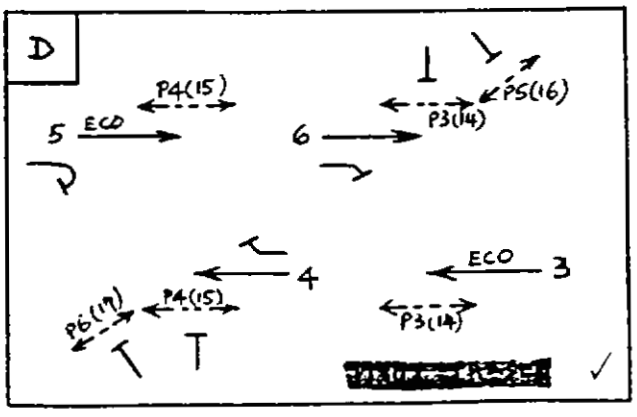


F1 F2

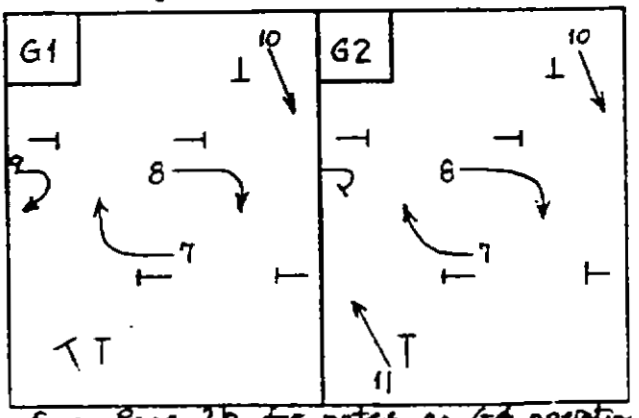


See Page 2a for notes on Fϕ operation

D



G1 G2



See Page 2b for notes on Gϕ operation

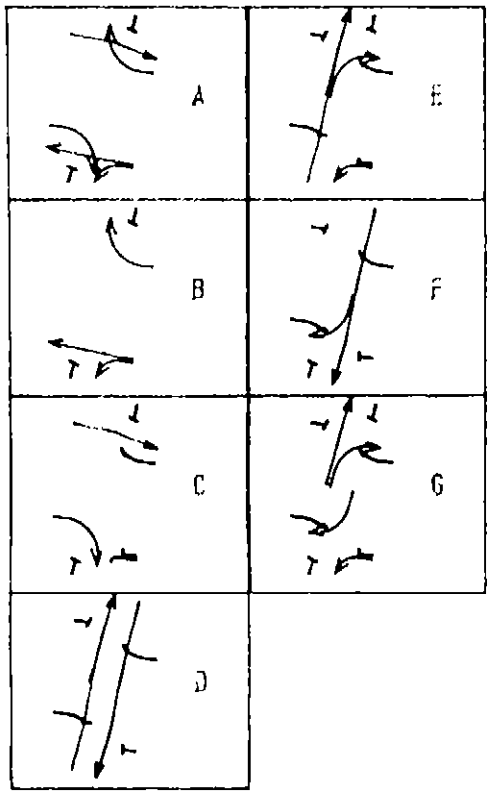
V.A. SEQUENCE: ABDEG

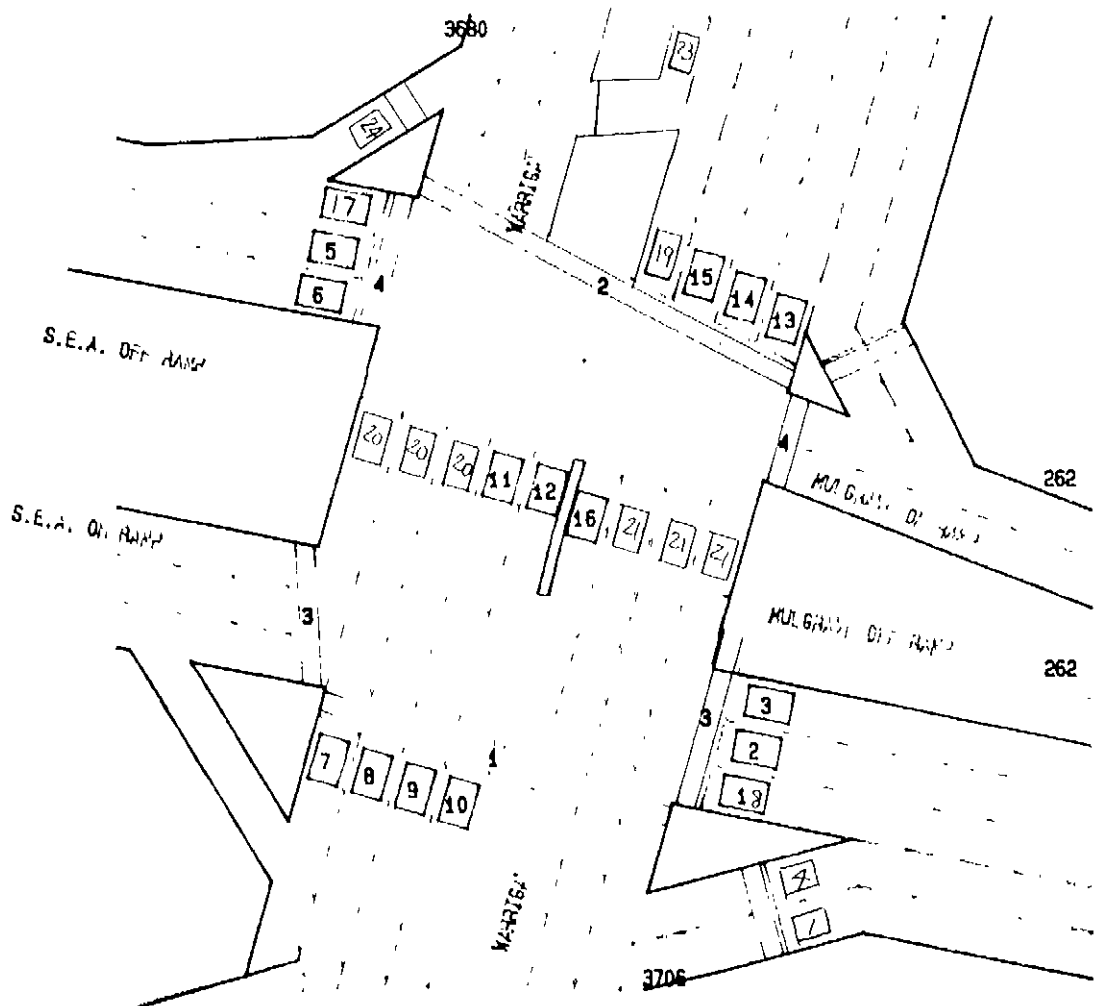
DESIGNED: C. EER

DATE: 23/4/93

SUBURB OAK [illegible] 069/03
CONTROLLER TYPE DELTA DIVISION = R
CONNECTED TO REGIONAL COMPUTER - GLT

7 PHASES





HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: South Eastern Arterial/ Warrigal Road, Cities of Malvern and Oakleigh, Chadstone (LGA = 32)

Location Details

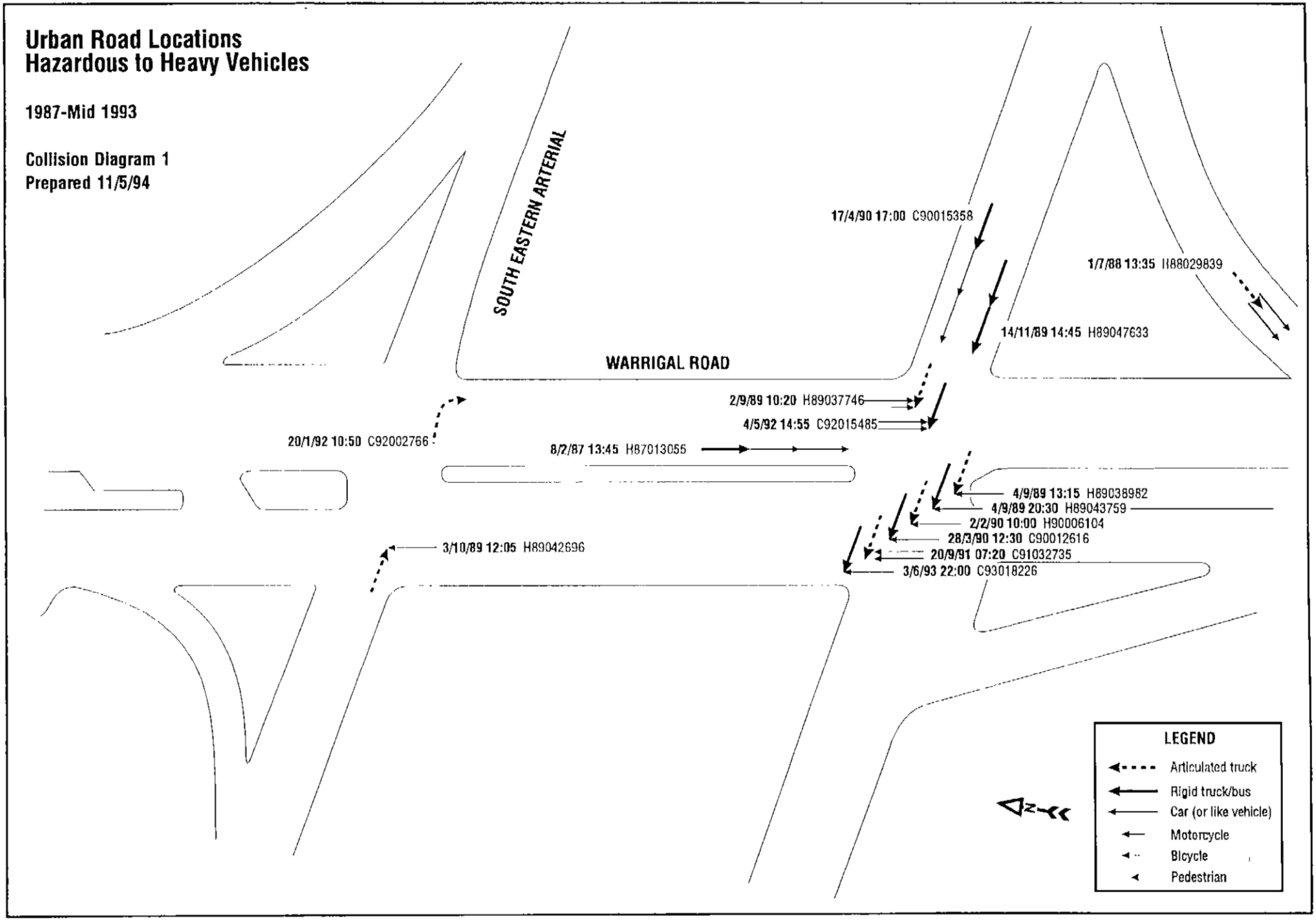
ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
H87013055	8-Feb-87	1345	Sunday	Rear End	Other Injury	S /S /S	7/01/99	60	DAY	Clear	Dry
H88029839	1-Jul-88	1335	Friday	Out of Control	Other Injury	W /W /W	6/02/01	60	DAY	Clear	Dry
H89038982	4-Sep-89	1315	Monday	Cross Traffic	Other Injury	W /N /	6/ 1/ .	80	DAY	Clear	Dry
H89043759	4-Sep-89	2030	Monday	Cross Traffic	Serious Injury	N /W /	1/ 7/ .	80	DARK	Clear	Dry
U89037746	2-Sep-89	1020	Sunday	Cross Traffic	Serious Injury	W /S /S	6/07/10	80	DAY	Clear	Dry
U89042696	3-Oct-89	1205	Tuesday	Cross Traffic	Other Injury	N /E /	1/ 6/ .	100	DAY	Clear	Dry
U89047633	14-Nov-89	1445	Tuesday	Rear End	Other Injury	W /W /	7/ 7/ .	100	DAY	Clear	Dry
C90012616	28-Mar-90	1230	Wednesday	Cross Traffic	Other Injury	W /N /	7/ 1/ .	60	DAY	Clear	Dry
C90015358	17-Apr-90	1700	Tuesday	Rear End	Other Injury	E /E /W	7/01/01	60	DAY	Clear	Dry
H90006104	2-Feb-90	1000	Friday	Cross Traffic	Other Injury	N /W /	1/ 6/ .	60	DAY	Unknown	Wet
C91032735	20-Sep-91	720	Friday	Cross Traffic	Other Injury	W /N /N	6/05/01	60	DAY	Clear	Dry
C92002766	20-Jan-92	1050	Monday	Out of Control	Serious Injury	W / /	6/ ./ .	60	DAY	Clear	Dry
C92015485	4-May-92	1455	Monday	Cross Traffic	Other Injury	W /S /S	7/01/05	100	DAY	Clear	Dry
C93018226	3-Jun-93	2200	Thursday	Cross Traffic	Serious Injury	N /W /	1/ 7/ .	100	DARK	Raining	Wet

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 1
Prepared 11/5/94



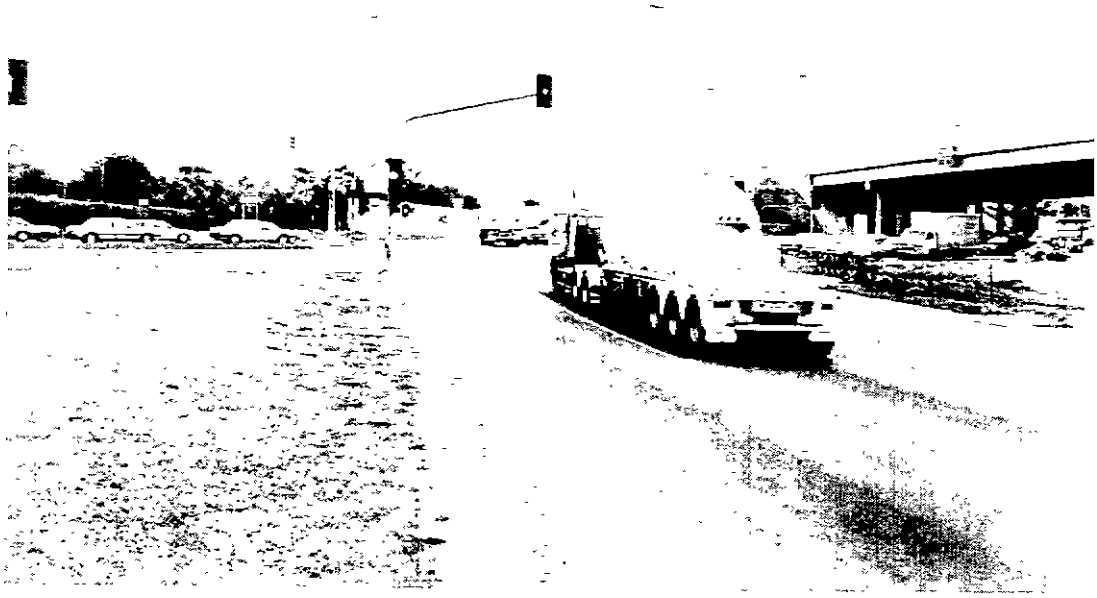


PHOTO 1 OF 4 - FACING WEST

PHOTO 2 OF 4 - FACING NORTH

PHOTO 3 OF 4 - FACING SOUTH

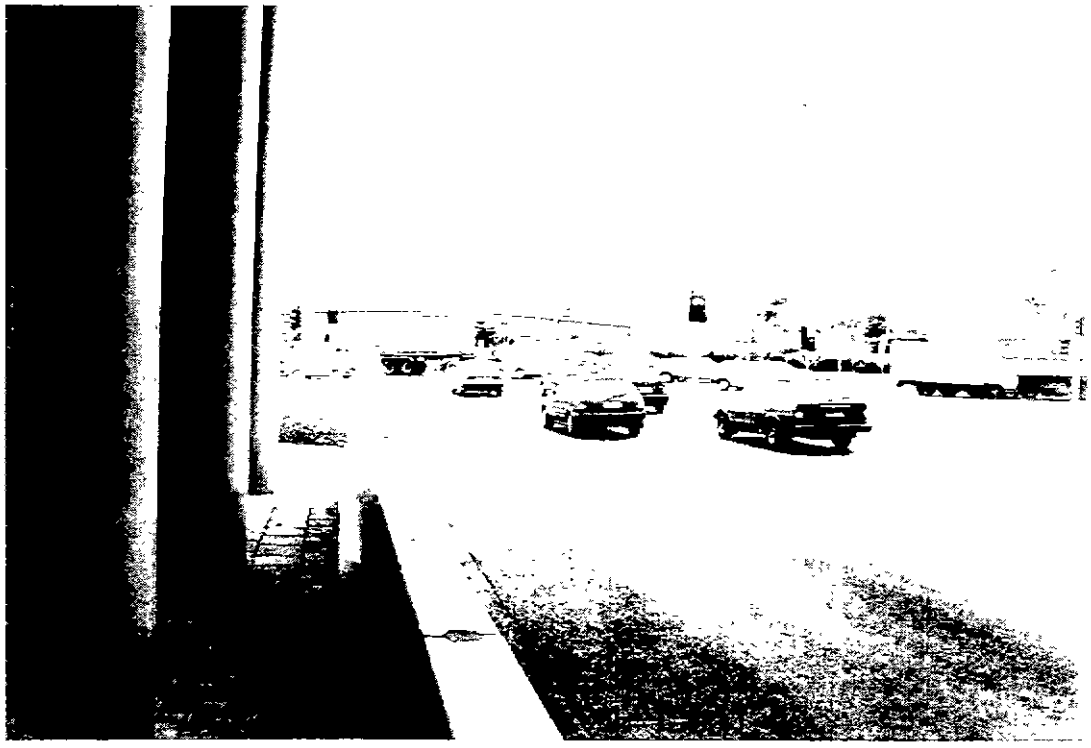


PHOTO 2 OF 4 - FACING SOUTH

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Barry Rd/Hume Highway, Campbellfield

Case No: M2

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 7 June 1994 **Case No: M2**

1. Location Details

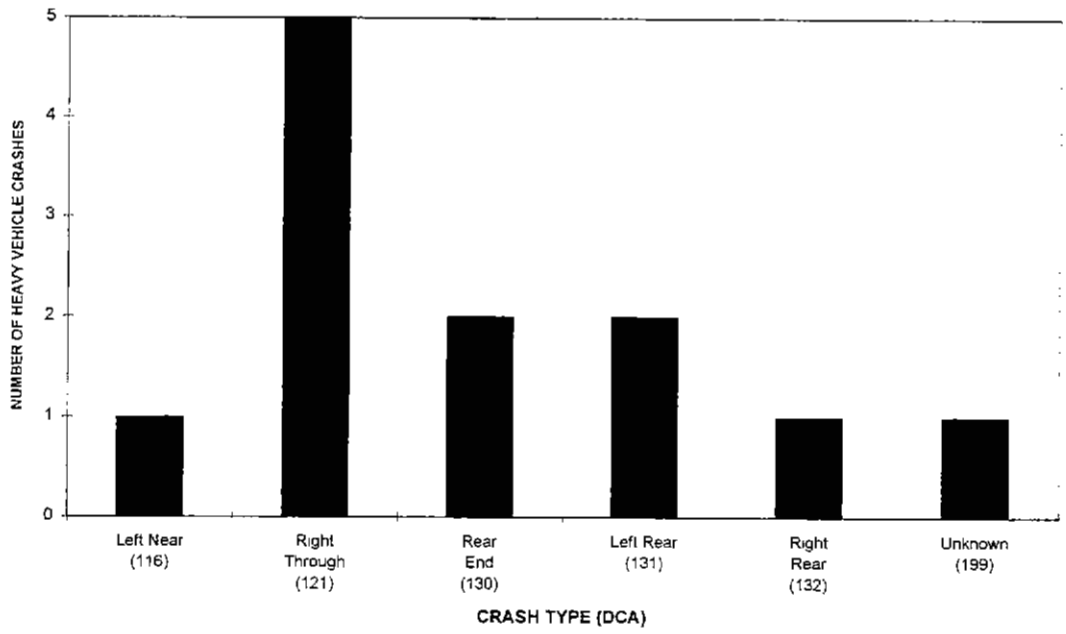
Street Names: Barry Rd/Hume Highway.
Suburb and Local Government Area: Campbellfield, City of Broadmeadows.
Melway Map Reference: 7 F4
Road Functional Classification: Barry Rd: secondary arterial/local street; Hume Highway: National Highway.
Alignment/Topography: Generally flat with straight approaches.
Intersection Geometry (if applicable): Fully channelised cross intersection.
Traffic Control Type: Intersection signals, with full control of right turns from the Hume Highway.
Surrounding Land Use: Residential/open space/commercial/Ford factory.
Designated Heavy Vehicle Route: Both roads (particularly the Hume Highway with its National Highway status) carry very high volumes of heavy vehicles.
Speed Zone: Barry Rd: 60 km/h; Hume Highway: 80 km/h.
Number of Traffic Lanes: Refer attached plan.
Pedestrian (or other vulnerable road user) Activity: Low pedestrian volumes.
Characteristics of Traffic (Control) Operation: Heavy vehicle volumes and speeds along the Hume Highway are high. The intersection operates at or near capacity for much of the day.
Treatment History: Fully controlled right turn phases for Hume Highway traffic installed in 1988.

Location Plan Attached: Yes
Photographs Attached: Yes
Other Observations/Comments: None

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 0 **Serious Injury** - 8 **Other Injury** - 24 **Total** - 32
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 3 **Other Injury** - 9 **Total** - 12
Ratio of Heavy Vehicle to All Casualty Crashes: 37.5% **Average Ratio of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 6 **Rigid** - 5 **Bus** - 1

Predominant Heavy Vehicle Crash Patterns (DCA):

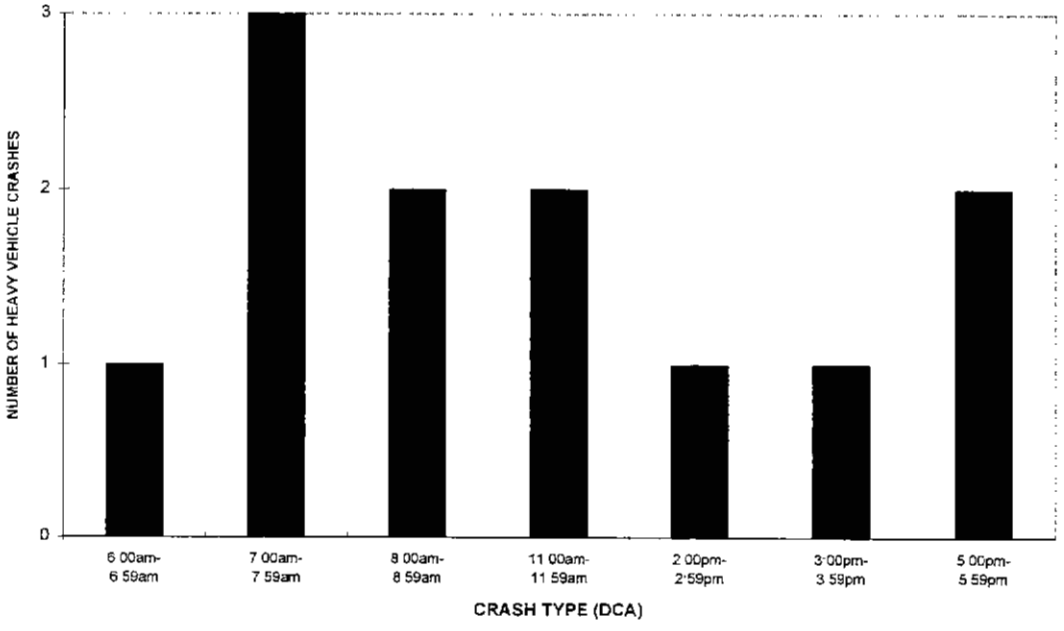


Predominant Heavy Vehicle Movements by DCA:

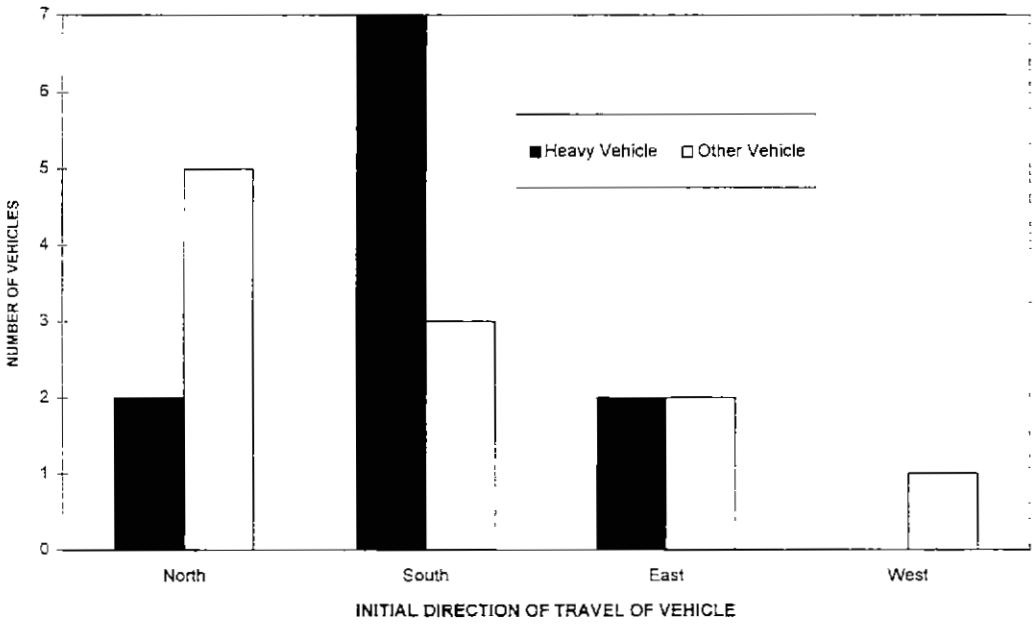
Rear-end - 50%

Right-through - 42%

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:
Yes

Other Patterns/Comments:
Given that Barry Rd/Hume Highway is one of the first sets of signals encountered as drivers enter the Melbourne Metropolitan Area after long periods of travel in rural highway/freeway conditions, it is noteworthy that southbound vehicles appear to be disproportionately involved in crashes.

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably - for many southbound motorists on the Hume Highway, the intersection is only the second signalised intersection to be encountered after a long period of driving at high speeds on the Hume Freeway, with little interruption to traffic flow. Adjusting to urban traffic conditions/lower speeds could present difficulties for motorists in general, and for drivers of heavy vehicles in particular.

Alignment/Topography:
Unlikely

Intersection Geometry (if applicable):
Unlikely in general but may be in respect of left-rear crashes occurring in the sweeping left turn slip lane for left turn movements from west to north.

Intersection Control (if applicable): Right-through and rear-end type crashes are characteristic of intersection signals but appear more pronounced for heavy vehicles in this instance. Signal displays appear adequate. The provision of fully controlled right turn phases, such as are provided for traffic turning right from the Hume Highway, is usually a highly effective means of preventing right-through type crashes. However, in this instance it would appear that non-compliance with red right turn arrows by drivers of heavy vehicles was a factor in at least half of the right-through crashes. All rear-end type collisions involved heavy vehicles striking the rear of other vehicles. Police reports indicate that in most cases, the struck vehicle was stationary at red traffic signals at the time.
Road Surface (friction and roughness): Possibly - the pavement is well worn due to the high volumes of heavy vehicles. Low skid resistance could be a contributing factor.
Roadside Features/Hazards: Unlikely.
Land Use: Unlikely.
Traffic Operation: There is an observable tendency for heavy vehicles turning from the Hume Highway to "run the red" and in general to have difficulty braking to avoid stationary vehicles at the traffic signals.
Delineation: Unlikely.
Street lighting: Unlikely.
Sight Distance: Unlikely, though large vehicles in themselves may be the source sight distance restrictions.
Road Divided/Undivided: Unlikely - both roads fully divided.
Lane Configuration (e.g. lane drop/merge, etc.): Unlikely.
Lane Provision for Turning: Left turn slip lane geometry of the type situated on the N-W corner may, because of its relatively long, sweeping path and low angle of intersection with conflicting through lanes, cause safety problems for left turners. Vehicle speeds tend to be high and detection of conflicting traffic is made more difficult by drivers having to look backwards as they approach the conflict area.
Road works: Unlikely.
Shoulder Condition: No.
Other: None

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Right-through Crashes

- drivers of heavy vehicles **failing to comply with right turn phases**, i.e. the red arrow display;

- the possibility that **insufficient all-red time** is provided for safe clearance between the termination of the right turn phase and the introduction of the through phase for Hume Highway traffic. Heavy vehicles, whose overall length means that extra time is required to clear the conflict area, may need a longer than standard all-red period for safe operation. Evidence in Police reports suggests that these crashes tend to occur at or around the end of the right-turn phase.

  The risk of this type of collision is heightened when the drivers of opposing through vehicles, approaching at the beginning of the green phase for them, have their view of late right turners obscured by other large vehicles on the same approach as the opposing vehicles.

Rear-end Crashes

- **high vehicle speeds and congested traffic conditions**. Adjusting to urban traffic conditions and lower speeds could present some difficulties in judgement for motorists in general, and for drivers of heavy vehicles in particular, given that many drivers would have been travelling for long periods in rural highway/freeway conditions;

- the drivers of heavy vehicles being unable to stop in time to avoid colliding with stationary or near-stationary vehicles (rear-end collisions are characteristic of traffic signal crash patterns generally). Brake failure was cited in one instance, while in other cases, the cause may be due to the **inferior braking performance** of heavy vehicles compared to lighter vehicles and/or to **poor skid resistance** of the highly trafficked pavement and/or to **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display;

- **left turn slip lane geometry** of the type situated on the N-W corner may, because of its relatively long sweeping path and low angle of intersection with conflicting through lanes, cause safety problems for left turners using them. Vehicle speeds tend to be high and detection of conflicting traffic is made more difficult by drivers having to look backwards as they approach the conflict area.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Right-through Crashes

- introduce a red light camera and/or targeted Police enforcement to improve heavy vehicle driver compliance with the red right turn arrow display; and
- increase the all-red time to provide safer clearance between the termination of the right turn phase and the introduction of the opposing through phase for the Hume Highway.

Rear-end Crashes

- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise;
- improve the skid resistance of pavements on all approaches to the intersection, but particularly on the Hume Highway approaches which carry the higher volumes of heavy vehicles;
- modify the geometry of the left turn slip lane situated on the N-W corner to increase the angle of intersection with conflicting through lanes. This measure will reduce left-turning heavy vehicle speeds and also reduce the difficulty for drivers looking to the right as they approach the conflict area.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Barry Road/Hume Highway, City of Broadmeadows, Campbellfield (LGA = 5)

Location Details

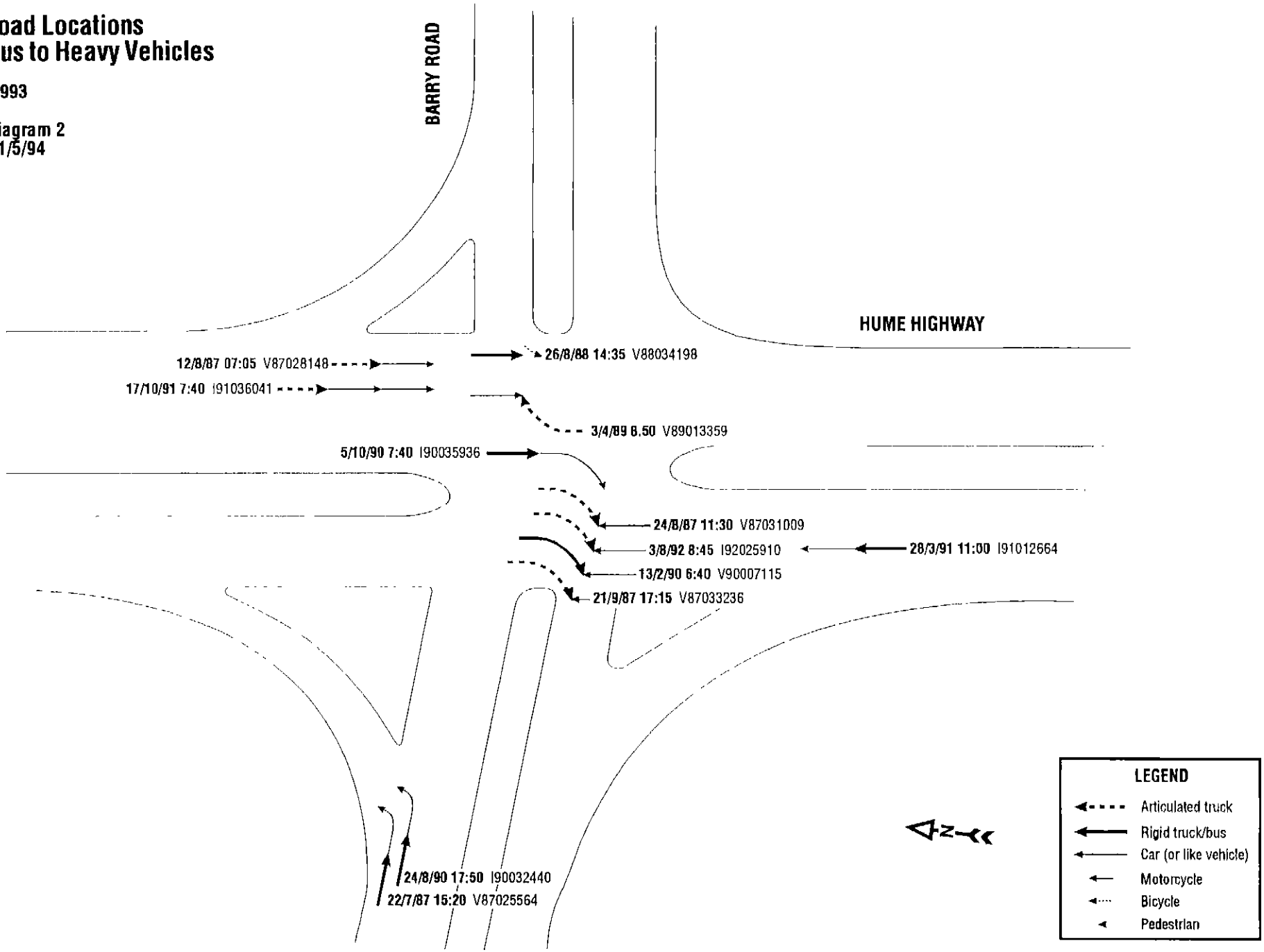
ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
V87025564	22-Jul-87	1520	Wednesday	Left Rear	Other Injury	E /E /	2/ 7/ .	60	DAY	Clear	Dry
V87028148	12-Aug-87	705	Wednesday	unknown	Other Injury	unknown	1/ 6/	60	DAWN	Clear	Dry
V87031009	24-Aug-87	1130	Monday	Right Through	Other Injury	N /S /	2/ 6/ .	75	DAY	Clear	Dry
V87033236	21-Sep-87	1715	Monday	Right Through	Serious Injury	N /S /	10/ 6/ .	75	DAY	Clear	Dry
V88034198	26-Aug-88	1435	Friday	Left Near	Serious Injury	S /W /	7/13/ .	75	DAY	Strong Winds	Dry
V89013359	3-Apr-89	850	Monday	Right Through	Other Injury	S /N /	4/ 6/ .	100	DAY	Clear	Dry
I90032440	24-Aug-90	1750	Friday	Left Rear	Other Injury	E /E /	7/ 1/ .	60	DAY	Clear	Wet
I90035936	5-Oct-90	740	Friday	Right Rear	Other Injury	S /S /	7/ 1/ .	75	DAY	Clear	Dry
V90007115	13-Feb-90	640	Tuesday	Right Through	Other Injury	S /N /	8/ 1/ .	75	DAWN	Clear	Dry
I91012664	28-Mar-91	1100	Thursday	Rear End	Serious Injury	N /N /	7/ 1/ .	75	DAY	Clear	Dry
I91036041	17-Oct-91	740	Thursday	Rear End	Other Injury	S /S /S	6/02/01	75	DAY	Clear	Dry
I92025910	3-Aug-92	845	Monday	Right Through	Other Injury	S /N /	6/ 4/ .	75	DAY	Raining	Wet

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 2
Prepared 11/5/94



LOCATION NUMBER: M2

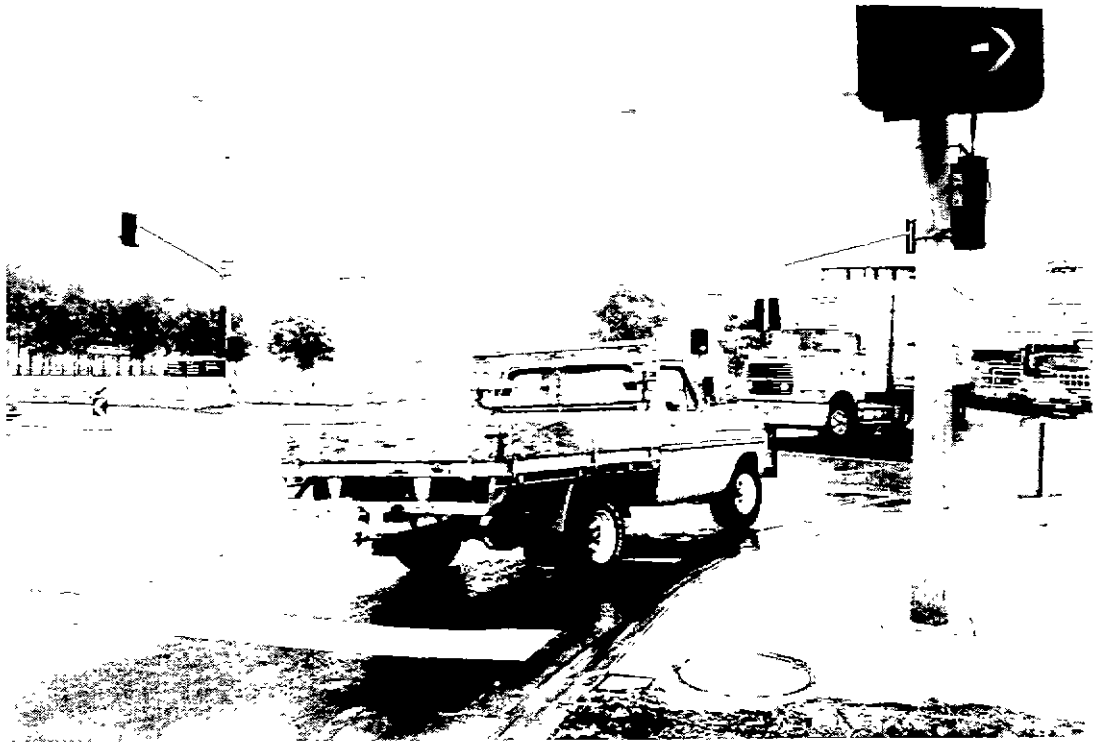


PHOTO 1 OF 4 - FACING NORTH

PHOTO 2 OF 4 - FACING NORTH

LOCATION NUMBER: M2

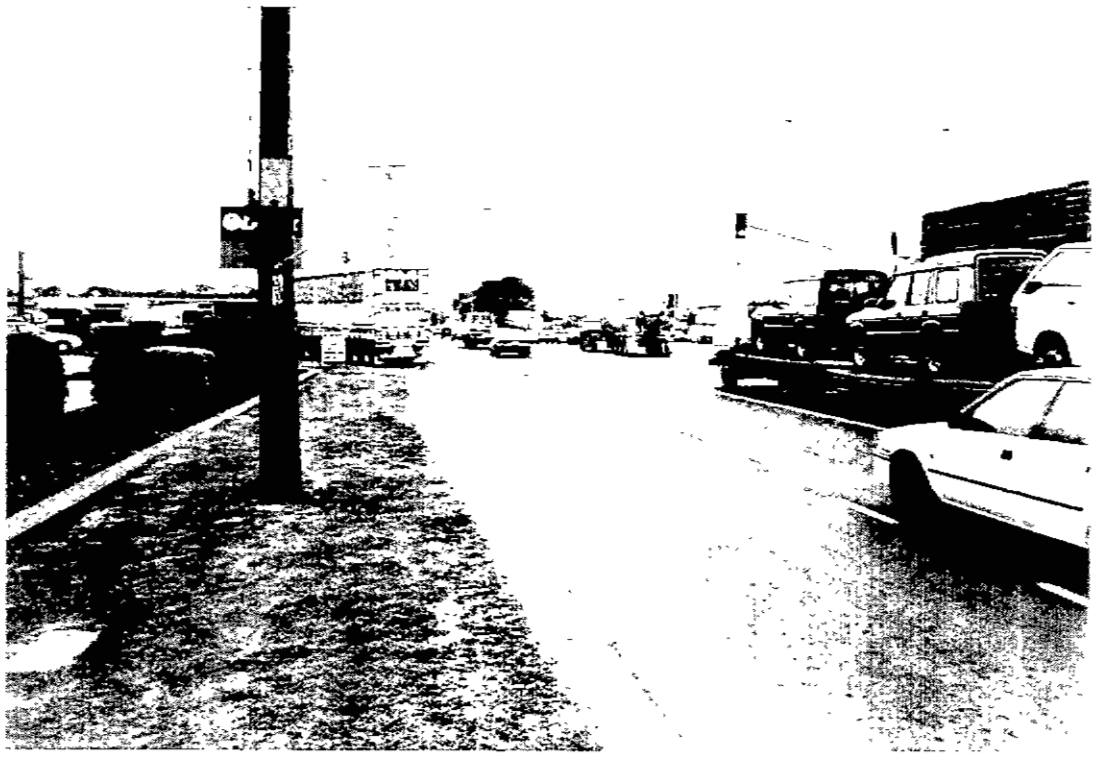


PHOTO 3 OF 4 - FACING SOUTH

PHOTO 4 OF 4 - FACING EAST

P.T.F. CONTROLLER OPERATIONS SHEETS

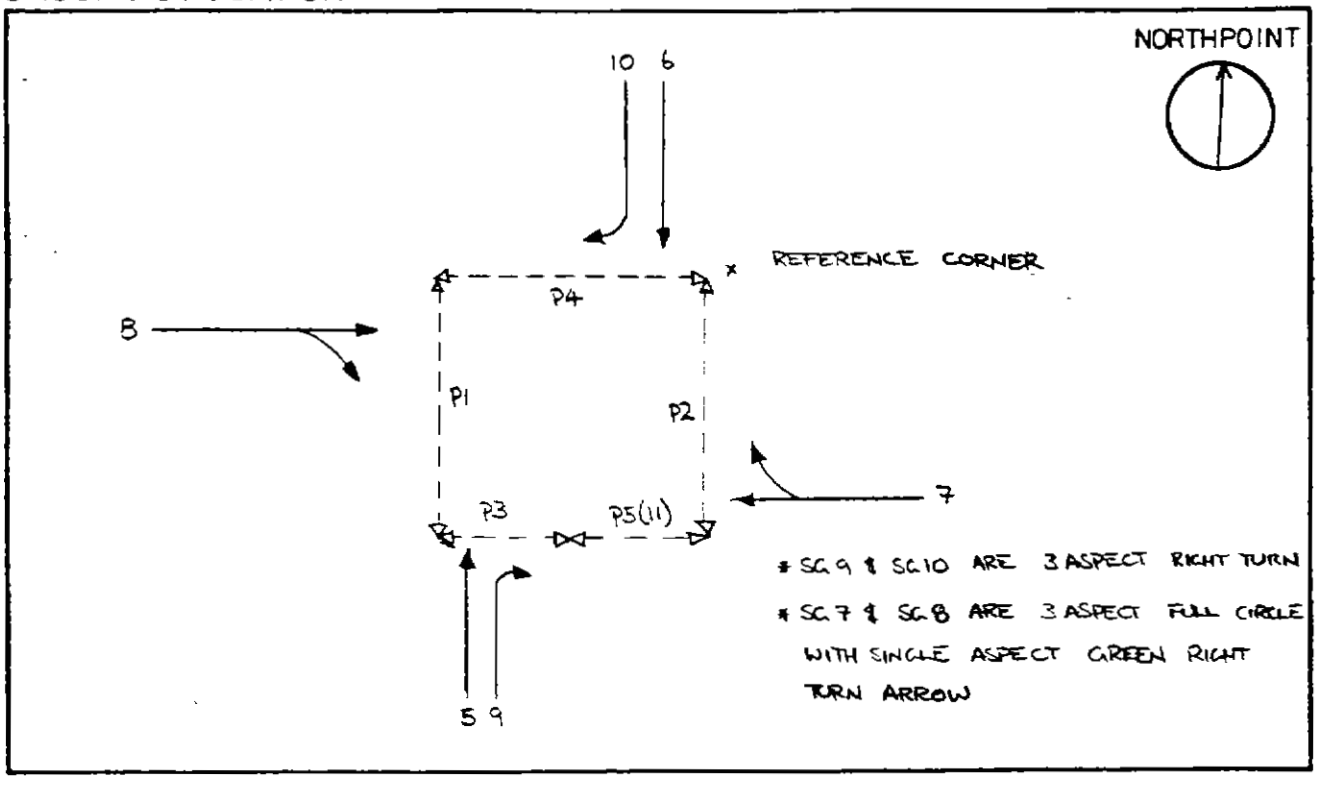
INTERSECTION: HUME HWY / BARRY RD No 2159

MUNICIPALITY: CITY OF BROADMEADOWS DESIGNER G. GOLDENBERG DATE 28/10/93

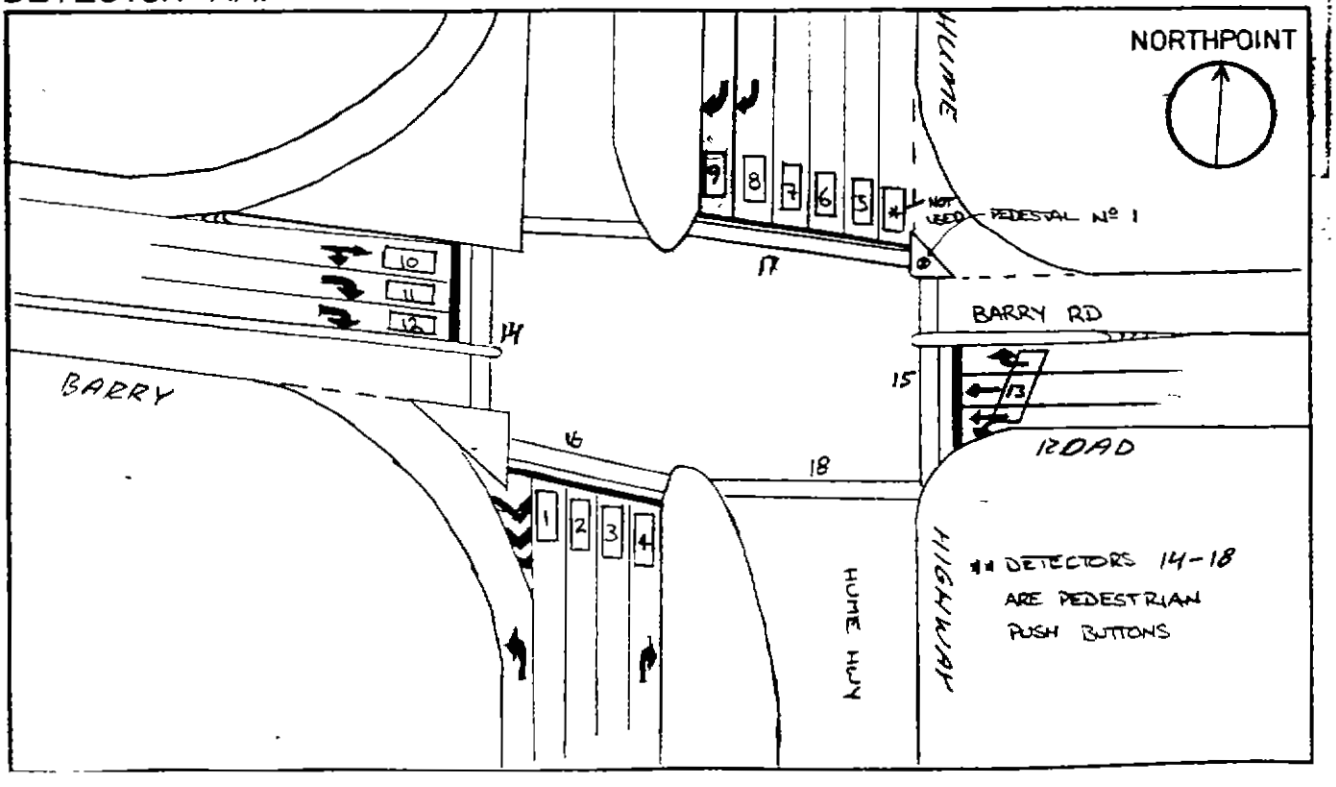
CONTROLLER: PTF VT3 SECTION LEADER M.J. Ehrlich DATE 28/10/93

PLAN No. P4256 24 PROGRAM CHECKED [signature] DATE 16/11/93

GROUP ALLOCATION

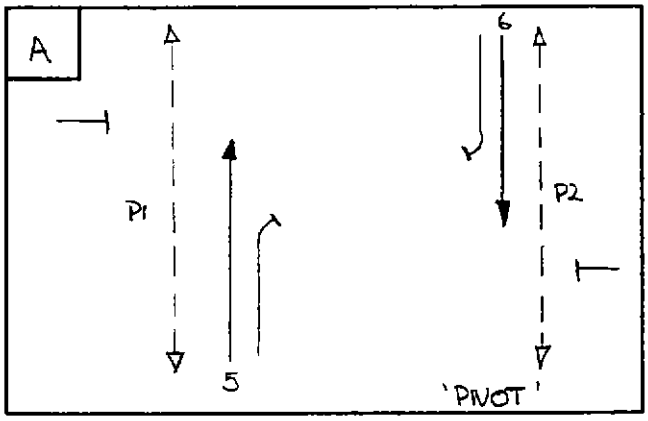


DETECTOR MAP



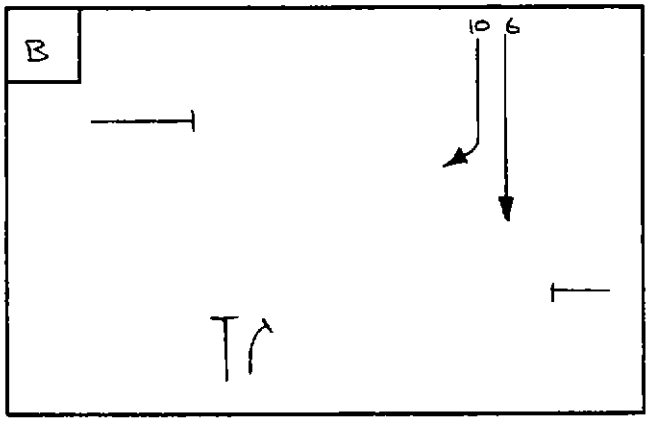
PHASING DIAGRAM

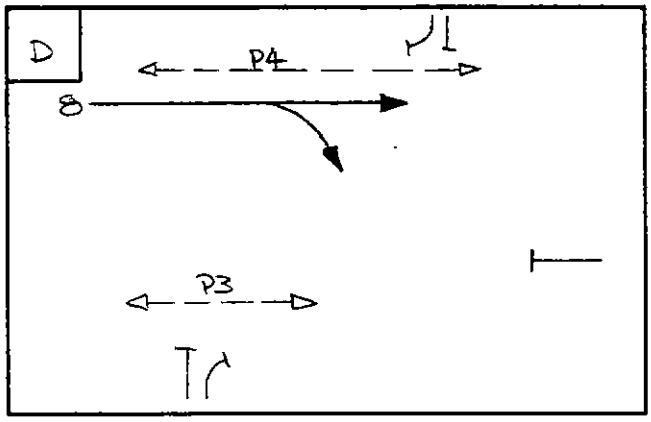
INTERSECTION HUME HWY / BARRY RD No 2159



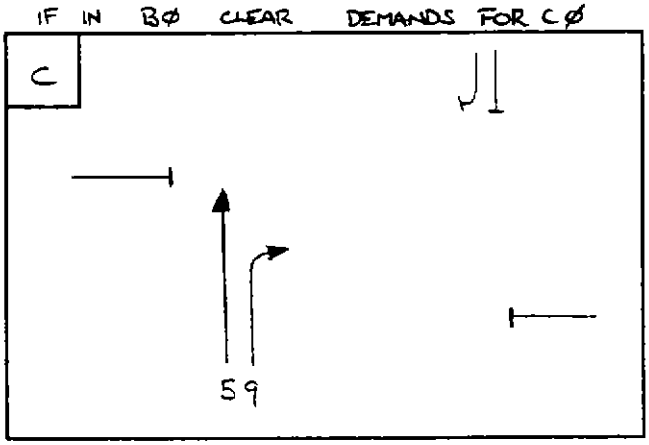
NORTHPOINT

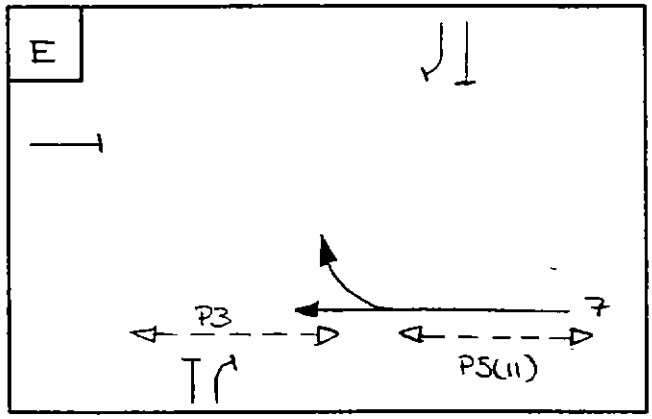
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION



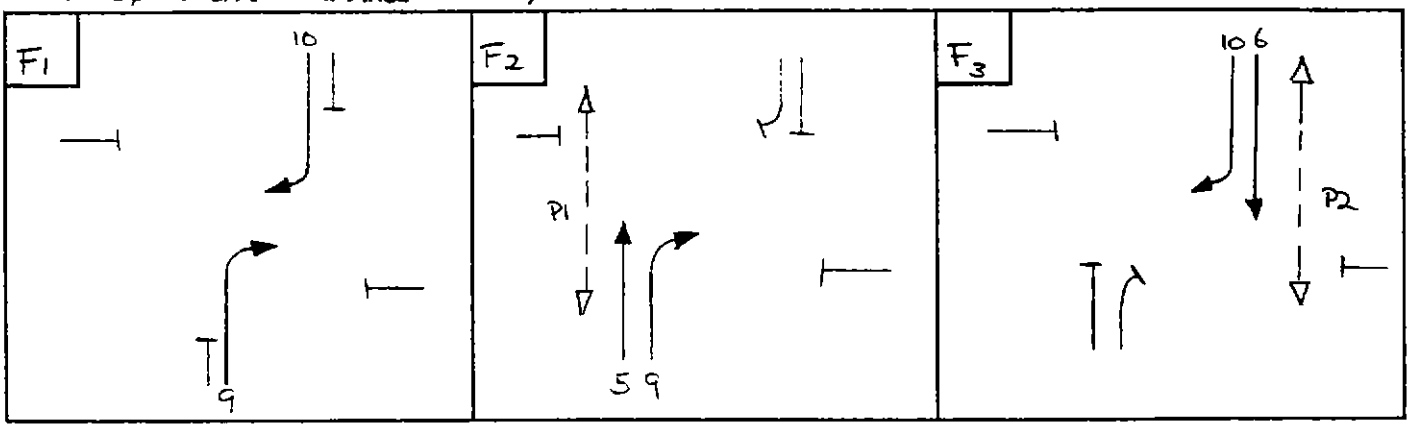


IF IN Bø CLEAR DEMANDS FOR Cø





IF IN Cø CLEAR DEMANDS FOR Bø

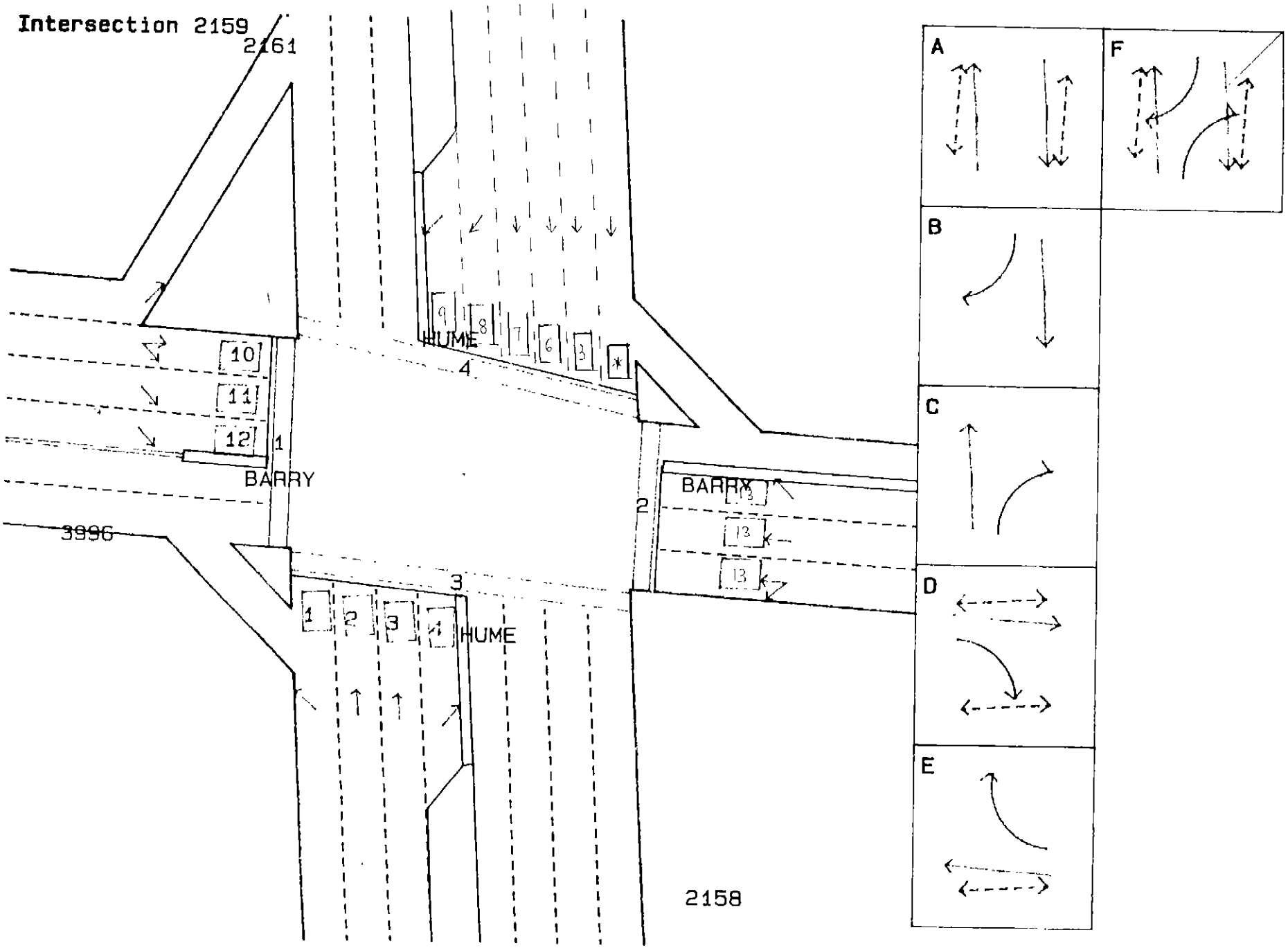


V.A. SEQUENCE: ADEF

IF IN Fø CLEAR DEMANDS FOR Bø & Cø

DESIGNED:

DATE: 26-10-93


Intersection 2159
2161
HUME
4
BARRY
1
BARRY
2
3996
3
HUME
2158
A
F
B
C
D
E

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Boundary Rd/Flemington Rd/Mt Alexander Rd/Tullamarine Freeway, North Melbourne

Case No: M3

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 3 June 1994 **Case No: M3**

1. Location Details

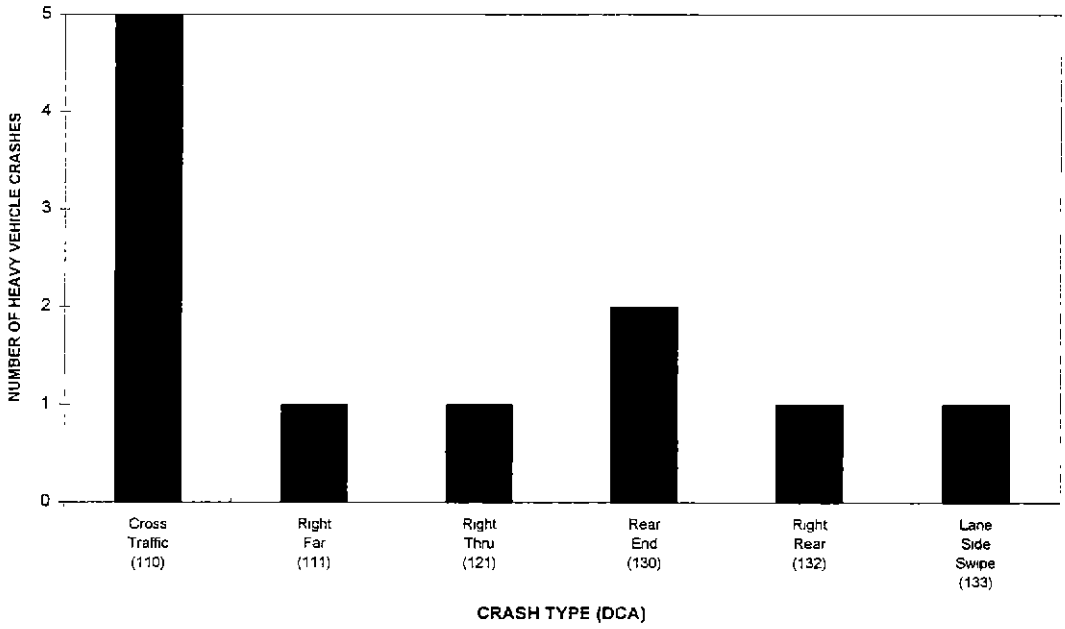
Street Names: Boundary Rd/Flemington Rd/Mt Alexander Rd/Tullamarine Freeway.
Suburb and Local Government Area: North Melbourne, City of Melbourne.
Melway Map Reference: 43 C1
Road Functional Classification: Boundary Rd. primary arterial; Flemington Rd: primary arterial; Mt Alexander Rd: secondary arterial; Tullamarine Freeway: freeway
Alignment/Topography: Generally flat with curved alignment on the Tullamarine Freeway (north) and Flemington Rd (south east) approaches.
Intersection Geometry (if applicable): Four-leg intersection of complex layout (refer attached plan).
Traffic Control Type: Intersection signals (refer attached plan).
Surrounding Land Use: Residential/business/open space.
Designated Heavy Vehicle Route: Highly trafficked heavy vehicle route - National Route 1.
Speed Zone: 60 km/h - all approaches.
Number of Traffic Lanes: Refer attached plan.
Pedestrian (or other vulnerable road user) Activity: Moderate level of pedestrian activity, mainly associated with tram stops.
Characteristics of Traffic (Control) Operation: Very complex and congested traffic situation, including large numbers of heavy vehicles and trams.
Treatment History: n/a

Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: Intersection also used by large numbers of coaches serving Melbourne Airport, Bendigo and beyond.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 0 **Serious Injury** - 11 **Other Injury** - 44 **Total** - 55
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 3 **Other Injury** - 8 **Total** - 11
Percentage of Heavy Vehicle to All Casualty Crashes: 20.0% **Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 5 **Rigid** - 6 **Bus** - 0

Predominant Heavy Vehicle Crash Types (DCA):

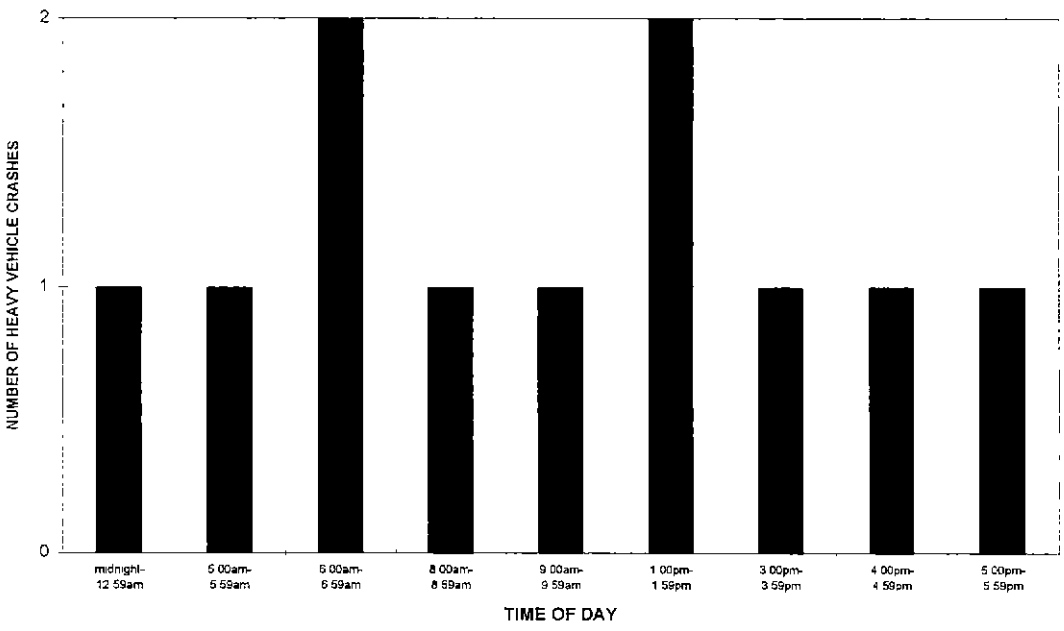


Predominant Heavy Vehicle Movements by DCA:

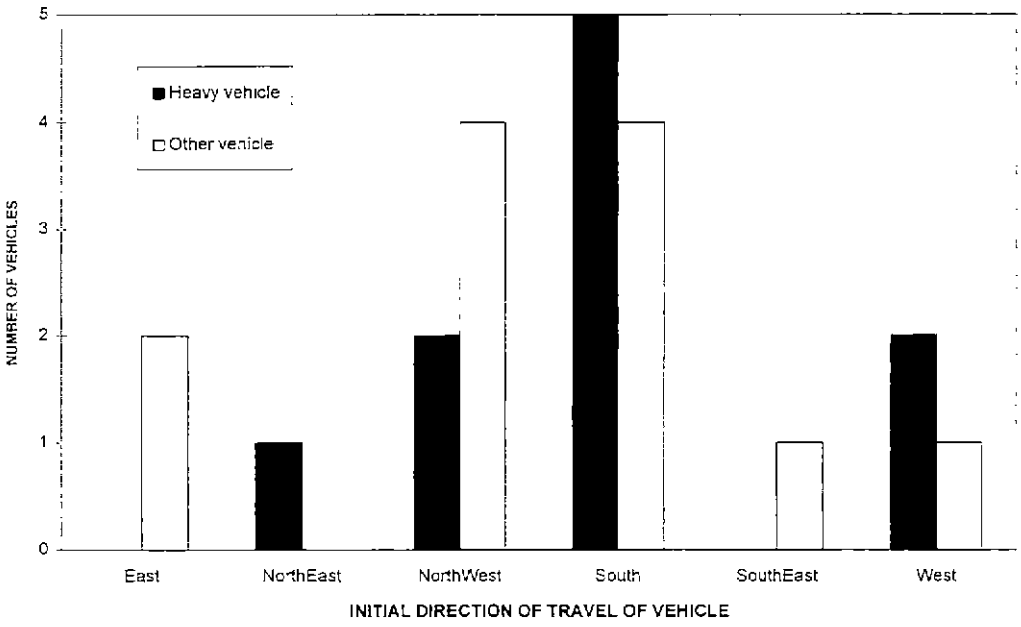
Cross Traffic - 45%

Rear-End Type - 27%

Time of Day Crash Patterns:



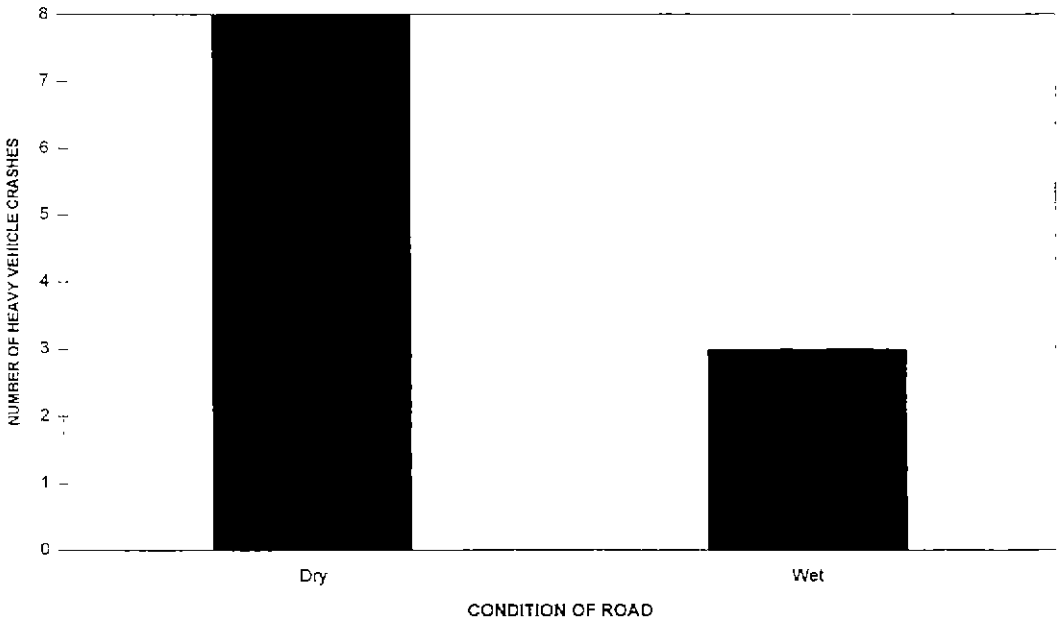
Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:

Other Patterns/Comments:

CONDITION OF ROAD CRASH PATTERNS



3. Road Environment Factors Contributing to Crash Occurrence

Speed: Unclear.
Alignment/Topography: Probably - alignment and presence of bridge structure on Tullamarine Freeway approach restrict sight distance to traffic signals.
Intersection Geometry (if applicable): Probably - generally complex layout requiring high level of driver attention.
Intersection Control (if applicable): Likely - crashes types at this intersection are consistent with the general characteristics of intersection signals. Inter-green periods may be inadequate given the high proportion of heavy vehicles using the intersection. The standard of signal displays for traffic leaving the Tullamarine Freeway is minimal, with existing lanterns obscured by railway bridge structure and curved alignment of the northern approach. There is evidence from Police reports that in at least three crashes, the drivers of the heavy vehicles failed to comply with red signal displays, while in three other cases the drivers of heavy vehicles collided with the rear of stationary or near-stationary vehicles.
Road Surface (friction and roughness): Not known but heavy volumes of heavy vehicles and other traffic appears to have damaged pavement condition, thereby progressively reducing skid resistance.
Roadside Features/Hazards: Railway bridge structure obscures signal lanterns on northern approach.
Land Use: No.
Traffic Operation: Complex intersection layout, signal displays and route/directional signing create a demanding traffic environment for all users of the intersection.
Delineation: Worn but not likely to be a significant contributing factor.
Street lighting: No.
Sight Distance: Yes - railway bridge structure obscures signal lanterns on northern approach for traffic crossing into Boundary Rd from Tullamarine Freeway.
Road Divided/Undivided: Highly channelised but not likely to be a significant contributing factor.
Lane Configuration (e.g. lane drop/merge, etc.): No.

Lane Provision for Turning: No.
Road works: No.
Shoulder Condition: No.
Other: No.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Cross-Traffic Crashes

- cross-traffic crash types are **characteristic of crashes at intersection signals. The standard of signal displays** is minimal for traffic leaving the Tullamarine Freeway, with existing **signal lanterns obscured** by the railway bridge structure and the curved alignment of the northern approach. Larger heavy vehicles themselves exacerbate this situation by also obscuring signal displays;
- evidence from Police reports indicates that in at least three of the cross-traffic crashes, the drivers of the heavy vehicles **failed to comply with red signals,**
- standard **inter-green periods may be inadequate** given the dimensions of heavy vehicles and high proportion of heavy vehicles using the intersection;
- complex intersection layout, signal displays, route/directional signing and congested traffic conditions create a **demanding traffic environment** for all users of the intersection.

Rear-end Type Crashes

- rear-end type crashes are also **characteristic of crashes at intersection signals. The standard of signal displays** generally is minimal (e.g. there are no mast arm displays even though the volumes of heavy vehicles are high). As with cross-traffic crashes, larger heavy vehicles themselves exacerbate the situation by also obscuring signal displays;
- in all three rear-end type crashes, the drivers of heavy vehicles **collided with the rear of stationary or near-stationary vehicles.** This may indicate **inferior braking performance** for heavy vehicles, a **tendency for drivers of heavy vehicles to run red signals,** as is evident in the cross-traffic crashes, or that the high volumes of heavy vehicles and of traffic generally may have progressively worn and damaged the pavement, and **reduced skid resistance,** thereby affecting vehicle braking performance.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Cross-Traffic Crashes

- upgrade the standard of traffic signal displays by erecting mast arms to reduce problems caused by larger heavy vehicles themselves obscuring signal displays and, in particular, improve the visibility and conspicuity of traffic signal displays presently obscured by the railway bridge structure and the curved alignment of the northern approach;
- install a red light camera to address the reported failure of some drivers of heavy vehicles to comply with red signals;
- increase the all-red periods to better provide for the dimensions and the high proportion of heavy vehicles using the intersection.

Rear-end Type Crashes

- improve the standard of signal displays as discussed above;
- improve the skid resistance of pavements on all approaches to the intersection to better provide for the special needs and shortcomings of heavy vehicles braking at traffic signals;
- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise.

ATTACHMENTS

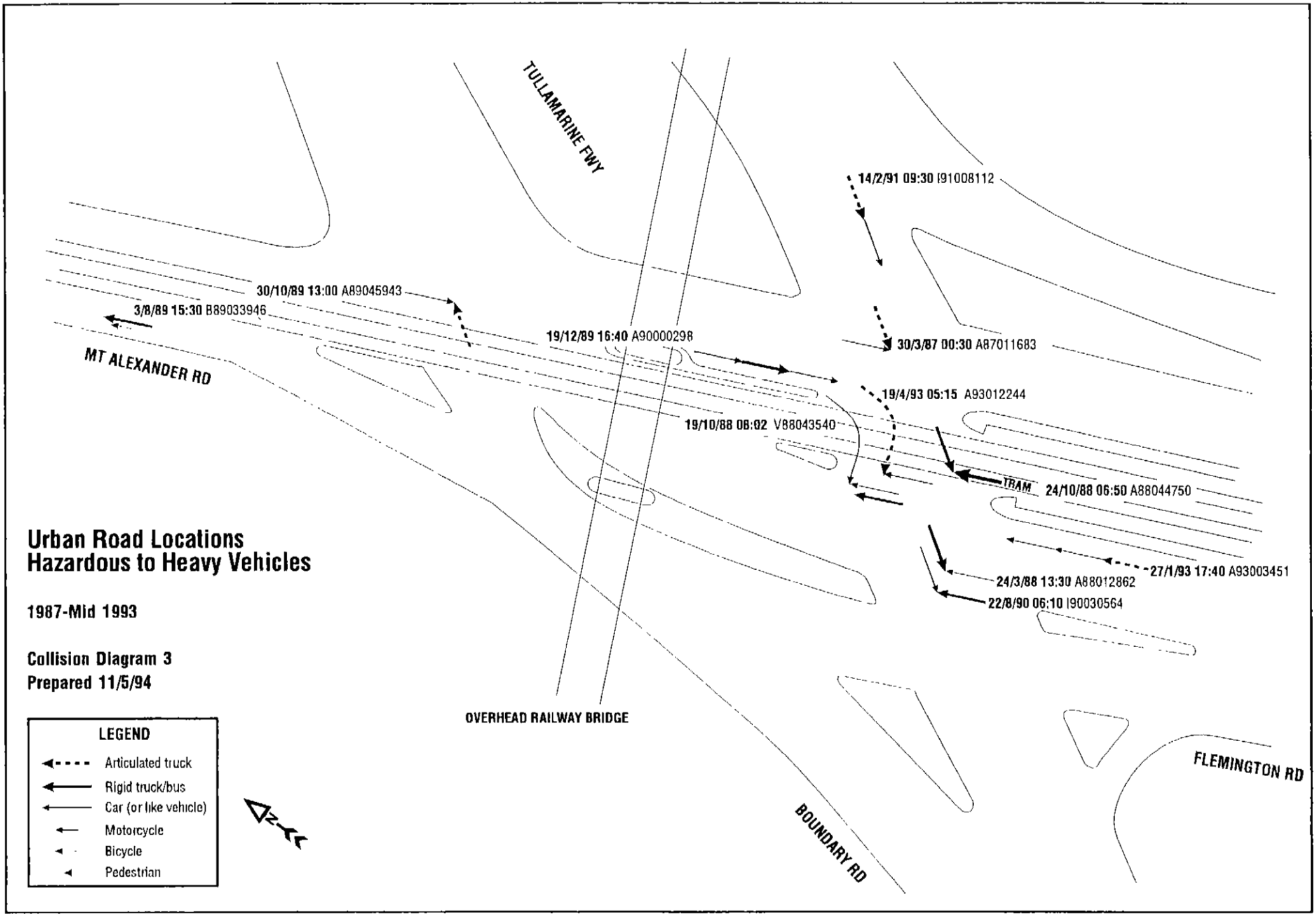
HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Boundary Road/ Tullamarine Freeway, City of Melbourne, North Melbourne (LGA = 33)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
A88012862	24-Mar-88	1330	Thursday	Cross Traffic	Other Injury	NW/S /	1/ 7/ .	60	DAY	Clear	Dry
A87011683	30-Mar-87	30	Monday	Cross Traffic	Other Injury	E /S /	1/ 6/ .	60	DARK	Clear	Wet
A88043540	19-Oct-88	802	Wednesday	Right Through	Other Injury	E /W /W	1/01/07	60	DAY	Clear	Dry
A88044750	24-Oct-88	650	Monday	Cross Traffic	Other Injury	S /W /	5/ 7/ .	60	DAY	Clear	Wet
A89045943	30-Oct-89	1300	Monday	Cross Traffic	Serious Injury	SE/NE/	1/ 6/ .	60	DAY	Clear	Dry
A90000298	19-Dec-89	1640	Tuesday	Rear End	Other Injury	S /S /S	1/07/01	60	DAY	Clear	Dry
B89033946	3-Aug-89	1530	Thursday	Lane Side Swipe	Other Injury	NW/NW/	7/13/ .	60	DAY	Clear	Dry
I90030564	22-Aug-90	610	Wednesday	Cross Traffic	Serious Injury	W /S /	7/ 1/ .	60	DAY	Clear	Wet
I91008112	14-Feb-91	930	Thursday	Rear End	Other Injury	S /S /	6/ 1/ .	75	DAY	Clear	Dry
A93003451	27-Jan-93	1740	Wednesday	Right Rear	Other Injury	NW/NW/NW	6/01/04	60	DAY	Clear	Dry
A93012244	19-Apr-93	515	Monday	Right Far	Serious Injury	NW/S /	1/ 6/ .	60	DARK	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle


TULLAMARINE FWY
14/2/91 09:30 I91008112
30/10/89 13:00 A89045943
3/8/89 15:30 B89033946
MT ALEXANDER RD
19/12/89 16:40 A90000298
30/3/87 00:30 A87011683
19/4/93 05:15 A93012244
19/10/88 08:02 V88043540
TRAM
24/10/88 06:50 A88044750
27/1/93 17:40 A93003451
24/3/88 13:30 A88012862
22/8/90 06:10 I90030564
OVERHEAD RAILWAY BRIDGE
FLEMINGTON RD
BOUNDARY RD
Urban Road Locations
Hazardous to Heavy Vehicles
1987-Mid 1993
Collision Diagram 3
Prepared 11/5/94
LEGEND
Articulated truck
Rigid truck/bus
Car (or like vehicle)
Motorcycle
Bicycle
Pedestrian

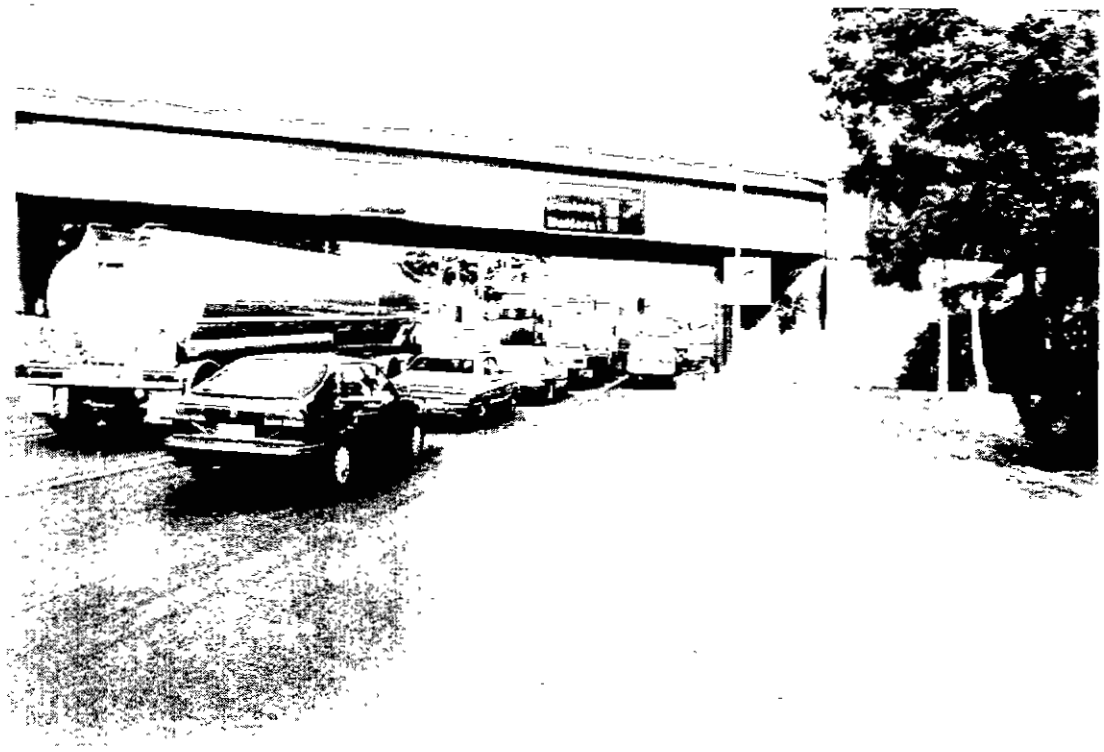


PHOTO 1 OF 4 - FACING SOUTH

PHOTO 2 OF 4 - FACING SOUTH-EAST

PHOTO 3 OF 4 - FACING NORTH-WEST

PHOTO 4 OF 4 - FACING NORTH-WEST

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

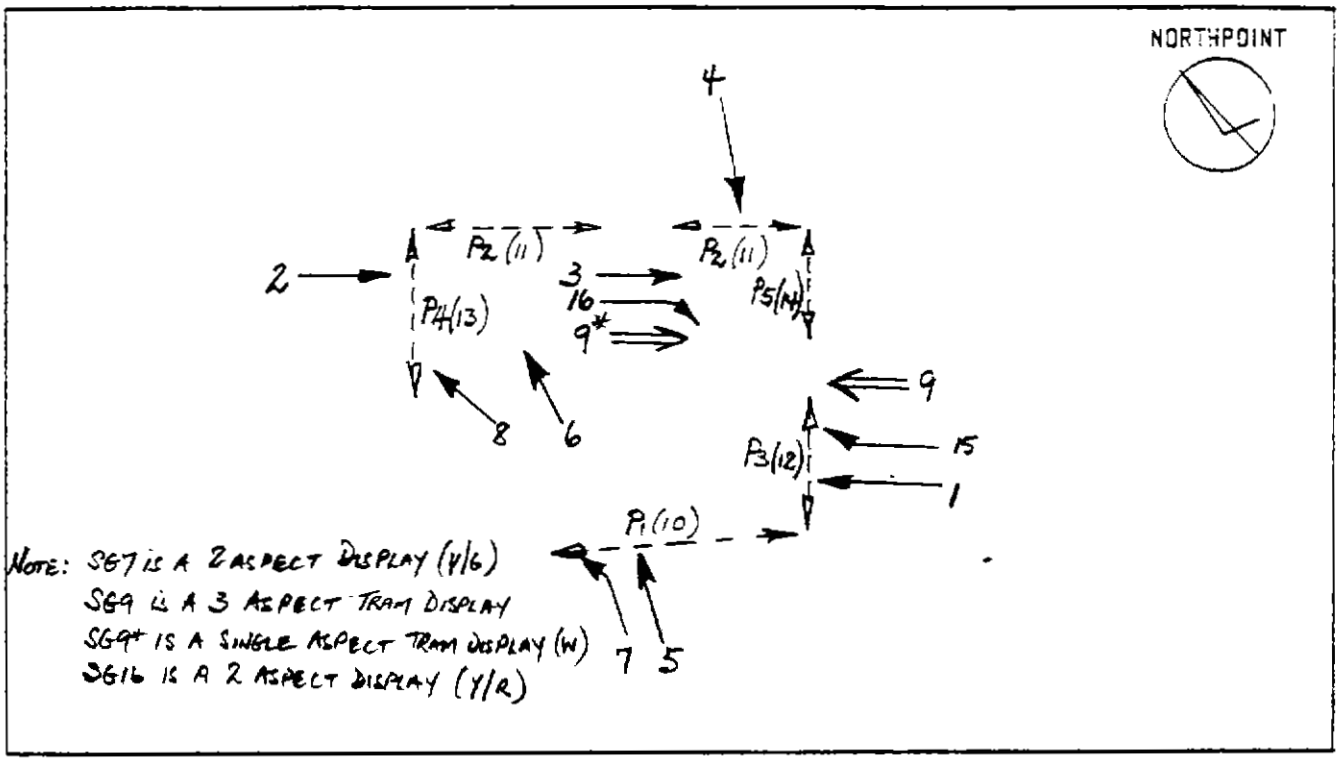
INTERSECTION FLEMINGTON RD / BOUNDARY RD / TULLAMARINE FWY No 2860

MUNICIPALITY MELBOURNE DESIGNER M. CHELINI DATE 1/6/90

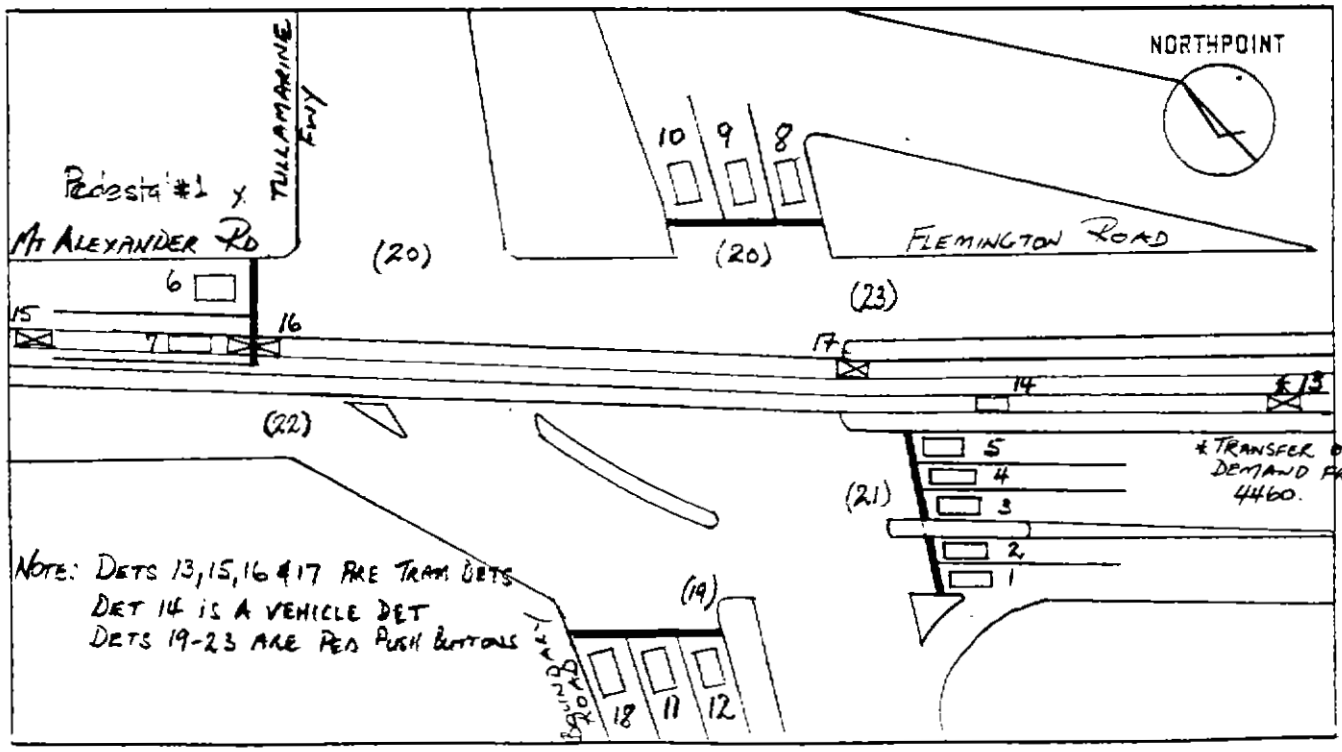
CONTROLLER CAPALITY 16 GROUPS DESIGN CHELKED DATE

PLAN No 880130 PROGRAM CHECKED Chris Lee DATE 8/8/90

GROUP ALLOCATION



DETECTOR MAP

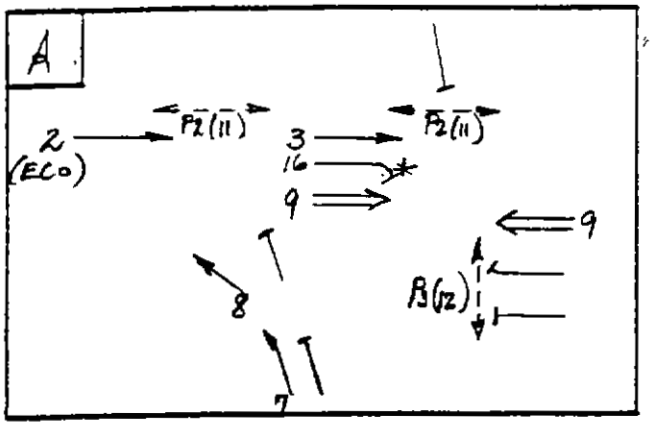


C - PERS

PHASING DIAGRAM

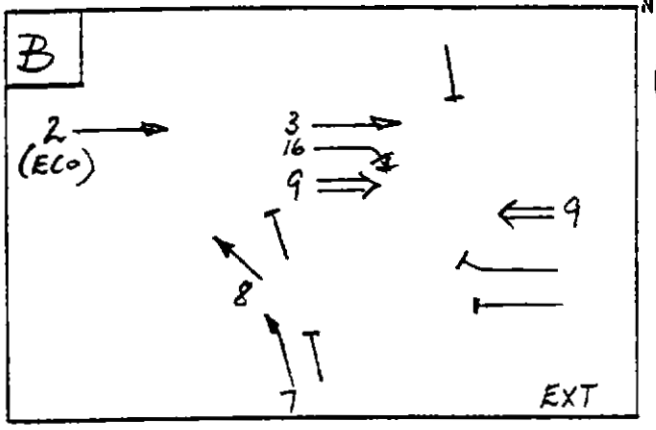
INTERSECTION FLEMINGTON Rd/BOUNDARY RD/TULLAMARINE Fwy NO 2860

A



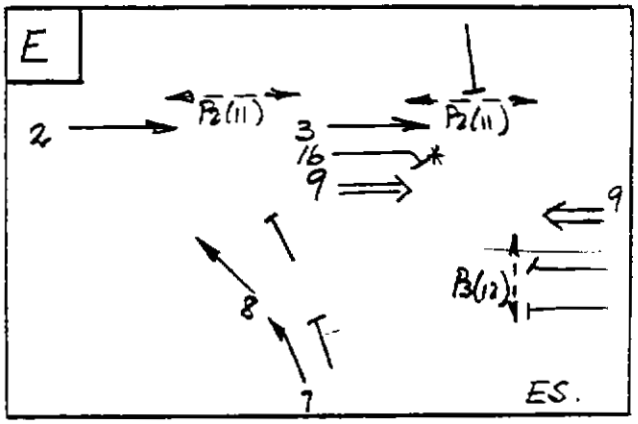
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION

B



NORTHPOINT

E



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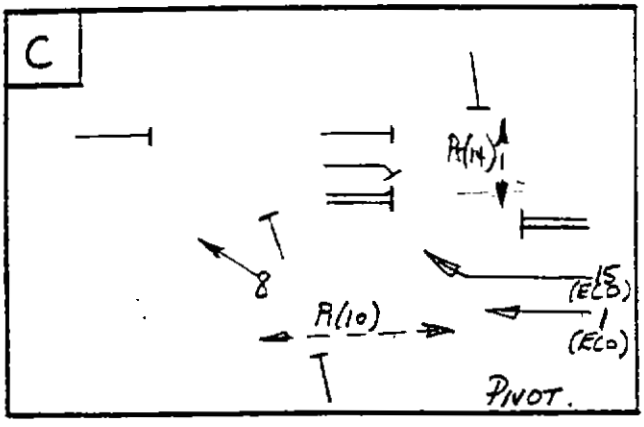
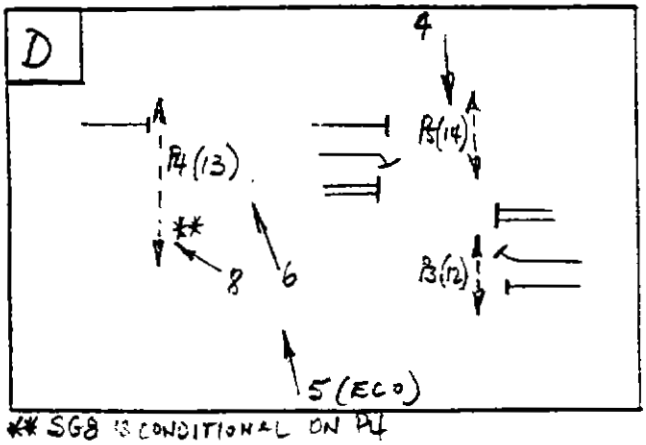


*NOTE: SG16 IS CONDITIONAL ON SG9 REFER TO SPECIAL NOTES.

D



** SG8 IS CONDITIONAL ON P4

V.A. SEQUENCE : ACD

DESIGNED : M CHELINI

DATE : 1/6/92

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Francis Street/Williamstown Road, Yarraville

Case No: M4

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 10 June 1994 **Case No: M4**

1. Location Details

Street Names: Francis Street/Williamstown Road.
Suburb and Local Government Area: Yarraville, City of Footscray.
Melway Map Reference: 41 J10
Road Functional Classification: Francis Street: secondary arterial road; Williamstown Road: primary arterial road.
Alignment/Topography: Generally flat and slightly curved on the north and east approaches.
Intersection Geometry (if applicable): Cross intersection, left turn slip lane for east to south movement.
Traffic Control Type: Intersection signals with fully controlled right turns from north and south approaches and partially controlled right turn from west approach.
Surrounding Land Use: Commercial/open space/residential.
Designated Heavy Vehicle Route: Very high volumes of large/heavy vehicles.
Speed Zone: 60 km/h.
Number of Traffic Lanes: North: left/through, 2 through, right; South: left/through, 2 through, right. East and West: left/through, through, right.
Pedestrian (or other vulnerable road user) Activity: Light to medium pedestrian activity.
Characteristics of Traffic (Control) Operation: Due to the relatively small turning radius, heavy vehicles encroach into second lane on both the approach and departure for the left turn from south to west.

Treatment History:
Fully controlled right turn phases were installed on north and south approaches during the second half of 1992. No right-through crashes involving heavy vehicles have been reported to Police since their installation.

Location Plan Attached:
Yes.

Photographs Attached:
Yes.

Other Observations/Comments:
Red light camera installed on the north approach to photograph southbound vehicles.

2. Crash Details

Period of Crash Analysis:
1987 to mid-1993.

Total Number of Crashes:
Fatal - 0
Serious Injury - 12
Other Injury - 18
Total - 30

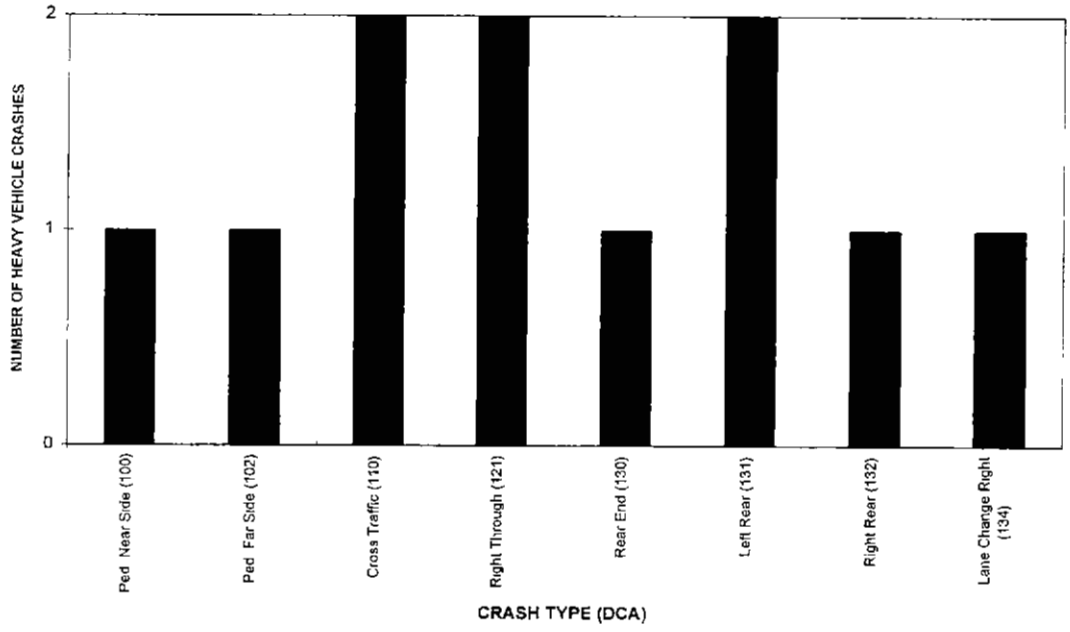
Total Number of Heavy Vehicle Crashes:
Fatal - 0
Serious Injury - 7
Other Injury - 4
Total - 11

Percentage of Heavy Vehicle to All Casualty Crashes: 36.7%

Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections: 8.3%

Number of Crashes by Heavy Vehicle Type:
Articulated - 7
Rigid - 4
Bus - 0

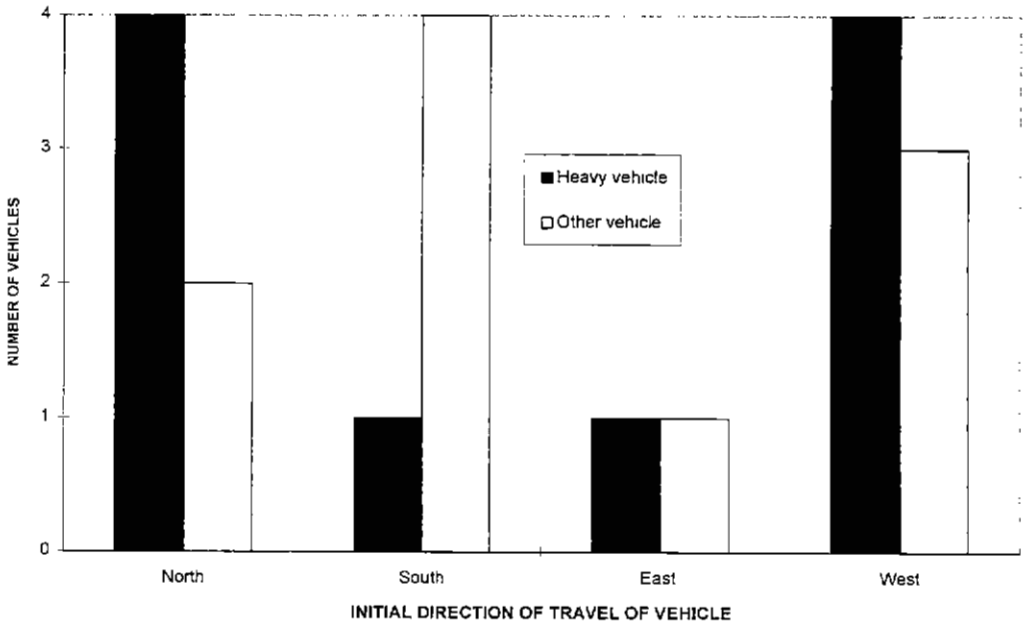
Predominant Heavy Vehicle Crash Types (DCA):



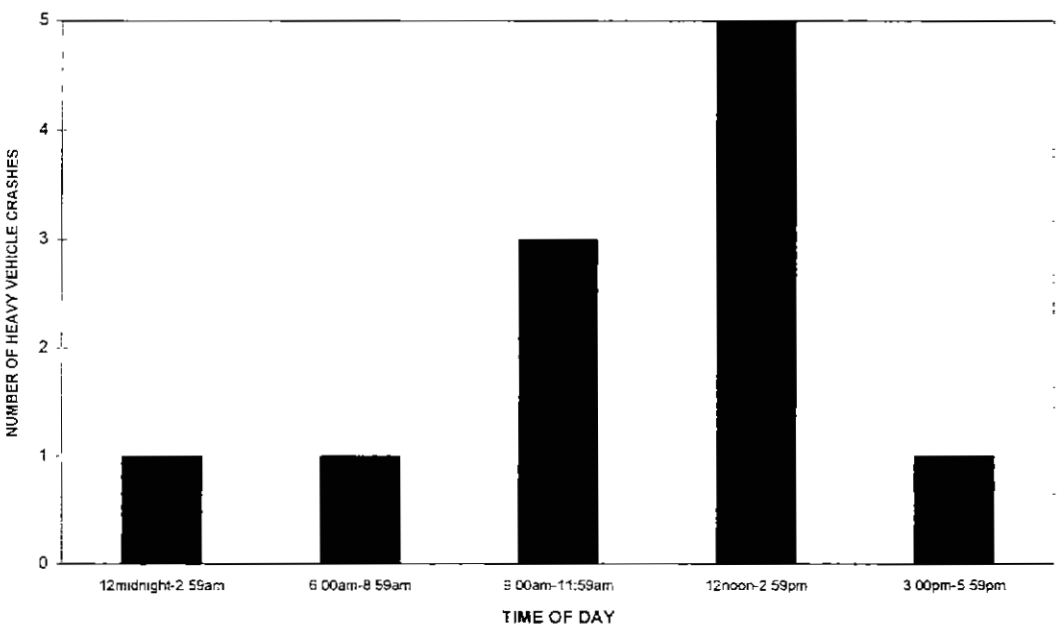
Predominant Heavy Vehicle Movements by DCA:

Rear-end type - 36%
Right-through - 18%
Cross -traffic - 18%
Pedestrian - 18%

Initial Direction of Travel of Vehicle Crash Patterns:



Time of Day Crash Patterns:



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
None.

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Possibly.

Alignment/Topography:
Unlikely

Intersection Geometry (if applicable):
Unlikely in general but may be in respect of left-rear crashes occurring in the sweeping left turn slip lane for left turn movements from east to south. Tight radius for left turners south to west could present hazards to pedestrians if trucks encroach on footpath while turning.

Intersection Control (if applicable):
Right-through and rear-end type crashes are characteristic of intersection signals. Signal displays are to a minimum standard only and appear not to take account of the high volumes of heavy vehicles using the intersection, nor the width of carriageway on the Williamstown Rd approaches.

The provision of fully controlled right turn phases is highly effective in preventing right-through type crashes. No right-through crashes involving heavy vehicles have been reported to Police since their installation. In the only crash involving heavy vehicles turning right from Williamstown Road, non-compliance with signals by the through-vehicle appears to have caused the crash.

All rear-end type collisions involved heavy vehicles striking stationary vehicles. Slip lanes intersecting at a low angle with conflicting traffic are characterised by this type of rear-end crash.

Road Surface (friction and roughness):
Possibly - the pavement is well worn due to the high volumes of heavy vehicles. Low skid resistance could be a contributing factor.

Roadside Features/Hazards:
No.

Land Use:
No.

Traffic Operation:
The adequacy of the intergreen times, all-red periods in particular, may be a factor in some crashes given the additional time required by long and/or heavy vehicles to clear an intersection.

Delineation:
No.

Street lighting:
No.

Sight Distance:
Unlikely, though large vehicles in themselves may be the source of sight distance restrictions.

Road Divided/Undivided:
Unlikely - both roads fully divided.

Lane Configuration (e.g. lane drop/merge, etc.):
No.

Lane Provision for Turning:
No.

Road works:
No.

Shoulder Condition:
No.

Other:
No.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Right-through Crashes

- there is no evidence to suggest particular risks due to heavy vehicles in either of the two right-through crashes. In one case the driver of the other vehicle was reported by Police to have failed to comply with signals. In the other case the crash occurred while the driver of the other vehicle was making a filter turn.

Rear-end Crashes

- the drivers of heavy vehicles being unable to stop in time to avoid colliding with stationary or near-stationary vehicles (rear-end collisions are characteristic of traffic signal crash patterns generally). Brake failure was cited in one instance, while in other cases, the cause may be due to the **inferior braking performance** of heavy vehicles compared to lighter vehicles and/or to **poor skid resistance** of the highly trafficked pavement and/or to **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display;

- **minimum standard signal displays** on the north approach, together with **limited sight distance to signals due to large numbers of heavy vehicles,** may have contributed to rear-end crashes on this approach;

- **left turn slip lane geometry** of the type situated on the S-E corner may, because of its relatively low angle of intersection with conflicting through lanes, cause safety problems for left turners, especially those following other left turners. Vehicle speeds tend to be high and detection of conflicting traffic is made more difficult by drivers having to look backwards as they approach conflict areas at or within the slip lanes.

Pedestrian Crashes

- **inappropriate pedestrian behaviour** may have contributed to these crashes. The tight radius for left turning heavy vehicles south to west presents potential hazards to pedestrians if trucks encroach unexpectedly onto or near the footpath while turning.

Cross-Traffic Crashes

- **malfunctioning traffic signals and non-compliance with the red signal by an emergency services** (fire) vehicle appear to be the main factors in the two cross-traffic crashes which have occurred. The emergency services vehicle had siren and flashing lights operating at the time.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Right-through Crashes

- no right-through crashes involving heavy vehicles have been reported to Police since the installation of fully controlled right turn phases on the north and south approaches. Fully controlled right turn phases could be provided on the east and/or west approaches should right-through crashes become a problem.

Rear-end Crashes

- improve pavement skid resistance, especially on the north approach, to better provide for the special needs and shortcomings of heavy vehicles braking at traffic signals;
- upgrade the standard of traffic signal displays by erecting mast arms to reduce problems caused by larger heavy vehicles themselves obscuring signal displays and, in particular, improve the visibility of traffic signal displays on the north approach;
- modify the geometry of the left turn slip lane situated on the S-E corner to increase the angle of intersection with conflicting through lanes. This measure will reduce left-turning heavy vehicle speeds and also reduce the difficulty for drivers looking to the right as they approach the conflict area.

Pedestrian and Cross-Traffic Crashes

- no countermeasures are proposed for these crash types, given their low frequencies and the circumstances under which they occurred. Any improvement which can be made to the left turn radius on the S-W corner would improve safety for pedestrians, and the efficiency of left turn movements by heavy vehicles.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Francis Street/ Williamstown Road, City of Footscray (LGA = 22)

Location Details

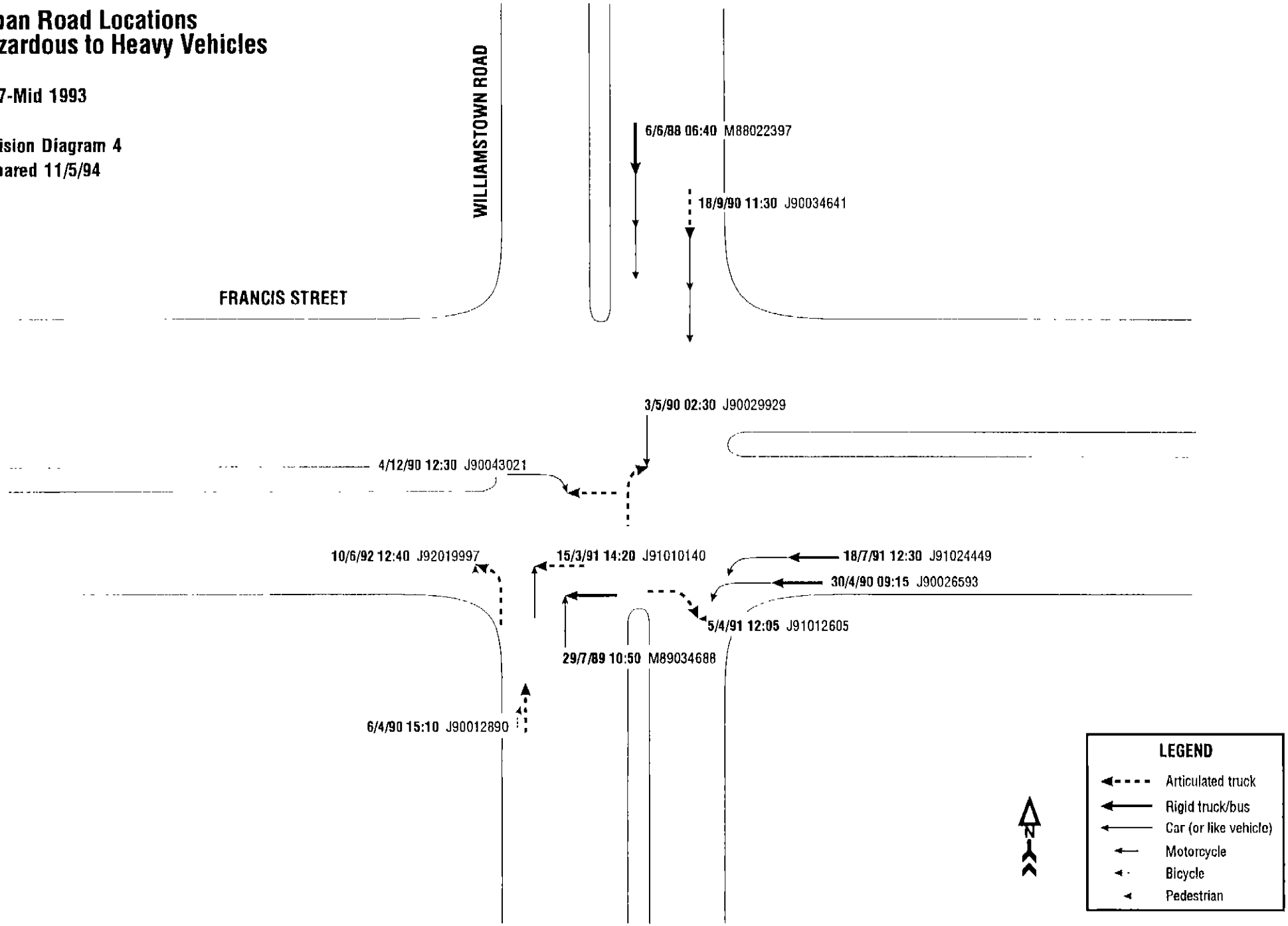
ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
M88022397	6-Jun-88	640	Monday	Right Rear	Other Injury	S /S /S	2/07/01	60	DAWN	Clear	Dry
M89034688	29-Jul-89	1050	Saturday	Cross Traffic	Serious Injury	W /N /	3/ 7/ .	60	DAY	Clear	Dry
J90012890	6-Apr-90	1510	Friday	Lane Change Right	Serious Injury	N /N /	6/13/ .	60	DAY	Clear	Dry
J90026593	30-Apr-90	915	Monday	Left Rear	Other Injury	W /W /	9/ 7/ .	60	DAY	Clear	Dry
J90029929	3-May-90	230	Thursday	Right Through	Serious Injury	S /N /	2/ 6/ .	60	DARK	Clear	Dry
J90034641	18-Sep-90	1130	Tuesday	Rear End	Other Injury	S /S /S	1/02/06	60	DAY	Clear	Dry
J90043021	4-Dec-90	1230	Tuesday	Right Through	Serious Injury	W /E /	6/ 1/ .	60	DAY	Clear	Dry
J91010140	15-Mar-91	1420	Friday	Cross Traffic	Serious Injury	N /W /	1/ 6/ .	60	DAY	Clear	Dry
J91012605	5-Apr-91	1205	Friday	Ped. Far Side	Serious Injury	E / /	6/ ./ .	60	DAY	Clear	Dry
J91024449	18-Jul-91	1230	Thursday	Left Rear	Other Injury	W /W /	7/ 1/ .	60	DAY	Clear	Dry
J92019997	10-Jun-92	1240	Wednesday	Ped. Near Side	Serious Injury	N / /	6/ ./ .	60	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 4
Prepared 11/5/94



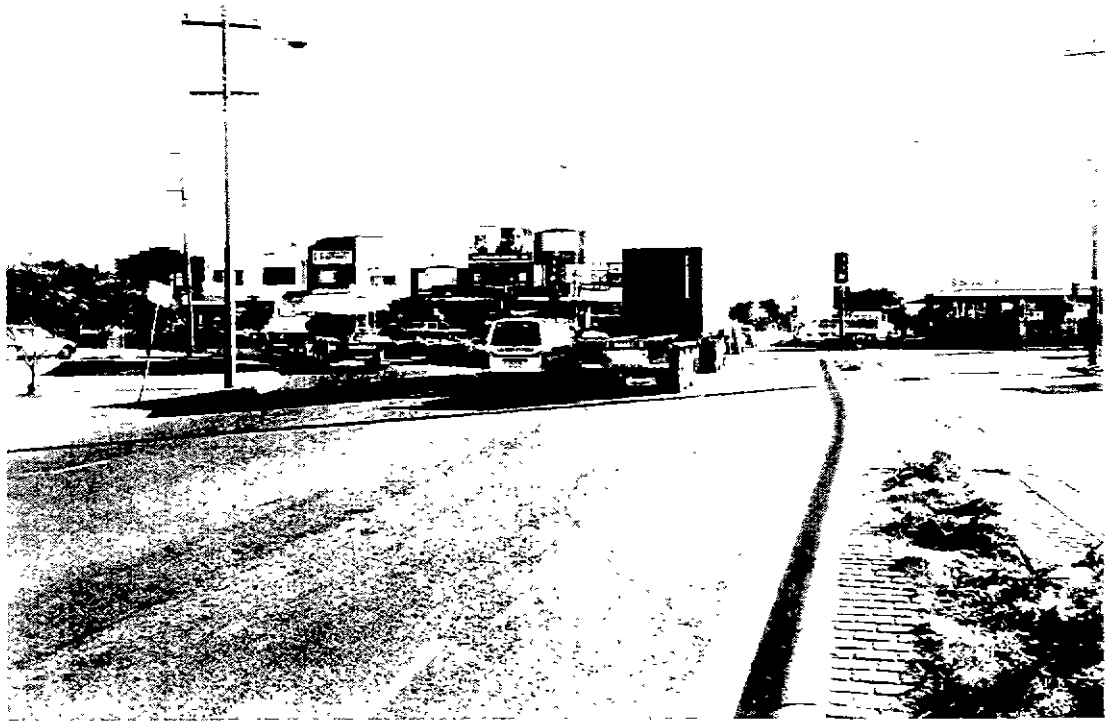


PHOTO 1 OF 4 - FACING WEST

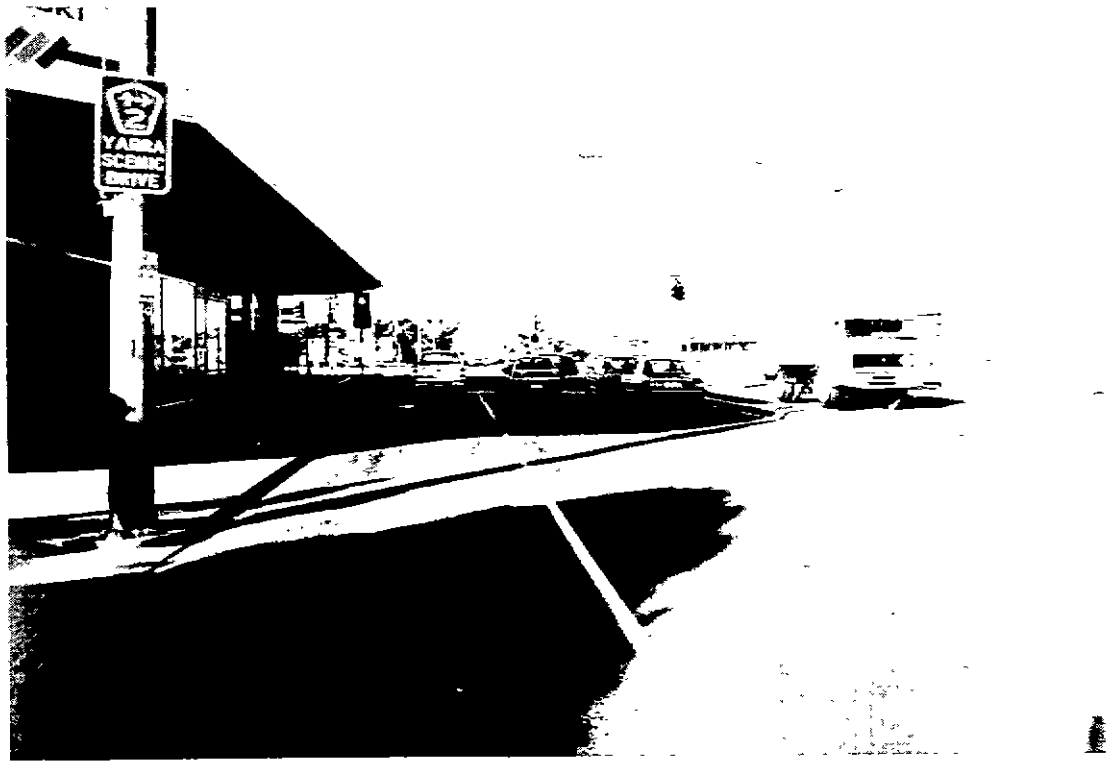


PHOTO 2 OF 4 - FACING EAST

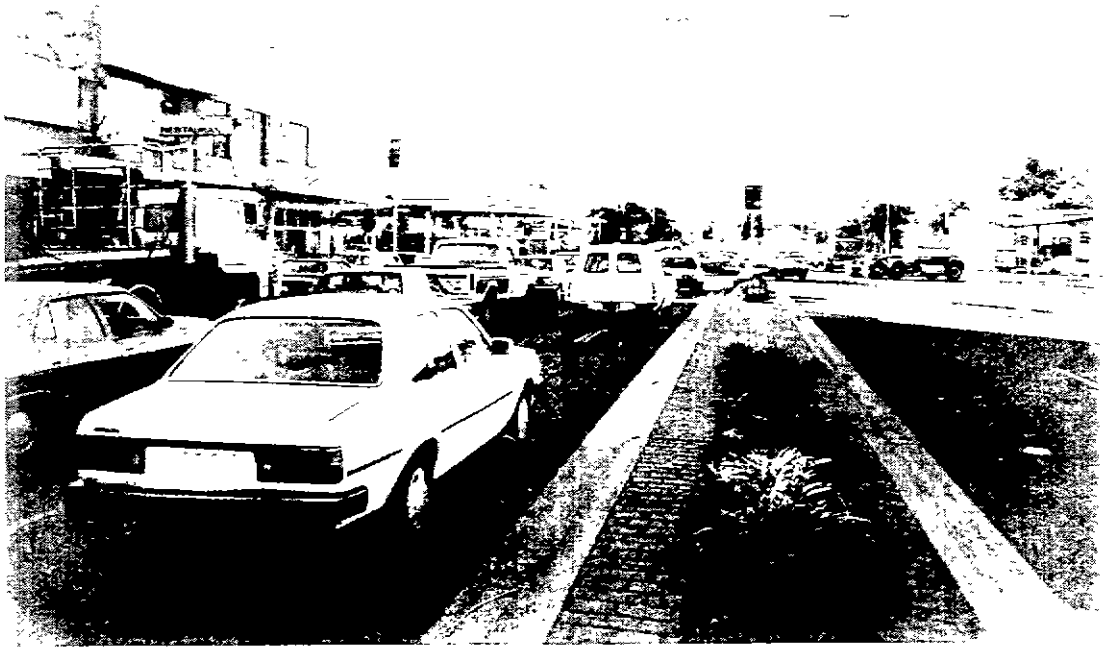


PHOTO 3 OF 4 - FACING NORTH

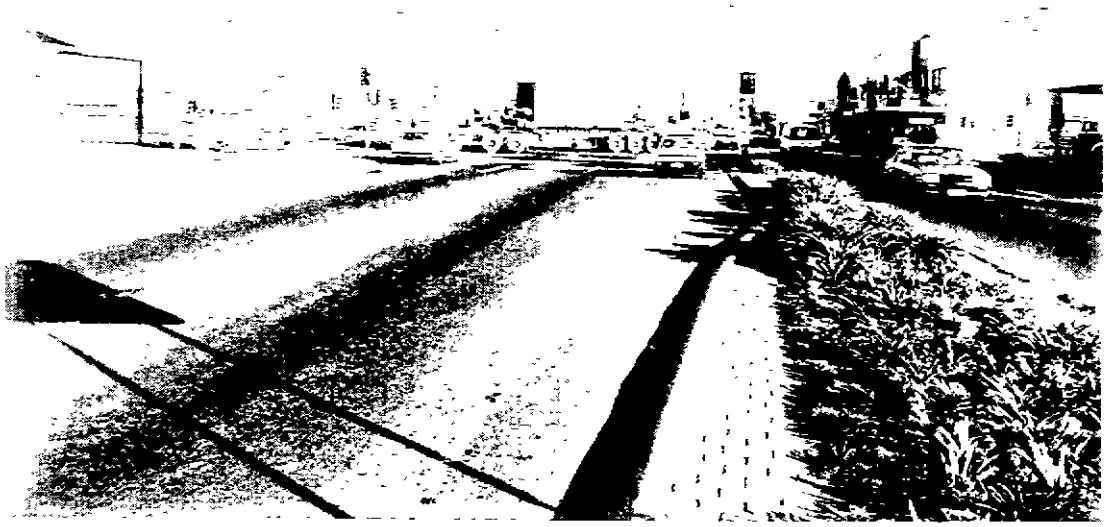


PHOTO 4 OF 4 - FACING SOUTH

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

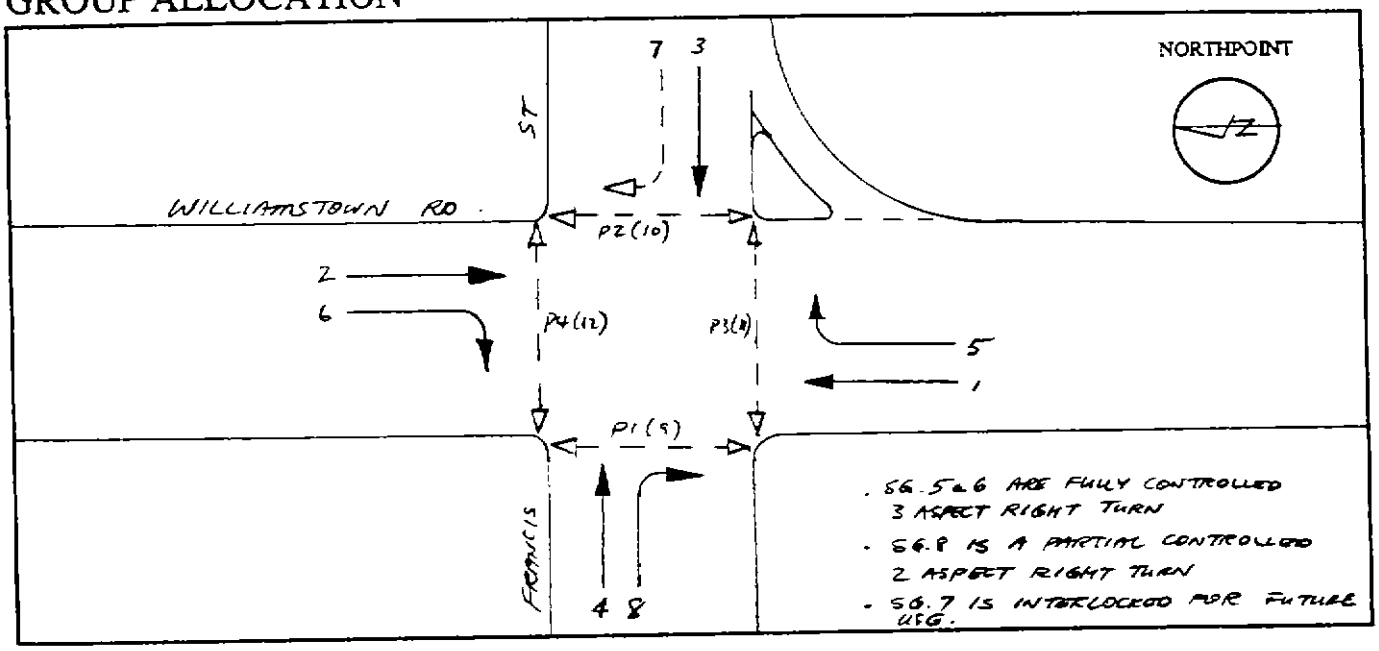
INTERSECTION WILLIAMSTOWN RD / FRANCIS ST No 4230

MUNICIPALITY CITY OF FOOTSCRAY DESIGNER A. LOW DATE 3/6/92

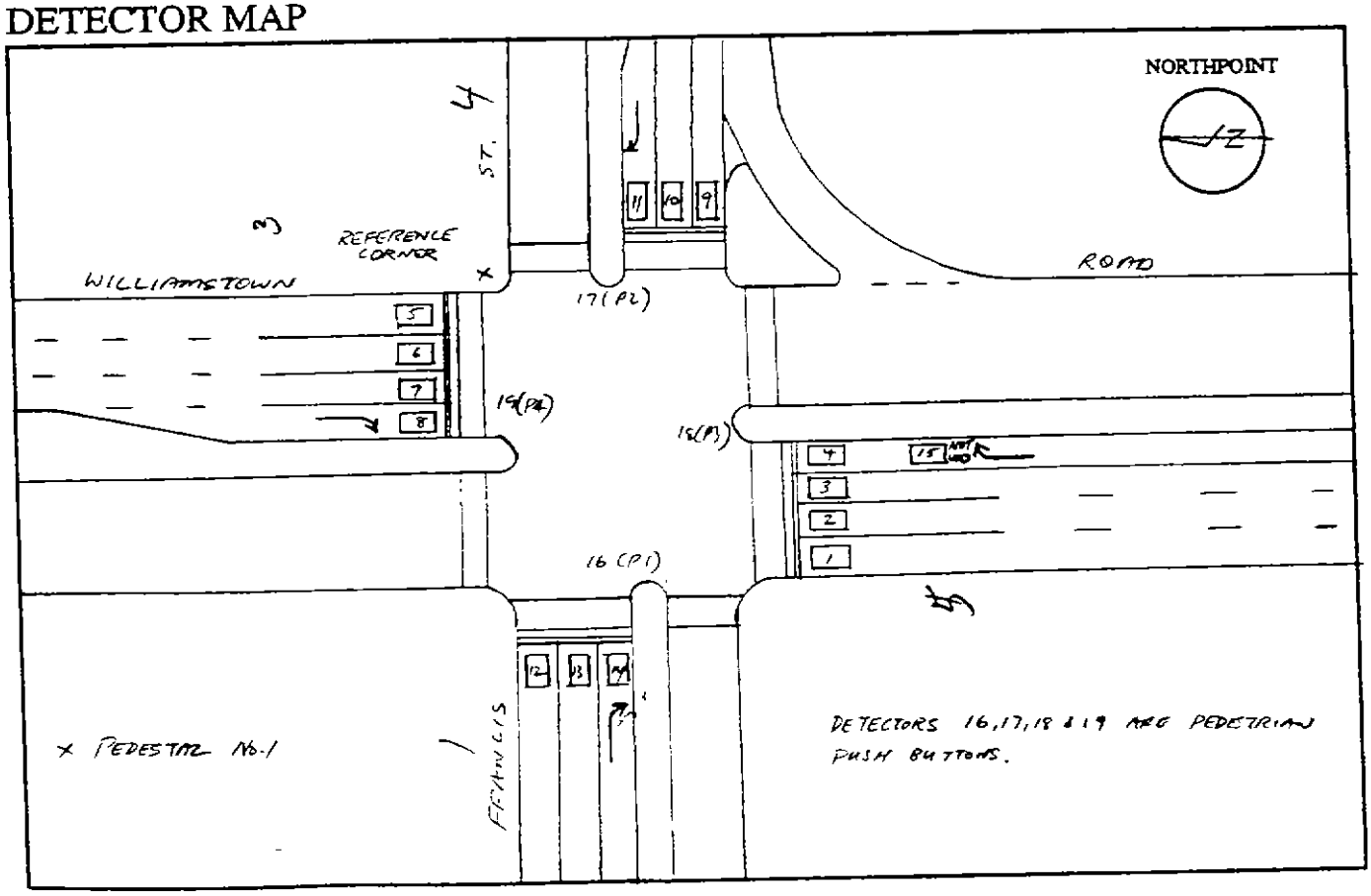
CONTROLLER CAPACITY _____ GROUPS DESIGN CHECKED N J Ghela DATE 10/6/92

PLAN No 232434A (MODIFIED) PROGRAM CHECKED Gordon DATE 6/7/92

GROUP ALLOCATION

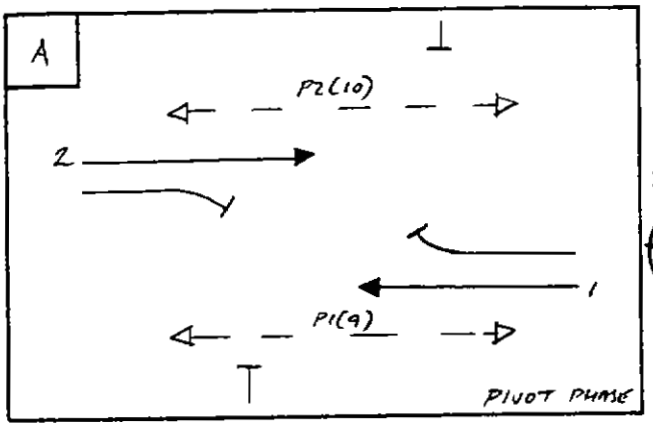


DETECTOR MAP



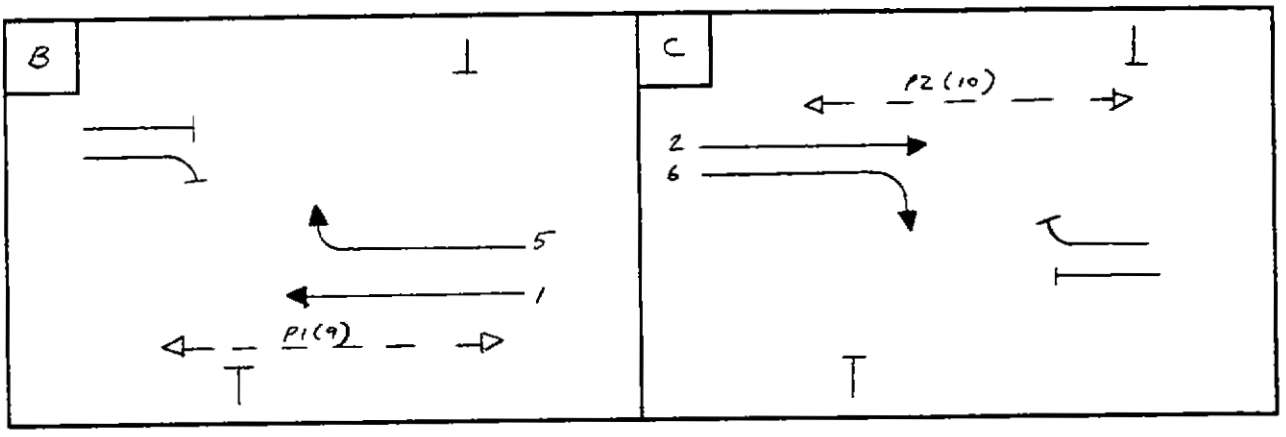
PHASING DIAGRAM

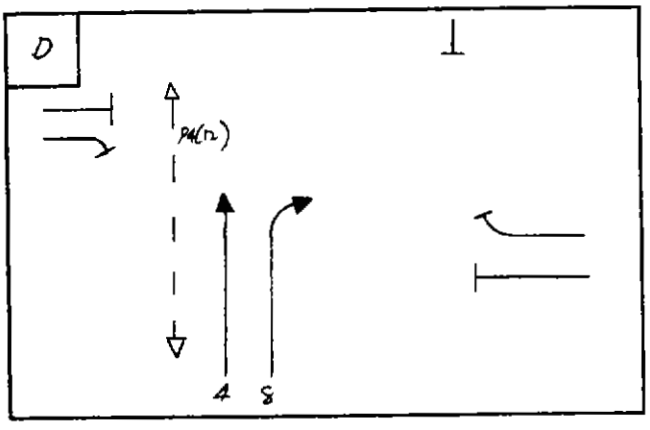
INTERSECTION WILLIAMSTOWN RD. / FRANCIS ST. No 4230



NORTHPOINT

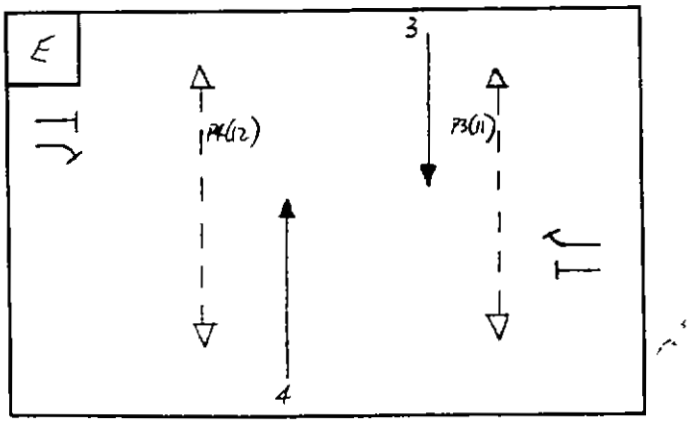
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION
E	D		

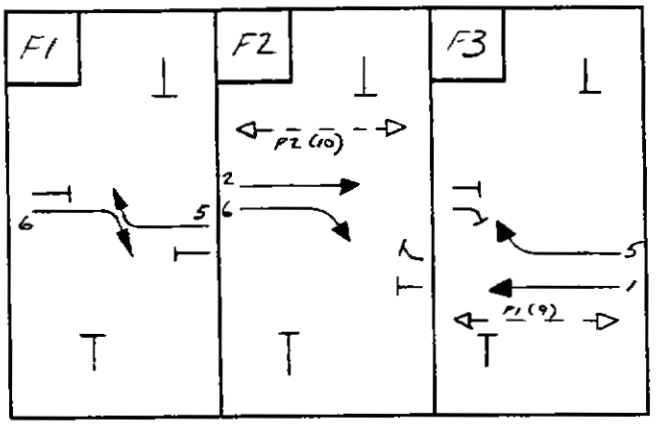




NOTES:

1. IF IN Bϕ CLEAR DEMAND FOR Cϕ
2. IF IN Cϕ CLEAR DEMAND FOR Bϕ
3. IF IN Eϕ CLEAR DEMAND FOR Dϕ
4. PEDS P1 & P2 ARE SECRET IN Fϕ





V.A. SEQUENCE: ADEF

DESIGNED: A LOW

DATE: 5/6/92

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Dandenong-Hastings Road/Thompsons Road, Lyndhurst

Case No: M5

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 4 July 1994 **Case No: M5**

1. Location Details

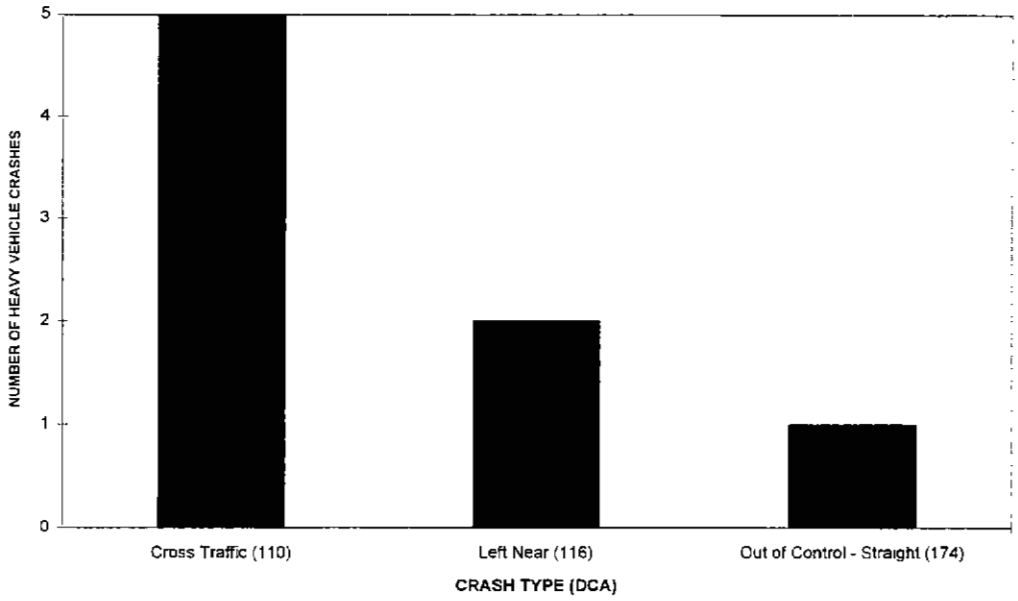
Street Names: Dandenong-Hastings Road/Thompsons Road.
Suburb and Local Government Area: Lyndhurst, Shire of Cranbourne.
Melway Map Reference: 128 K8
Road Functional Classification: Dandenong-Hastings Road. primary arterial road. Thompsons Road: secondary arterial road.
Alignment/Topography: Flat, straight approaches.
Intersection Geometry (if applicable): Initially staggered T intersections. now roundabout layout.
Traffic Control Type: Stop signs on Thompsons Road when staggered T intersection, now roundabout signs.
Surrounding Land Use: Farmland. horse agistment. open space.
Designated Heavy Vehicle Route: Dandenong-Hastings Road is an important freight route which links Melbourne with the Mornington Peninsula, via the South Eastern Arterial.
Speed Zone: Dandenong-Hastings Road: 100 km/h; Thompsons Road: 100 km/h.
Number of Traffic Lanes: Currently two lanes on Dandenong-Hastings Road, one lane on Thompsons Road.
Pedestrian (or other vulnerable road user) Activity: Very low.
Characteristics of Traffic (Control) Operation: High approach speeds on both roads.
Treatment History: Roundabout constructed during 1990.
Location Plan Attached: No.

Photographs Attached: Yes.
Other Observations/Comments: Adverse super-elevation within the roundabout is a potential problem for vehicles with a high centre of gravity.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 4 **Serious Injury** - 7 **Other Injury** - 14 **Total** - 25
Total Number of Heavy Vehicle Crashes: **Fatal** - 3 **Serious Injury** - 1 **Other Injury** - 4 **Total** - 8
Percentage of Heavy Vehicle to All Casualty Crashes: 32.0% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 1 **Rigid** - 7 **Bus** - 0

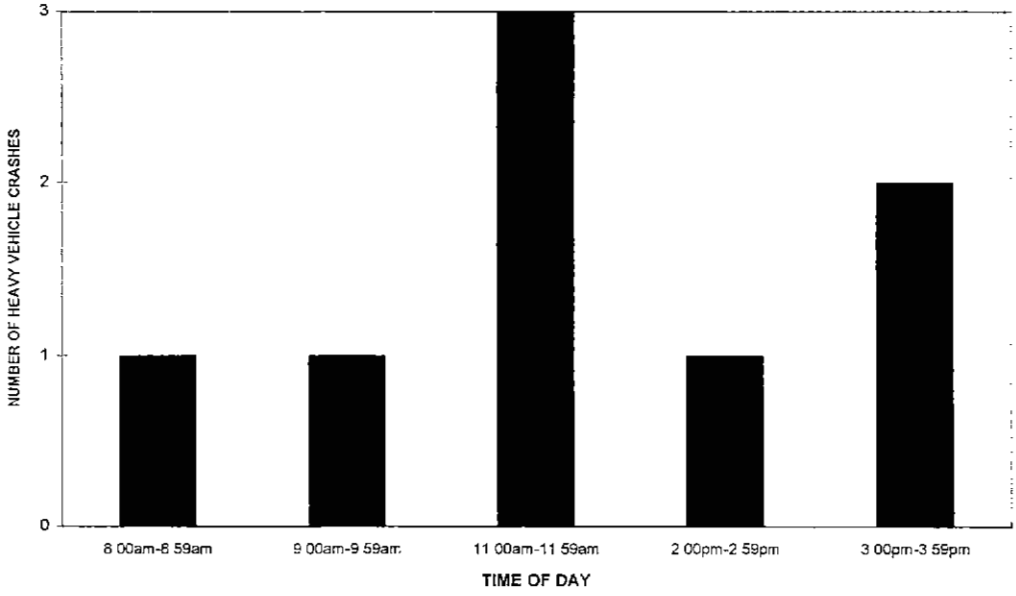
Predominant Heavy Vehicle Crash Patterns (DCA):



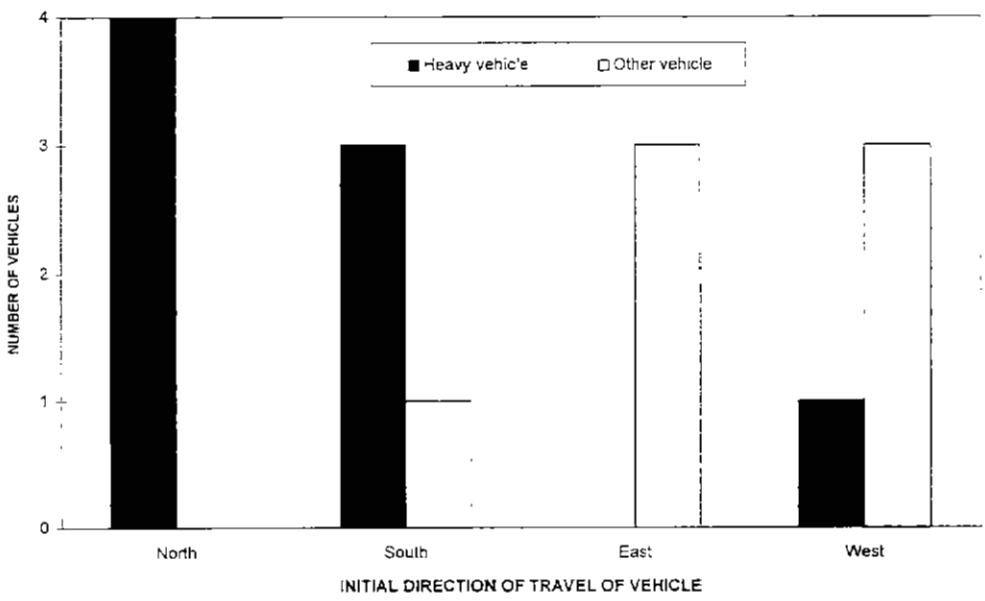
Predominant Heavy Vehicle Movements by DCA:

Cross Traffic - 63%.

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
Most crashes occurred while the intersection was controlled by stop signs in Thompsons Road. Only two heavy vehicle crashes have occurred since the roundabout was constructed. In all cases but one, the heavy vehicle was travelling along Dandenong-Hastings Road before the collision.

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably - very high (100+ km/h) on both approaches to the intersection.

Alignment/Topography:
No

Intersection Geometry (if applicable):
No.

Intersection Control (if applicable):
Stop signs in high speed zones, with single lane conflicting flow require drivers to exercise considerable skill in gap selection.

Road Surface (friction and roughness):
Unlikely - super-elevation within the roundabout may present problems for vehicles with a high centre of gravity.

Roadside Features/Hazards: No, although there is a potential hazard in the form of a utility pole positioned on the departure from the roundabout. This arrangement presents a serious potential hazard in high speed environments
Land Use: No.
Traffic Operation: Traffic volumes and speeds are high on Dandenong-Hastings Road. Single lane approach flows make gap selection in Dandenong-Hastings Road especially difficult.
Delineation: Unlikely.
Street lighting: No.
Sight Distance: Unlikely
Road Divided/Undivided: Unlikely - most crashes occurred under staggered-T layout.
Lane Configuration (e.g. lane drop/merge, etc.): Unlikely.
Lane Provision for Turning: Unlikely.
Road works: No.
Shoulder Condition: No.
Other: Gap selection - Police reports frequently mention failure by drivers on Thompsons Road to give way to Dandenong-Hastings Road drivers as the main reason for crash occurrence.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Cross-Traffic Crashes

- **high vehicle speeds and volumes increase the risk of severe crashes** at cross intersections;
- **poor selection of gaps** in the Dandenong-Hastings Road flow, generally by drivers of other than heavy vehicles.

Loss-of-Control Crashes

- in one of the two crashes which have occurred since the roundabout was constructed, **adverse super-elevation within the roundabout**, in combination with a **relatively high centre of gravity** of the heavy vehicle and possibly **excessive entry speed**, appears to have contributed to a loss-of-control crash.

5. Countermeasure Options

Only two crashes have occurred since the roundabout was constructed in 1990. This has eliminated the potential for the main crash types that had occurred at the intersection prior to its construction. No further action is proposed other than to monitor crash records to ensure that adverse super-elevation within the roundabout, in combination with the relatively high centre of gravity of heavy vehicles and possibly excessive entry speed, do not lead to a loss-of-control crash problem.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Thompsons Road/ Dandenong-Hastings Road, City of Cranbourne (LGA = 13)

Location Details

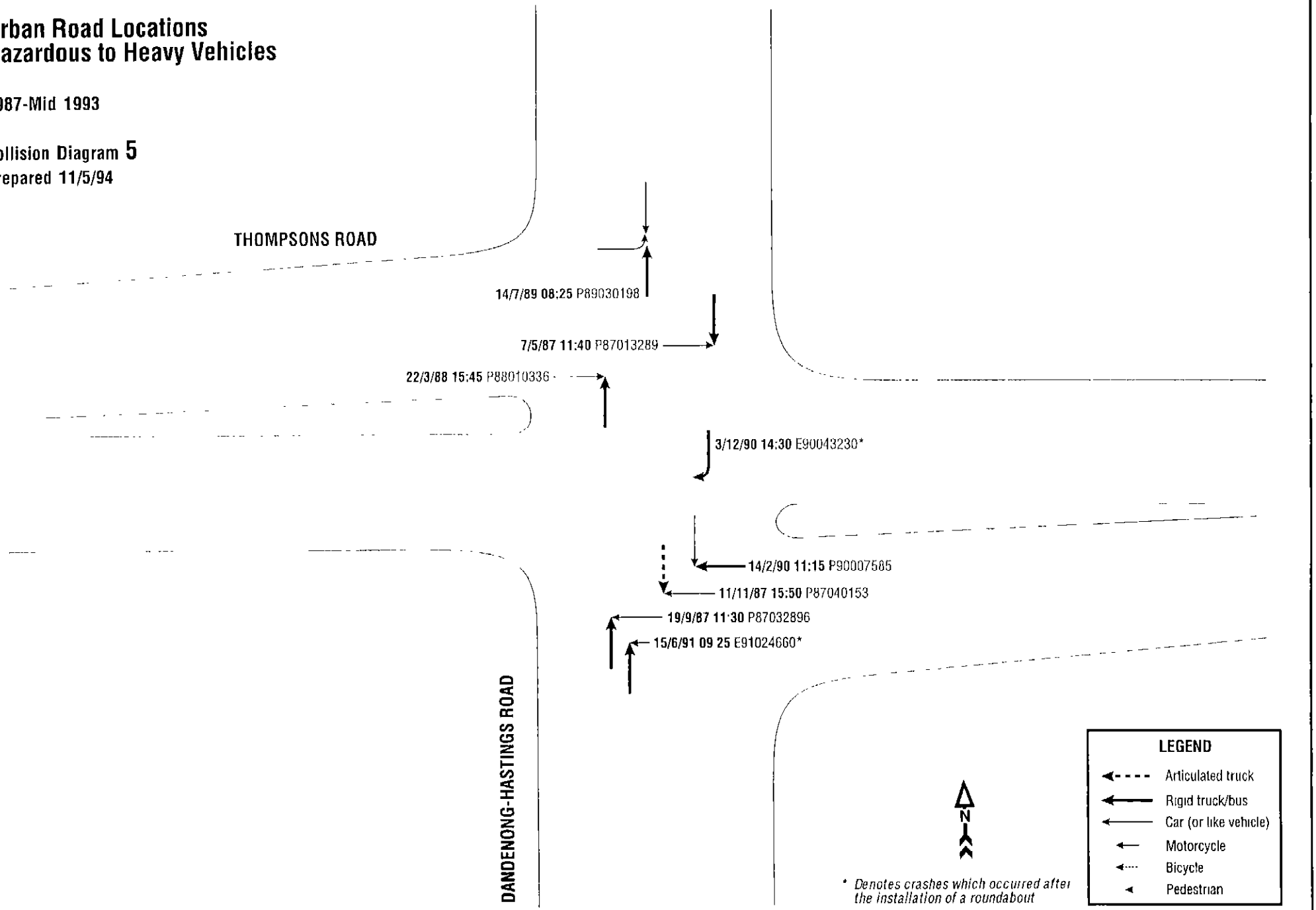
ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
P87013289	7-May-87	1140	Thursday	Cross Traffic	Fatality	E /S /	1/ 7/ .	100	DAY	Clear	Dry
P87032896	19-Sep-87	1130	Saturday	Cross Traffic	Serious Injury	W /N /	1/ 7/ .	100	DAY	Clear	Dry
P87040153	11-Nov-87	1550	Wednesday	Cross Traffic	Fatality	S /W /	6/ 1/ .	100	DAY	Clear	Dry
P88010336	22-Mar-88	1545	Tuesday	Cross Traffic	Fatality	E /N /	1/ 7/ .	100	DAY	Clear	Dry
P89030198	14-Jul-89	825	Friday	Left Near	Other Injury	E /N /S	1/07/01	100	DAY	Clear	Wet
E90043230	3-Dec-90	1430	Monday	Out of Control	Other Injury	S / /	7/ / .	100	DAY	Clear	Dry
P90007585	14-Feb-90	1115	Wednesday	Left Near	Other Injury	W /S /	7/ 2/ .	100	DAY	Clear	Dry
E91024660	15-Jun-91	925	Saturday	Cross Traffic	Other Injury	N /W /	7/10/ .	100	DAY	Clear	Wet

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 5
Prepared 11/5/94



CASE NUMBER: M5

PHOTO 1 OF 4 - FACING WEST

PHOTO 2 OF 4 - FACING EAST

PHOTO 3 OF 4 - FACING NORTH

PHOTO 4 OF 4 - FACING SOUTH

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Anderson Road/McIntyre Road/Western Highway, Sunshine

Case No: M6

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 17 June 1994 **Case No:** M6

1. Location Details

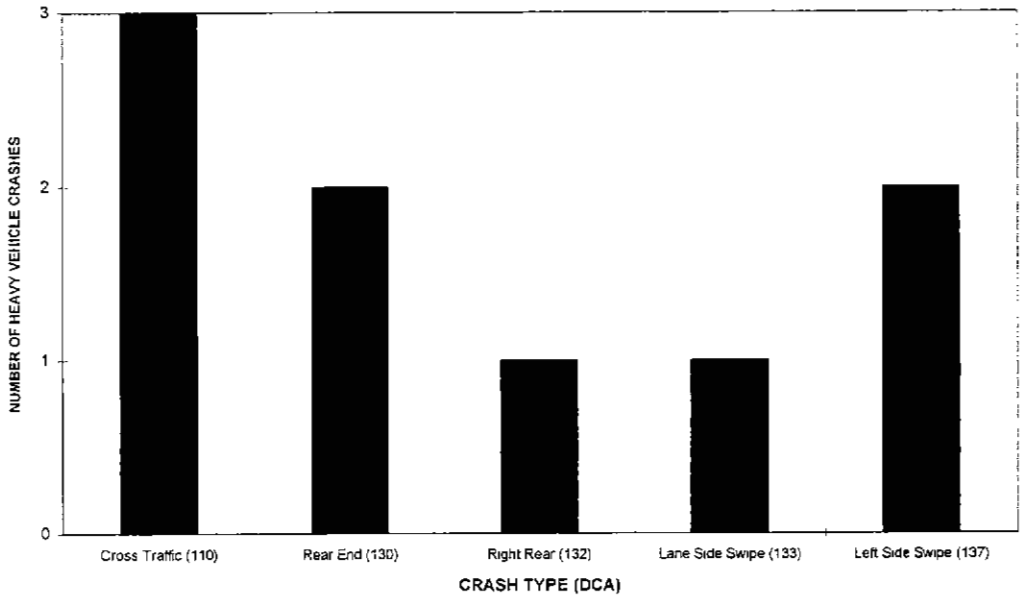
Street Names: Anderson Road/McIntyre Road/Western Highway.
Suburb and Local Government Area: Sunshine, City of Sunshine.
Melway Map Reference: 26 G10
Road Functional Classification: Western Highway. primary arterial road; Anderson & McIntyre Roads: secondary arterial roads.
Alignment/Topography: Straight, flat (except for influence of overpass on western approach).
Intersection Geometry (if applicable): Basic cross. with complex additional legs.
Traffic Control Type: Intersection signals, with full control of right turns off Western Hwy, partial control of right turns off Anderson & McIntyre Roads, others approaches have separate phases.
Surrounding Land Use: Industry/vacant land.
Designated Heavy Vehicle Route: Western Highway. National Highway linking Melbourne, Ballarat and Adelaide.
Speed Zone: Western Highway: 80 km/h. Anderson & McIntyre Roads: 60 km/h.
Number of Traffic Lanes: Refer plan
Pedestrian (or other vulnerable road user) Activity: Very light.
Characteristics of Traffic (Control) Operation: Long cycle times and complex, multiple traffic movements.
Treatment History: Refer plan.

Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: Congested, with very large numbers of heavy vehicles using the intersection.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 0 **Serious Injury** - 7 **Other Injury** - 28 **Total** - 35
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 1 **Other Injury** - 8 **Total** - 9
Percentage of Heavy Vehicle to All Casualty Crashes: 25.7% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 2 **Rigid** - 6 **Bus** - 1

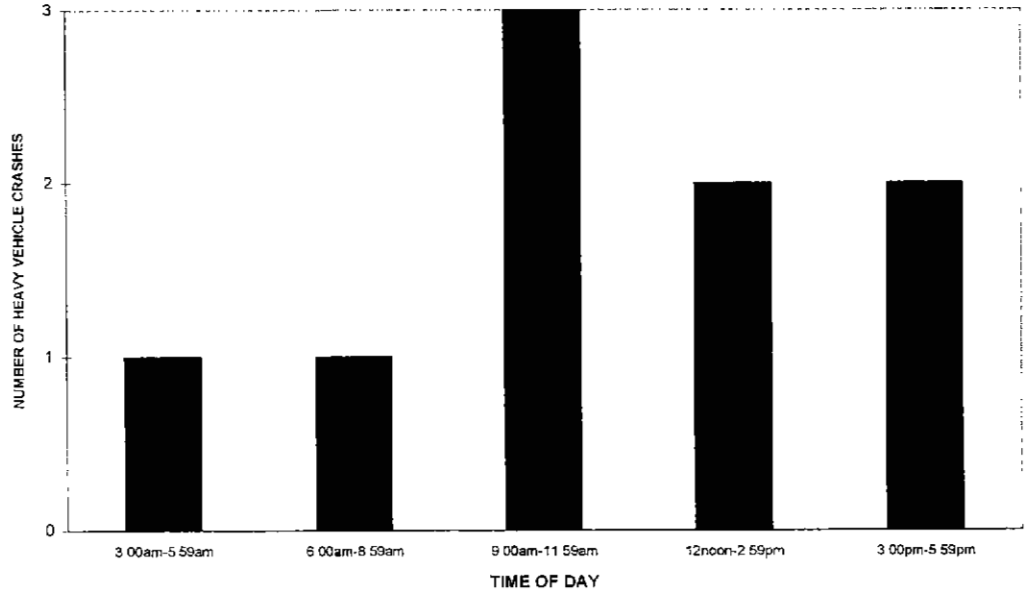
Predominant Heavy Vehicle Crash Patterns (DCA):



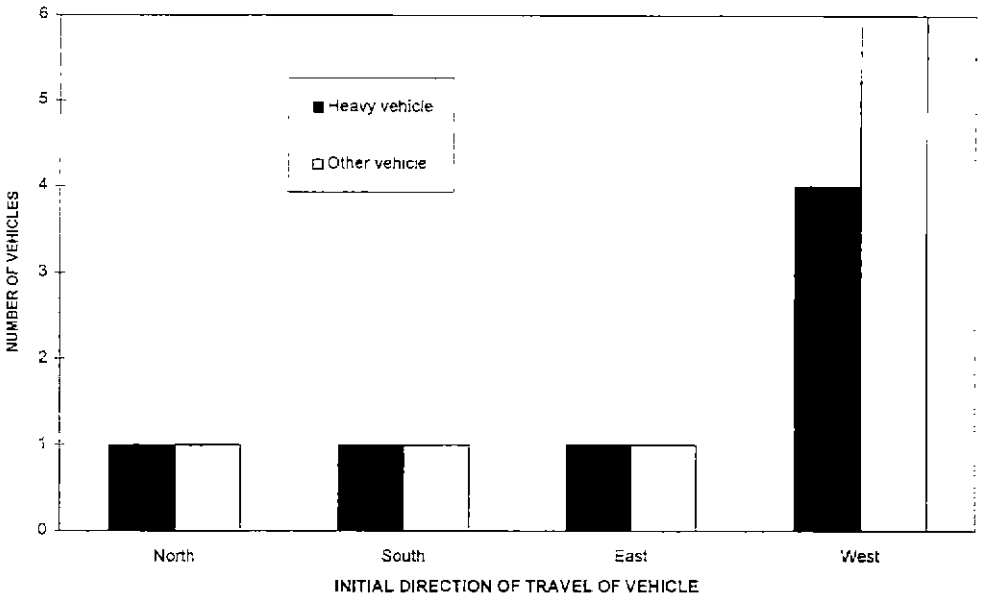
Predominant Heavy Vehicle Movements by DCA:

Cross Traffic - 33%
Rear-end Type - 33%
Side Swipe Type - 33%

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
No particular approach or vehicle movements predominate

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably - safety performance of traffic signals may be less in high speed zones (e.g. 80+ km/h), particularly for crash types occurring at or around a change of phase

Alignment/Topography:
Unlikely - downhill gradient associated with the overpass might potentially increase speeds but this factor is not reflected in heavy vehicle crash patterns.

Intersection Geometry (if applicable):
Possibly - the general complexity of the intersection layout may be a factor in crash occurrence.

Intersection Control (if applicable):
Crashes occurring at this intersection tend to be of types which are characteristic of intersection signals, though no particular approach predominates. A number of the crashes occurred at or around a change of phase or involved vehicles entering on the red. In one instance, a fire truck entered on a red signal while on an emergency call (fire truck lights flashing and siren operating) and collided with a vehicle entering on a green signal.

Road Surface (friction and roughness): Pavement well worn and may have low skid resistance.
Roadside Features/Hazards: No.
Land Use: No.
Traffic Operation: Refer to Intersection Control above.
Delineation: Unlikely, though pavement markings showed signs of wear at the time of inspection.
Street lighting: No.
Sight Distance: No.
Road Divided/Undivided: No - divided all round.
Lane Configuration (e.g. lane drop/merge, etc.): No.
Lane Provision for Turning: The left-turn slip on the south-east corner of the intersection is the site of a two side swipe crashes. Factors which may have contributed to these crashes include the two relatively narrow lanes operating for this movement, on the approaches to and departures from the intersection. More generous lane widths may be needed for heavy vehicles given their swept path requirements.
Road works: No.
Shoulder Condition: No.
Other: No.

4. Conclusions

While crash characteristics at this location are not clearly defined, the following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes:

Cross-Traffic Crashes

- Police report **non-compliance with the red traffic signals by the drivers of light vehicles** in two of the three cases. In the third instance, a **fire truck on an emergency call** entered the intersection on a red signal, with flashing lights and siren operating, and was struck by another vehicle which had entered on the green signal.

Rear-end Crashes

- **high vehicle speeds and congested traffic conditions** on Western Highway;
- in all cases the heavy vehicle was the striking vehicle indicating that the drivers have **difficulty responding to changing circumstances** ahead (e.g. starting up from a stationary position when signals change from red to green or stopping when signals are red). It is noteworthy that, while rear-end collisions are characteristic of traffic signal crash patterns generally, heavy vehicles seem to be over-involved in such crashes as the striking vehicle;
- the worn condition of the pavement, and a consequent **low skid resistance**, may also be a factor in rear-end collisions.

Side Swipe Type Crashes

- the left turn movement from east to south is particularly difficult for heavy vehicles because of the relatively narrow lanes available on the approach to and departure from the turn. **Lane encroachment by heavy vehicles** occurs because of the combination of **inadequate lane widths and the geometry of the turn**. The other side swipe crash was due to the driver of a heavy vehicle taking evasive action after a lighter vehicle changed into the heavy vehicle's lane.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Cross-Traffic Crashes

- introduce a red light camera and/or targeted Police enforcement to improve compliance by the drivers of all vehicle types with the red signals; and
- increase the all-red periods, in recognition of the additional clearance time needed by long/heavy vehicles.

Rear-end Crashes

- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise;
- improve the skid resistance of pavements on all approaches to the intersection, but particularly on the Western Highway approaches which carry the higher volumes and speeds of heavy vehicles.

Side Swipe Type Crashes

- increase lane widths for the left turn from east to south and improve the geometry of the left turn by eliminating kerb radii which are unduly tight for long/heavy vehicles.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Anderson Road/ Western Highway, City of Sunshine (LGA = 52)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
M87030640	18-Aug-87	1055	Tuesday	Lane Side Swipe	Serious Injury	E /E /E	1/07/01	60	DAY	Clear	Dry
M88013136	2-Apr-88	1700	Saturday	Rear End	Other Injury	N /N /	1/ 7/ .	60	DAY	Clear	Dry
M88023687	22-Jun-88	330	Wednesday	Cross Traffic	Other Injury	unknown	7/ 1/ .	60	DARK	Clear	Dry
M88025932	23-Jun-88	735	Thursday	Right Rear	Other Injury	W /W /	3/ 8/ .	60	DAY	Clear	Dry
M89011594	18-Jan-89	1320	Wednesday	Left Side Swipe	Other Injury	W /W /	1/ 6/ .	60	DAY	Clear	Dry
J90022061	9-May-90	1600	Wednesday	Rear End	Other Injury	W /W /	7/ 1/ .	60	DAY	Clear	Dry
J91013522	12-Apr-91	930	Friday	Left Side Swipe	Other Injury	W /W /	1/ 6/ .	60	DAY	Clear	Dry
J91020084	23-Mar-91	1450	Saturday	Cross Traffic	Other Injury	W /S /	1/ 7/ .	60	DAY	Clear	Dry
J91033972	7-Oct-91	950	Monday	Cross Traffic	Other Injury	W /S /N	1/01/07	60	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 6
Prepared 11/5/94

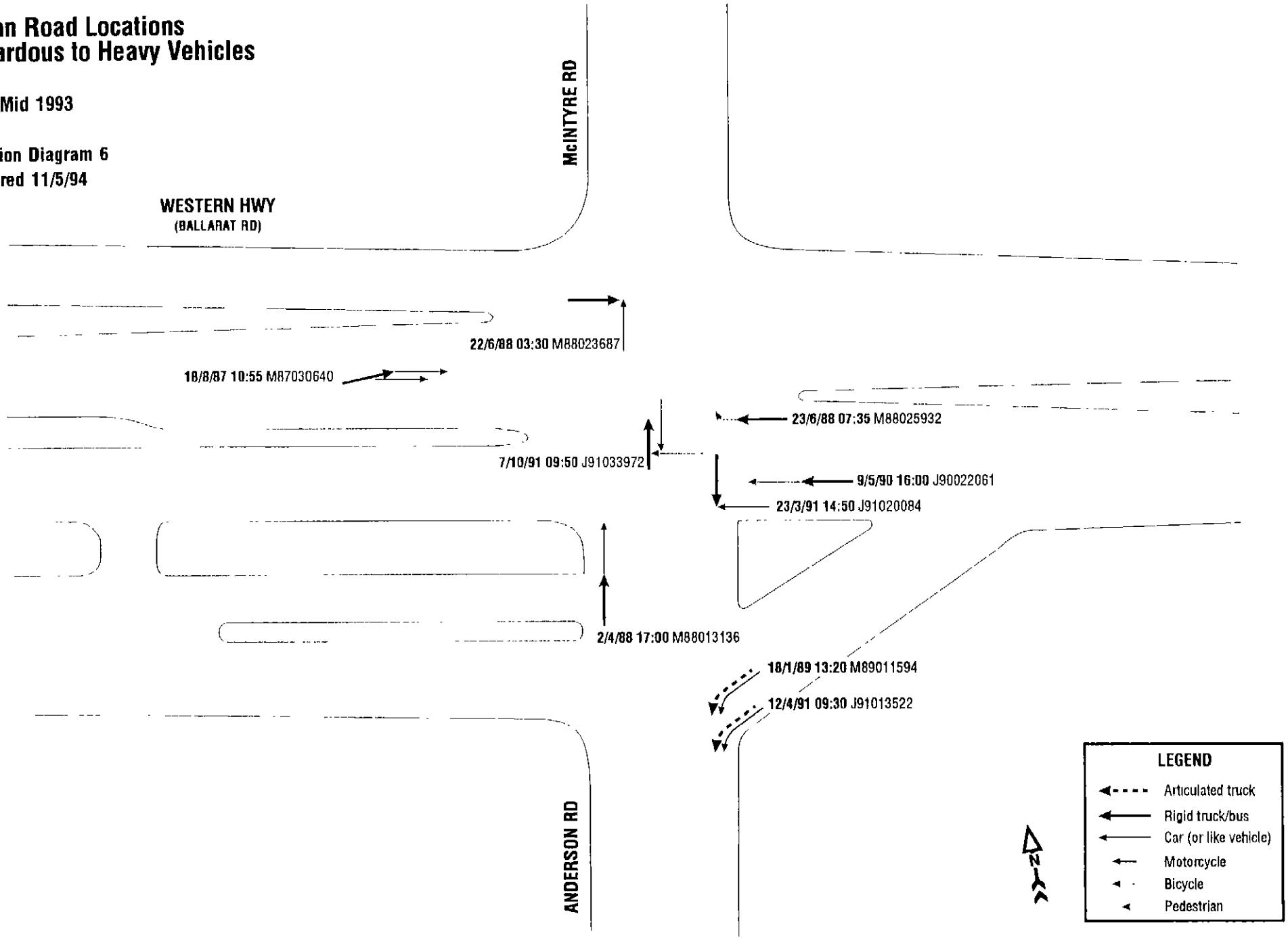


PHOTO 1 OF 6 - FACING NORTH

PHOTO 2 OF 6 - FACING EAST

PHOTO 3 OF 6 - FACING WEST

PHOTO 4 OF 6 - FACING WEST

PHOTO 5 OF 6 - FACING EAST (SOUTHERN STOP LINE)

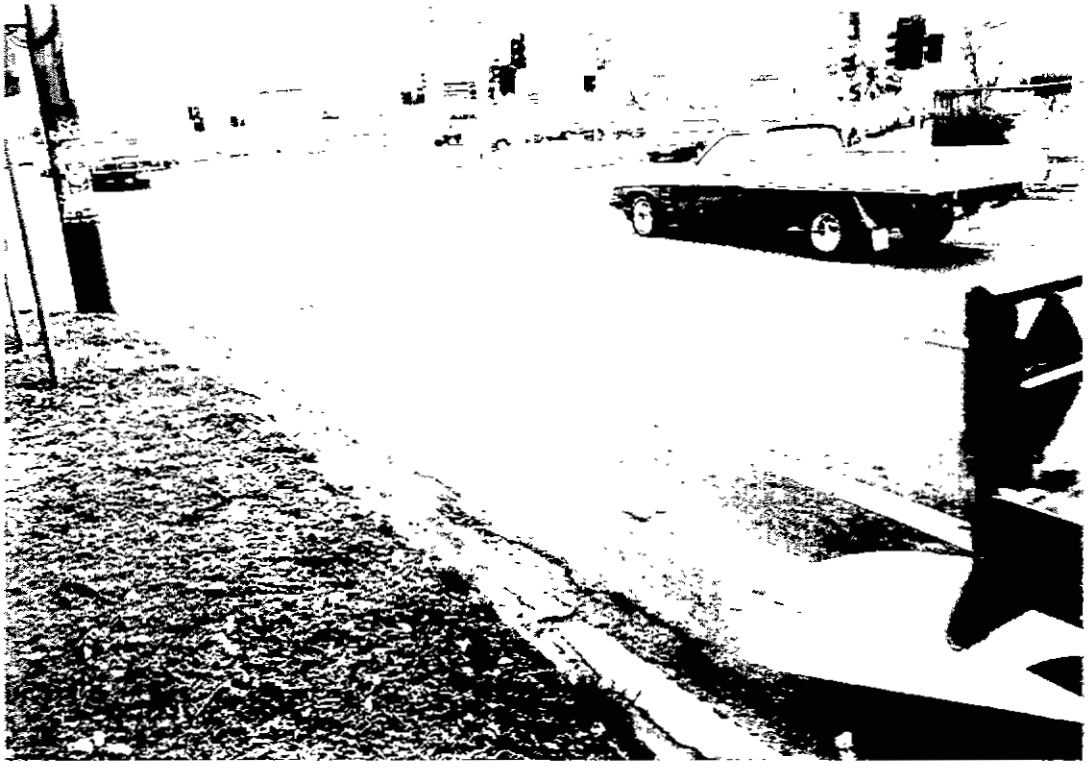


PHOTO 6 OF 6 - FACING NORTH-EAST (SOUTHERN STOP LINE)

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

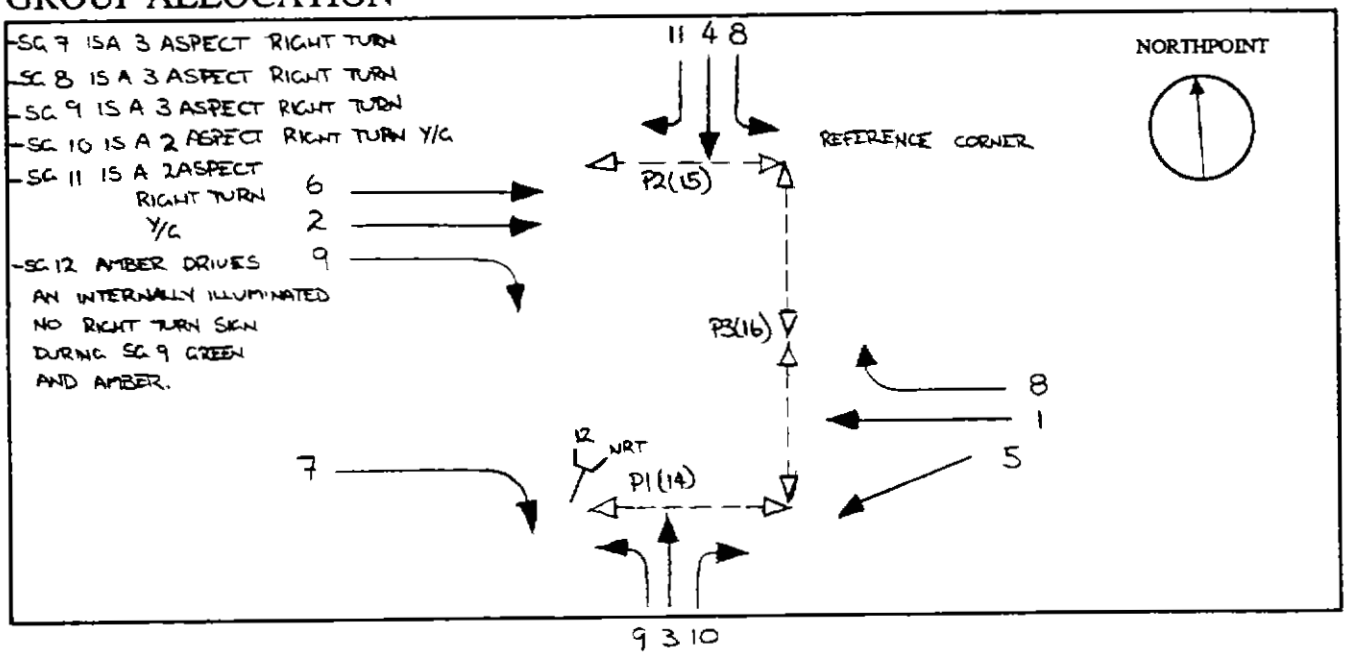
INTERSECTION WESTERN HIGHWAY / McINTYRE RD / ANDERSON RD No 2613

MUNICIPALITY CITY OF SUNSHINE DESIGNER BRYAN SHERRITT DATE 5-3-92

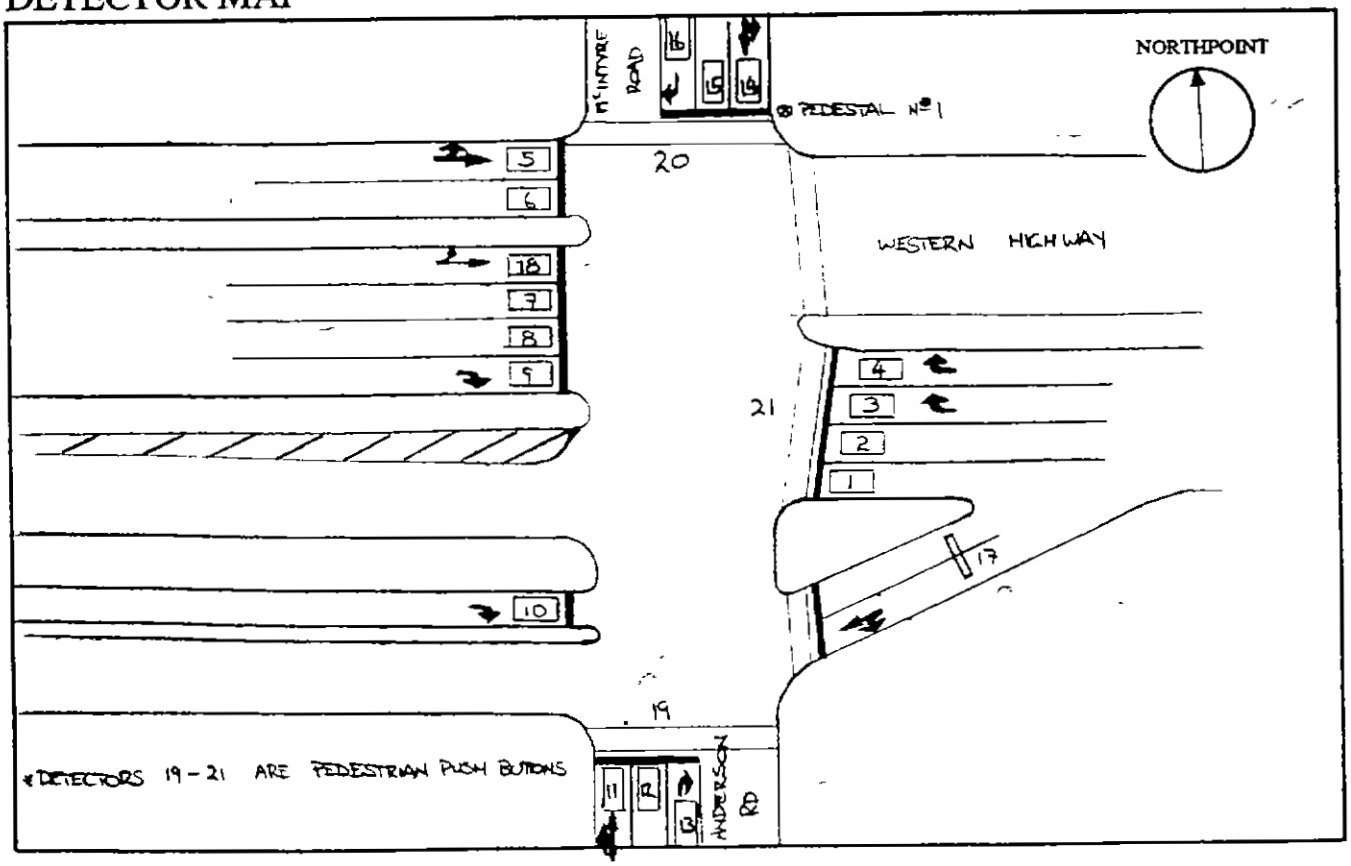
CONTROLLER CAPACITY 16 GROUPS DESIGN CHECKED DATE 30/3/92

PLAN No 364 844 PROGRAM CHECKED DATE 27/5/92

GROUP ALLOCATION

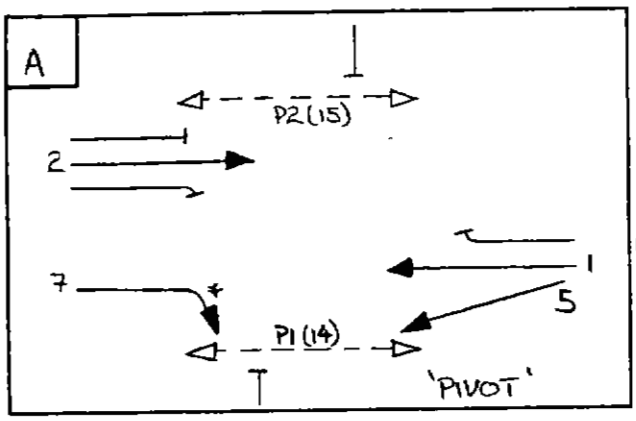


DETECTOR MAP



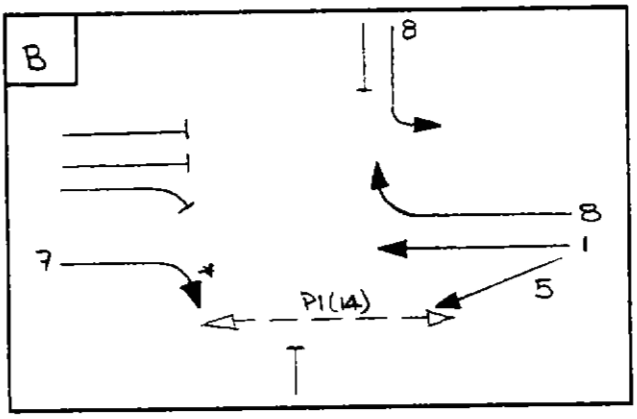
PHASING DIAGRAM

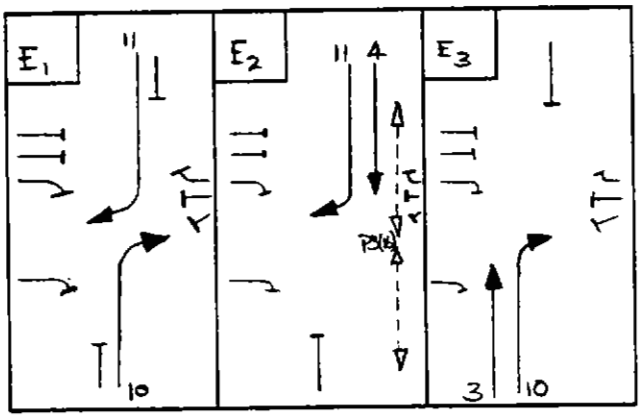
INTERSECTION WESTERN HIGHWAY / McINTYRE RD / ANDERSON RD No 2613

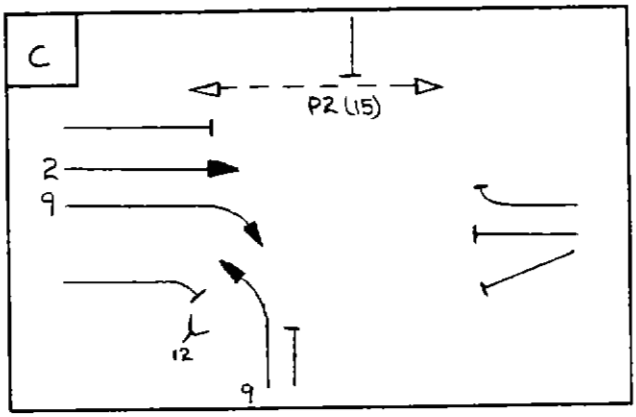


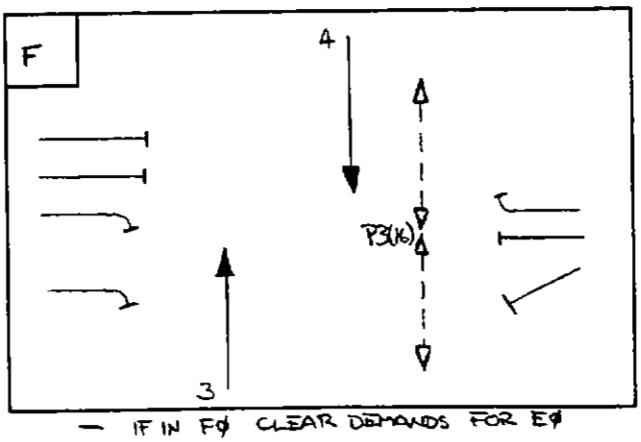
NORTHPOINT

PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION
F	E		









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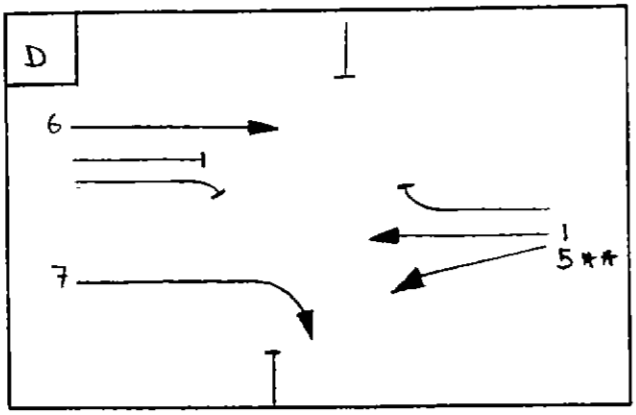
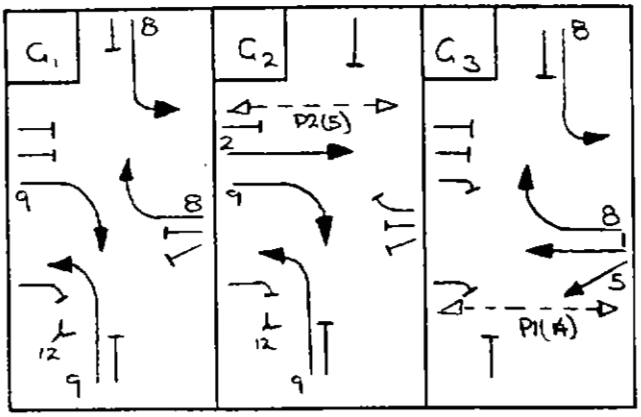




* SG 7 IS CONDITIONAL ON P1 & SG 5

** SG 5 IS CONDITIONAL ON SG 7 (REFER TO SPECIAL NOTES)

V.A. SEQUENCE: A D E F G

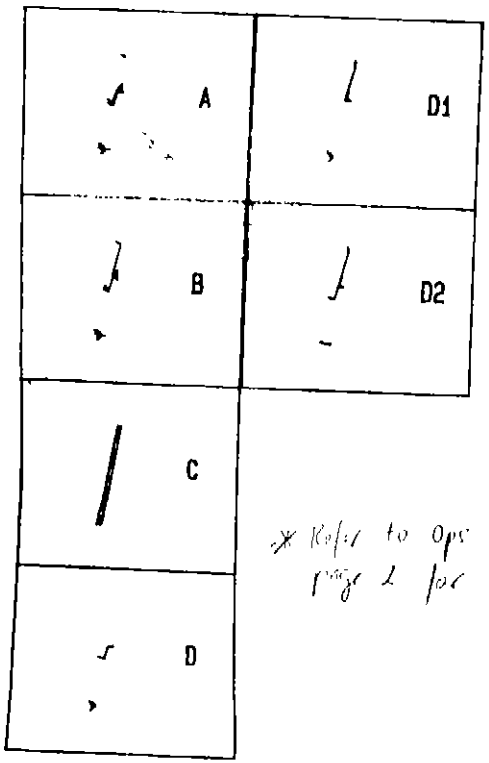
DESIGNED: BRYAN SHERRITT

DATE: 6-3-92

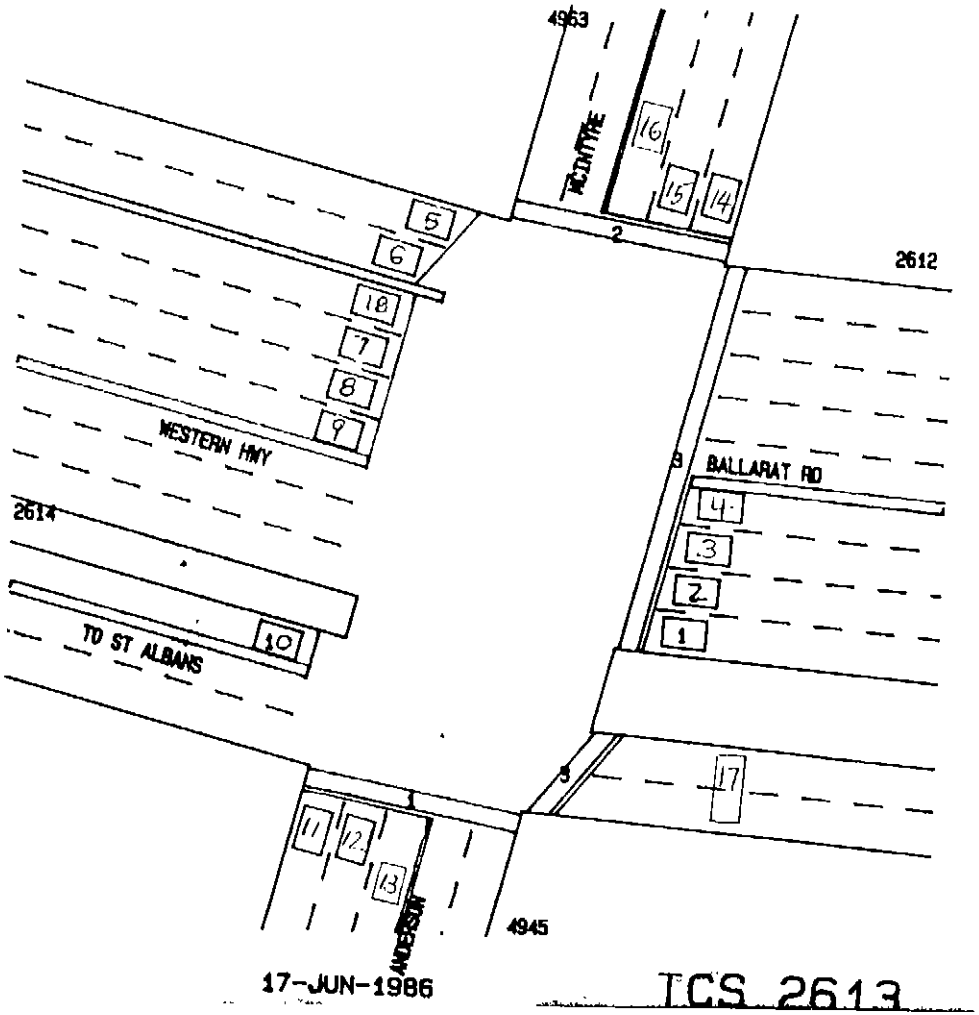
TCS 2613

SUBURB - SUN UBD REFERENCE - 026610
CONTROLLER TYPE - DELTA DIVISION - R
CONNECTED TO REGIONAL COMPUTER - FTS

6 PHASES



* Refer to Ops sheets page 2 for phasing.



STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Blackburn Road/Doncaster Road, Doncaster East

Case No: M7

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 7 June 1994 **Case No: M7**

1. Location Details

Street Names: Blackburn Road/Doncaster Road.
Suburb and Local Government Area: Doncaster East, City of Doncaster and Templestowe.
Melway Map Reference: 48 C1
Road Functional Classification: Blackburn Road: secondary arterial road; Doncaster Road: primary arterial road.
Alignment/Topography: Straight alignment, uphill gradient on south approach and slight downhill gradient on east approach.
Intersection Geometry (if applicable): Channelised cross intersection.
Traffic Control Type: Signalised with fully controlled turn phases for all right turns.
Surrounding Land Use: Residential, commercial, petrol, church.
Designated Heavy Vehicle Route: Doncaster Road in particular carries high volumes of heavy vehicles.
Speed Zone: Blackburn Road: 60 km/h (south approach), 70 km/h (north approach); Doncaster Road: 70 km/h
Number of Traffic Lanes: Refer attached plan.
Pedestrian (or other vulnerable road user) Activity: Medium pedestrian activity, including school children and/or bus passengers
Characteristics of Traffic (Control) Operation: None

Treatment History:
A substantial remodel of the intersection signals was commissioned on 20 December 1991, involving the conversion of partial right turn phases on the north, east and west approaches and no right turn phase on the southern approach, to fully controlled right turn phases on all four approaches. Prior to that time, no significant works had been undertaken since August 1987 at which time the exclusive right turn lanes in Doncaster Road were extended to provide greater vehicle storage capacity.

Location Plan Attached:
Yes.

Photographs Attached:
Yes.

Other Observations/Comments:
None.

2. Crash Details

Period of Crash Analysis:
1987 to mid-1993

Total Number of Crashes:
Fatal - 0
Serious Injury - 8
Other Injury - 37
Total - 45

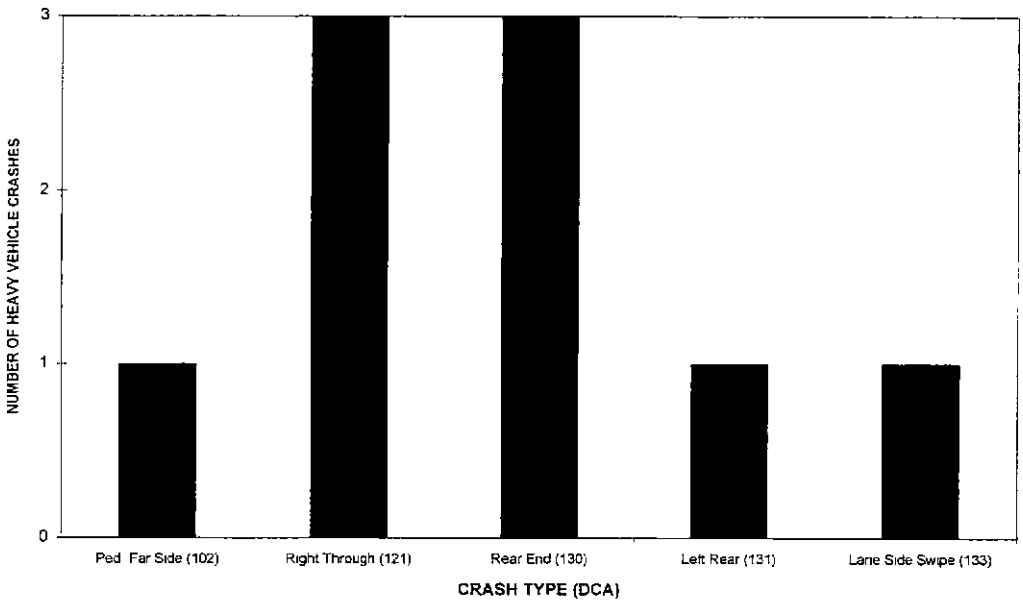
Total Number of Heavy Vehicle Crashes:
Fatal - 0
Serious Injury - 4
Other Injury - 5
Total - 9

Percentage of Heavy Vehicle to All Casualty Crashes: 20.0%

Average Percentage for Metro Melbourne Arterial/Arterial Intersections: 8.3%

Number of Crashes by Heavy Vehicle Type:
Articulated - 2
Rigid - 4
Bus - 3

Predominant Heavy Vehicle Crash Types (DCA):

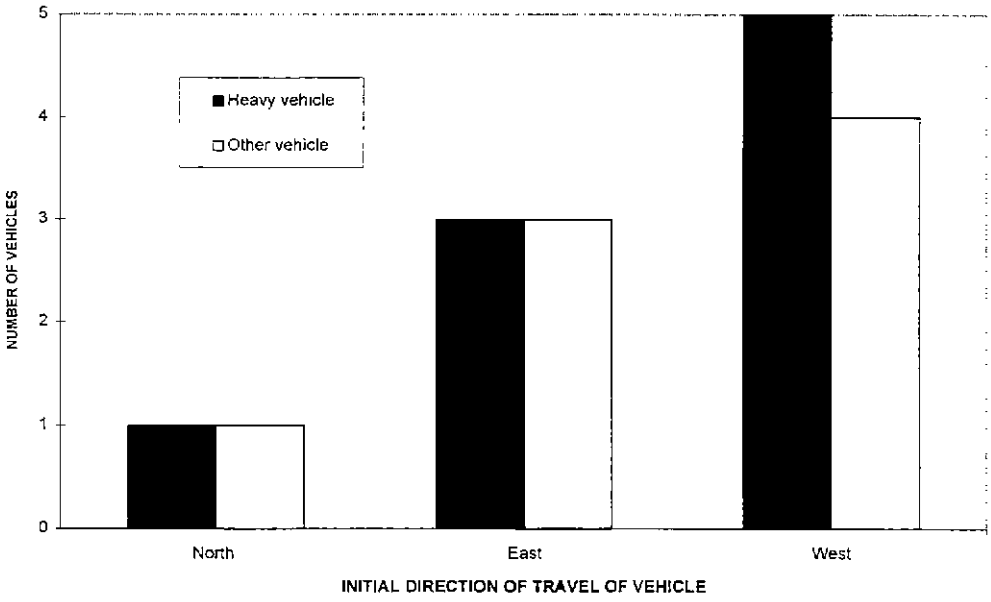


Predominant Heavy Vehicle Movements by DCA:

Right-Through - 33.3%

Rear-End (130 and 131) - 44.4%

Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:

Yes.

Other Patterns/Comments:

All but one of the heavy vehicles were travelling along Doncaster Road before crashing.

3. Road Environment Factors Contributing to Crash Occurrence

Speed: Probably - the downhill gradient on the westbound approach adds to the already high vehicle speeds through the intersection.
Alignment/Topography: Possibly - note downhill gradient on the westbound approach referred to above.
Intersection Geometry (if applicable): Unlikely.
Intersection Control (if applicable): Right-through crashes are characteristic of intersection signals However, the through-vehicle in the right-through crashes is a heavy vehicle in each of the three crashes at this intersection. While the provision of fully controlled right turn phases at the end of 1991 seems to have prevented further right-through type crashes, it would appear that these earlier crashes occurred at the change of signal phase, indicating that non-compliance with traffic signals by drivers of heavy vehicles may have been a factor in the right-through crashes. Rear-end crashes are also characteristic of intersection signals. All four rear-end type collisions involved heavy vehicles striking other vehicles. Police reports indicate that in most cases, the struck vehicle was stationary at red or changing traffic signals. Signal displays appear adequate.
Road Surface (friction and roughness): Unlikely.
Roadside Features/Hazards: Unlikely.
Land Use: Unlikely.
Traffic Operation: The congested nature of traffic flow may contribute to increased risk of crashes.
Delineation: Unlikely.
Street lighting: No.
Sight Distance: Unlikely.
Road Divided/Undivided: Unlikely - both roads fully divided.
Lane Configuration (e.g. lane drop/merge, etc.): No
Lane Provision for Turning: No.

Road works: No.
Shoulder Condition: No.
Other: None.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes:

Rear End (DCA 130 and 131) Crashes

- there is an **inherent risk of rear-end collisions at traffic signals,** given the need for vehicles to stop for red signals (i.e. an unavoidable characteristic of traffic signal operation). Heavy vehicles appear to have a **particular propensity to be the striking vehicle** in such collisions. This is the case in each of the four rear-end crashes at this intersection - Police reports indicate that the drivers of heavy vehicles have been unable to stop in time to avoid colliding with stationary or near-stationary vehicles;

- possible contributing factors may be the **inferior braking performance** of heavy vehicles compared to lighter vehicles, **poor skid resistance** of the highly trafficked pavement and/or **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display (i.e. the driver of the front (lighter) vehicle decides to stop while the driver of the rear (heavy) vehicle decides to proceed through the intersection as the signals change from green to red).

Right-Through (DCA 121) Crashes

- right-through crashes are also **characteristic of traffic signal operation**, unless adequate provision is made for turning vehicles. The right-through crashes which have occurred here have each involved a heavy vehicle as the through-vehicle and are reported by Police to have taken place at the change of phase. This suggests that either right-turners (in light vehicles) are selecting inappropriate gaps in opposing traffic or that, as in the case of rear-end crashes, the drivers of heavy vehicles are **experiencing difficulty in stopping** when the signals applicable to them change from green to red;

- the moderate **downhill gradient** of the westbound approach to the intersection may have contributed to the difficulty experienced by the drivers of heavy vehicles in stopping to avoid right-through (or indeed, rear-end) crashes on this approach;

- the introduction of fully controlled right turn phases at the end of 1991 appears to have prevented further crashes of this type.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Rear End (DCA 130 and 131) Crashes

- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise;

- improve the skid resistance of pavements on the Blackburn Road approaches which carry the higher volumes and speeds of heavy vehicles.

Right-Through (DCA 121) Crashes

- no countermeasures are proposed for this crash type as the introduction of fully controlled right turn phases at the end of 1991 appears to have prevented further such crashes.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Blackburn Road/ Doncaster Road, City of Doncaster and Templestowe (LGA = 17)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
Q87017594	27-May-87	1920	Friday	Right Through	Serious Injury	E /W /	1/ 7/ .	60	DARK	Clear	Dry
Q88032689	23-Aug-88	1505	Tuesday	Right Through	Other Injury	E /W /	1/ 6/ .	60	DAY	Clear	Dry
Q89029216	11-Jul-89	700	Tuesday	Right Through	Serious Injury	W /E /	1/ 8/ .	60	DAWN	Raining	Wet
G90012278	15-Jan-90	1215	Monday	Rear End	Other Injury	W /W /	7/ 1/ .	60	DAY	Clear	Dry
G90038231	8-Oct-90	1430	Monday	Rear End	Other Injury	E /E /	7/ 1/ .	60	DAY	Raining	Wet
G90040536	3-Nov 90	1740	Saturday	Lane Side Swipe	Serious Injury	W /W /	3/ 8/ .	60	DAY	Clear	Dry
G90041509	22-Nov-90	1045	Thursday	Rear End	Serious Injury	W /W /W	6/01/01	60	DAY	Clear	Dry
G91026353	7-Jun-91	1345	Friday	Left Rear	Other Injury	N /N /	7/ 1/ .	60	DAY	Clear	Dry
G93009563	12-Mar-93	810	Friday	Ped. Far Side	Other Injury	E / /	8/ ./	60	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 7
Prepared 11/5/94

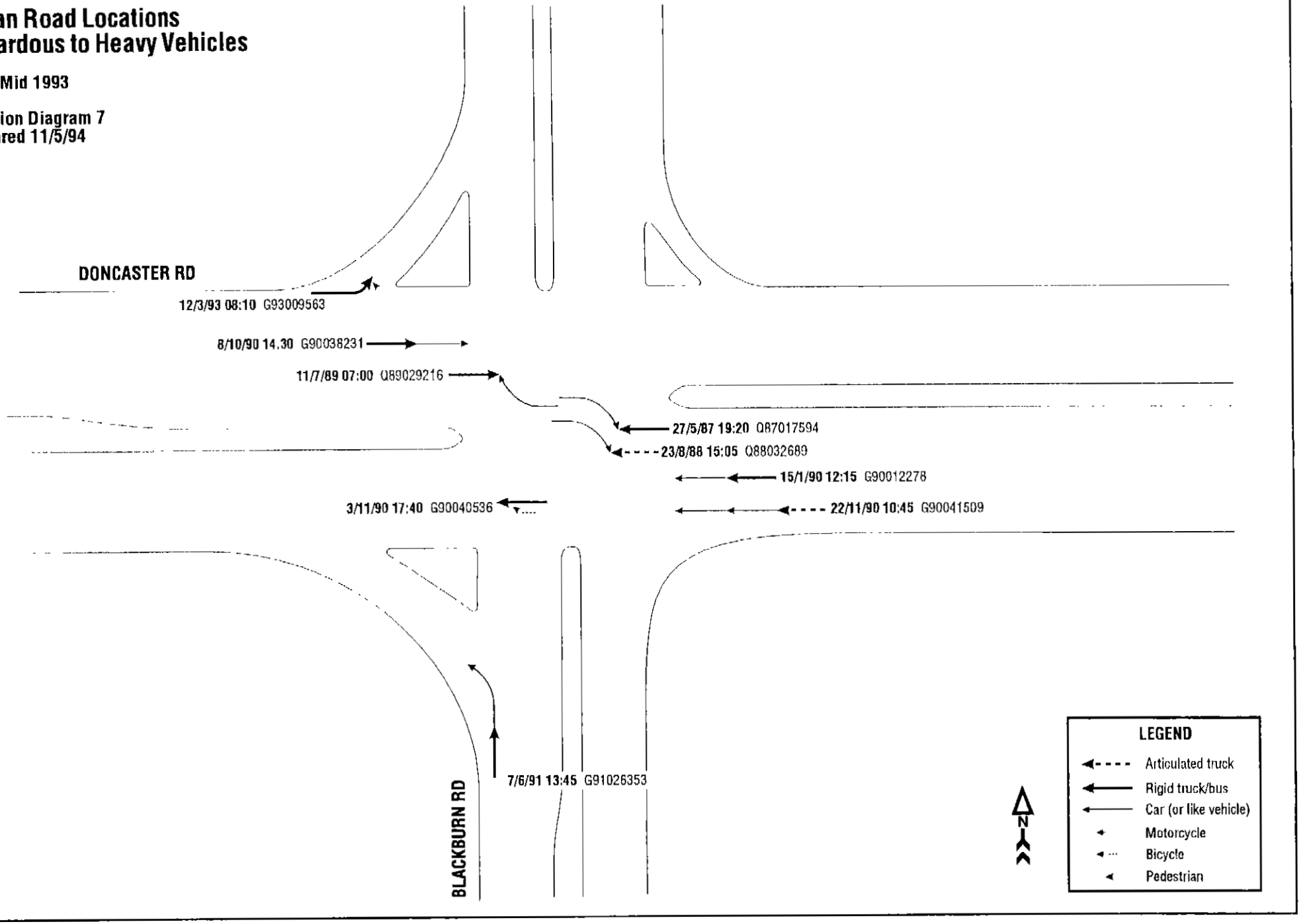


PHOTO 1 OF 2 - FACING WEST

PHOTO 2 OF 2 - FACING EAST

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

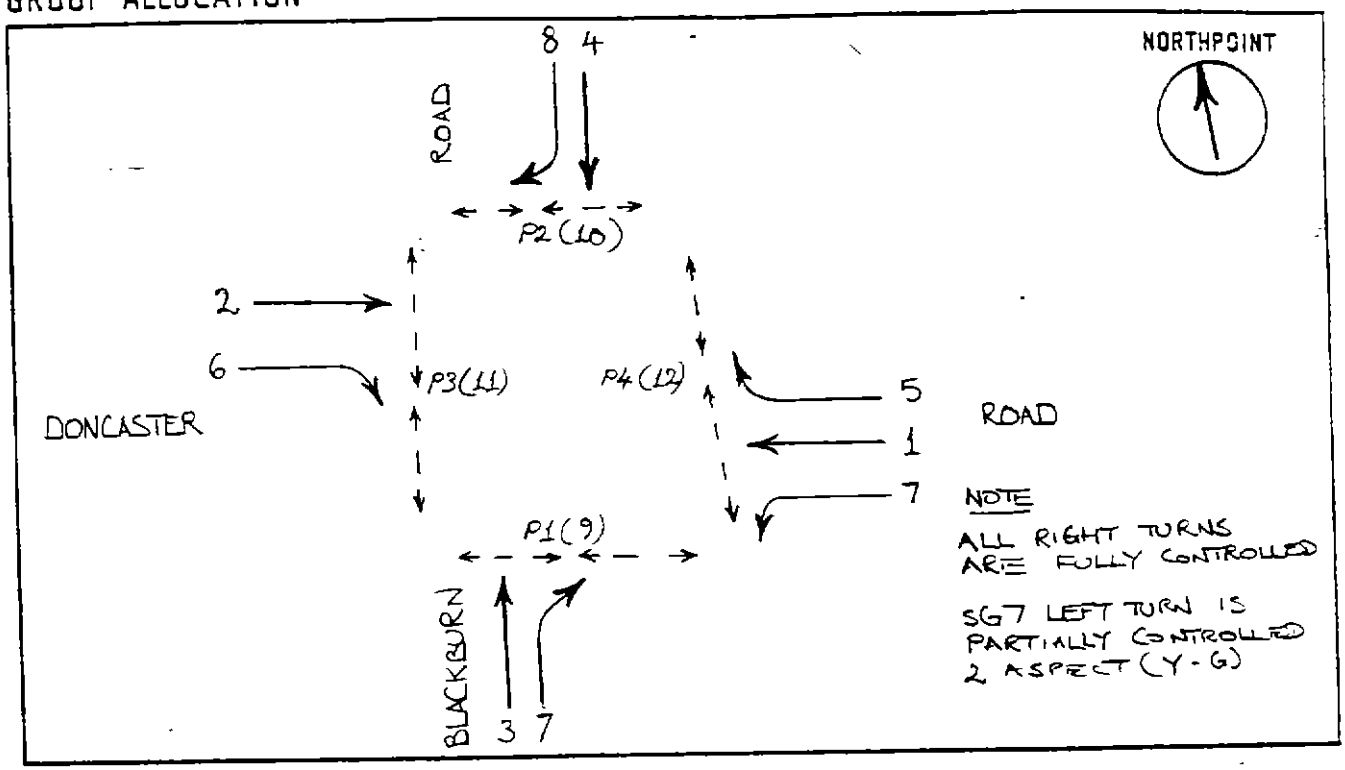
INTERSECTION DONCASTER RD/BLACKBURN RD No 335

MUNICIPALITY CITY OF DONCASTER & TEMPLESTOWE DESIGNER A.M. RASULO DATE 6/5/91

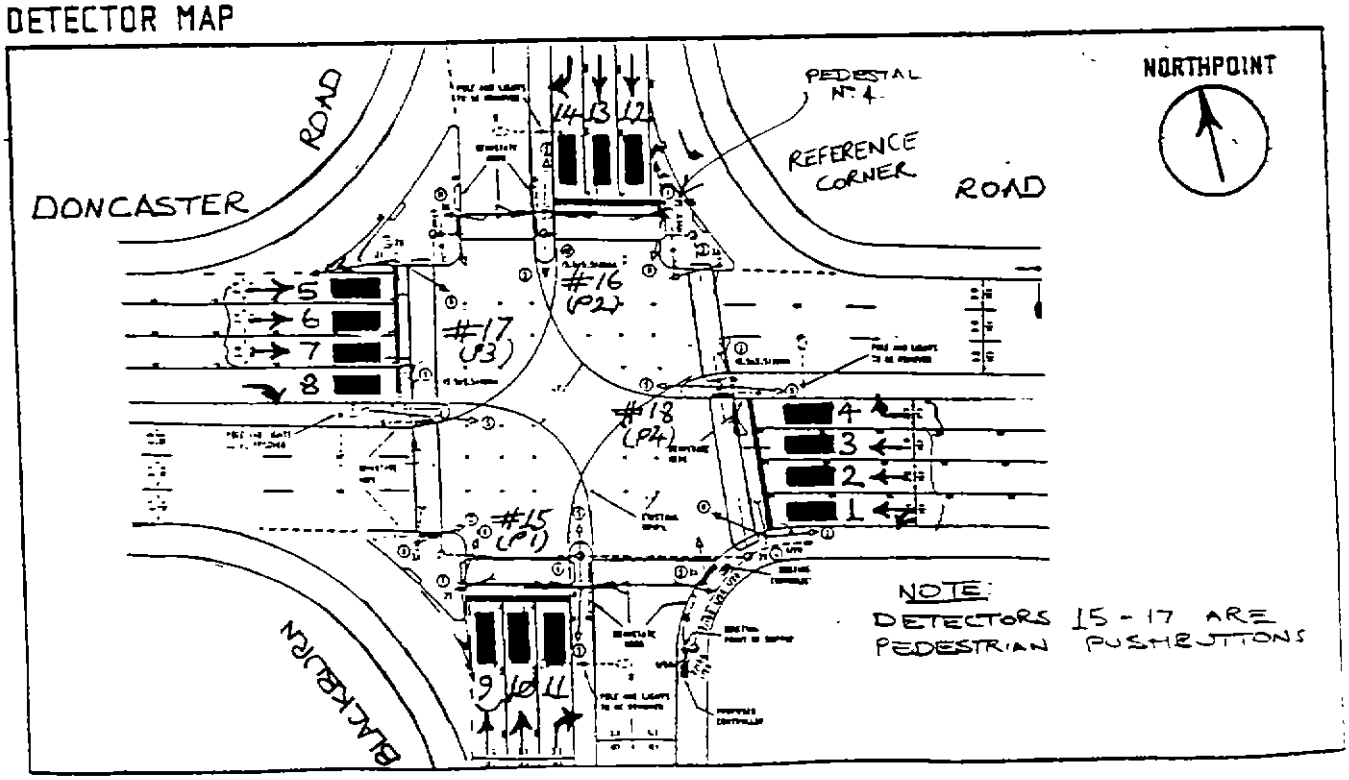
CONTROLLER CAPACITY 12 GROUPS DESIGN CHECKED DATE 14-5-91

PLAN No 135182 PROGRAM CHECKED DATE 22-5-91

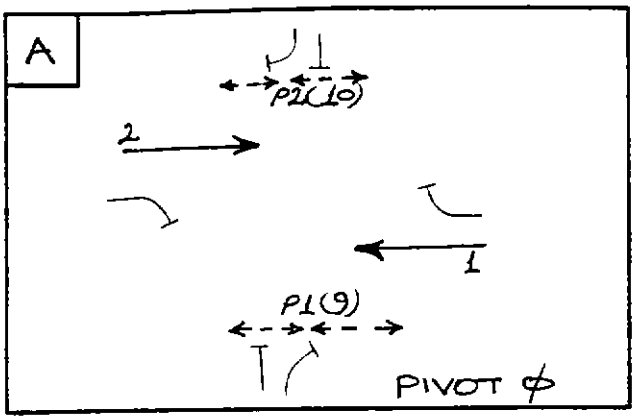
GROUP ALLOCATION



DETECTOR MAP

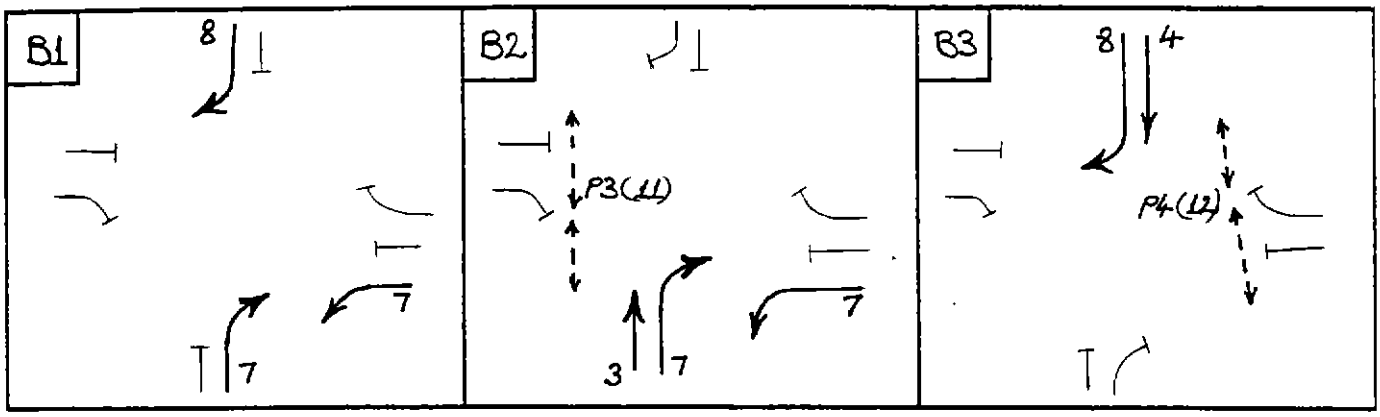


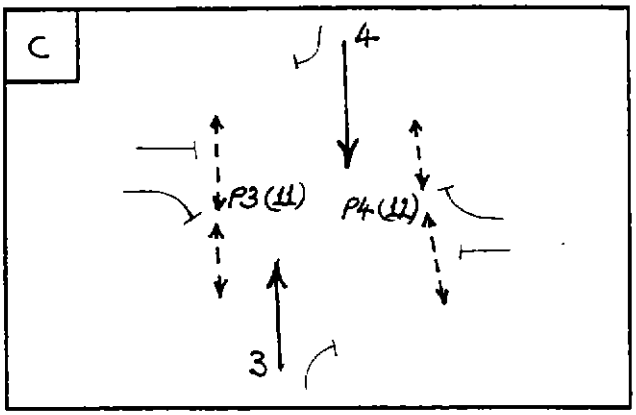
INTERSECTION LONGASTER RD/BLACKBURN RD No 335

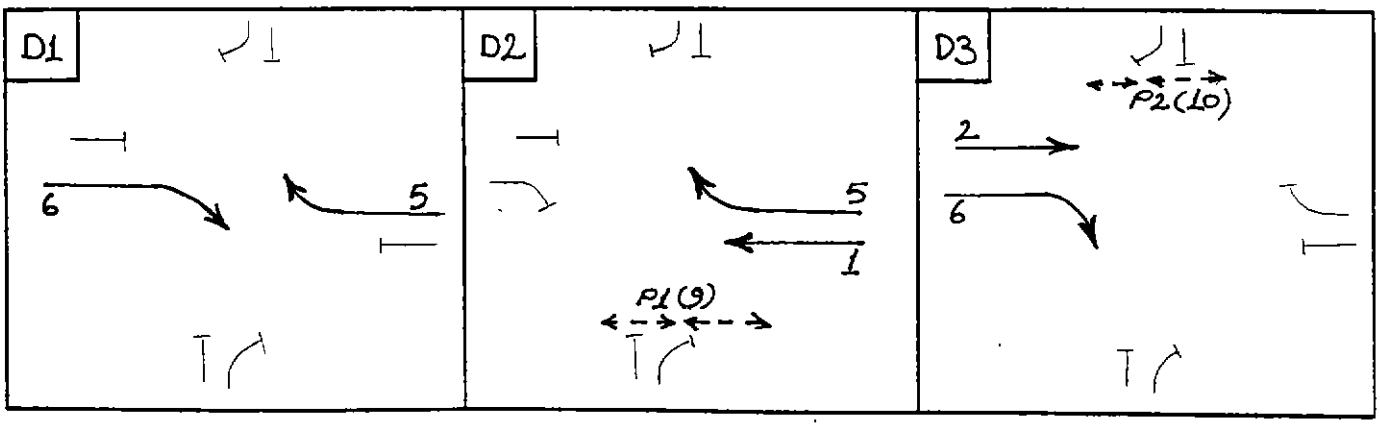


NORTHPOINT

PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION





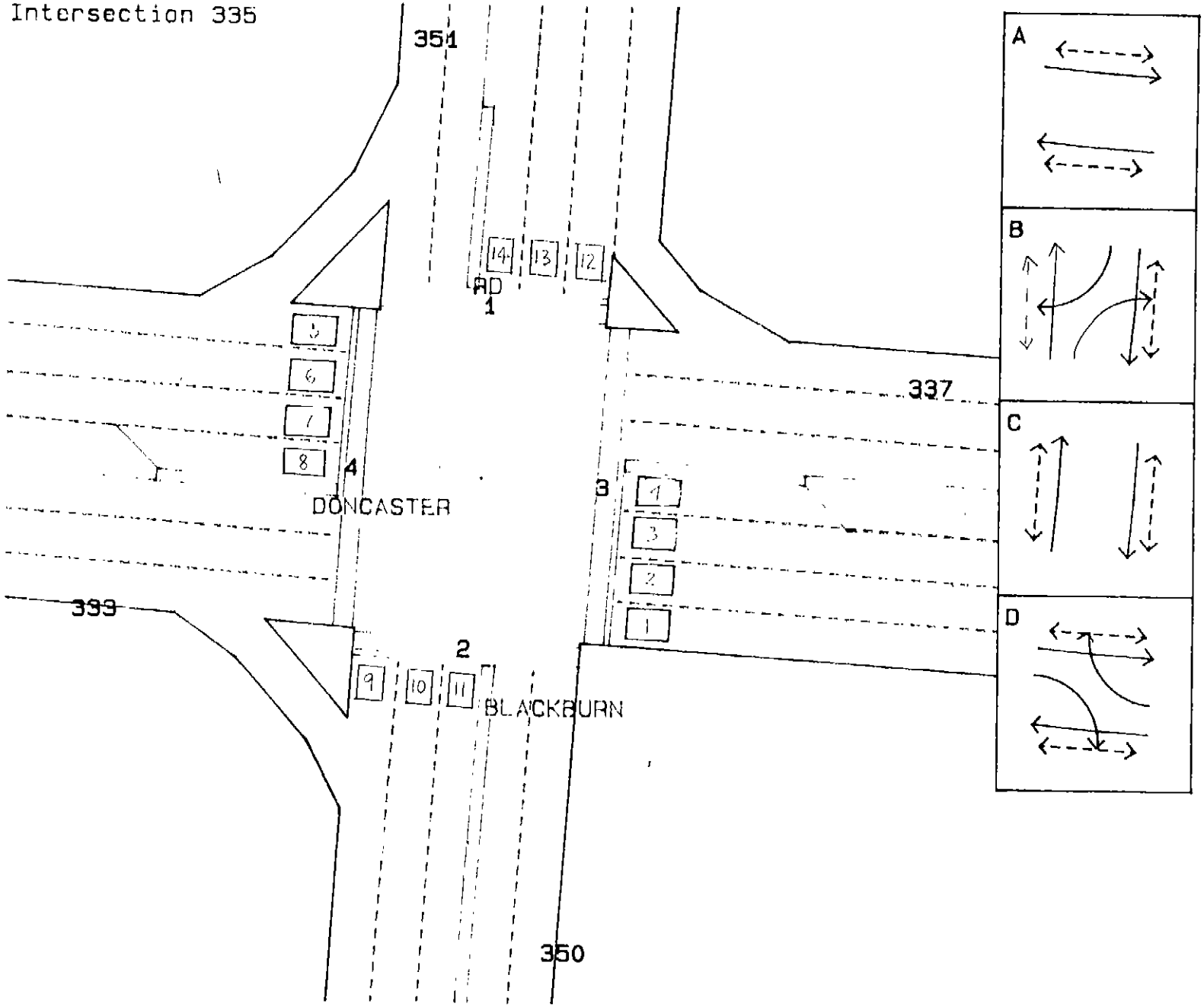


V.A. SEQUENCE: A B C D

DESIGNED: A. M. RASULO

DATE: 6/5/91

Intersection 335



STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Burke Rd/South Eastern Arterial, Glen Iris

Case No: M8

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 7 June 1994 **Case No: M8**

1. Location Details

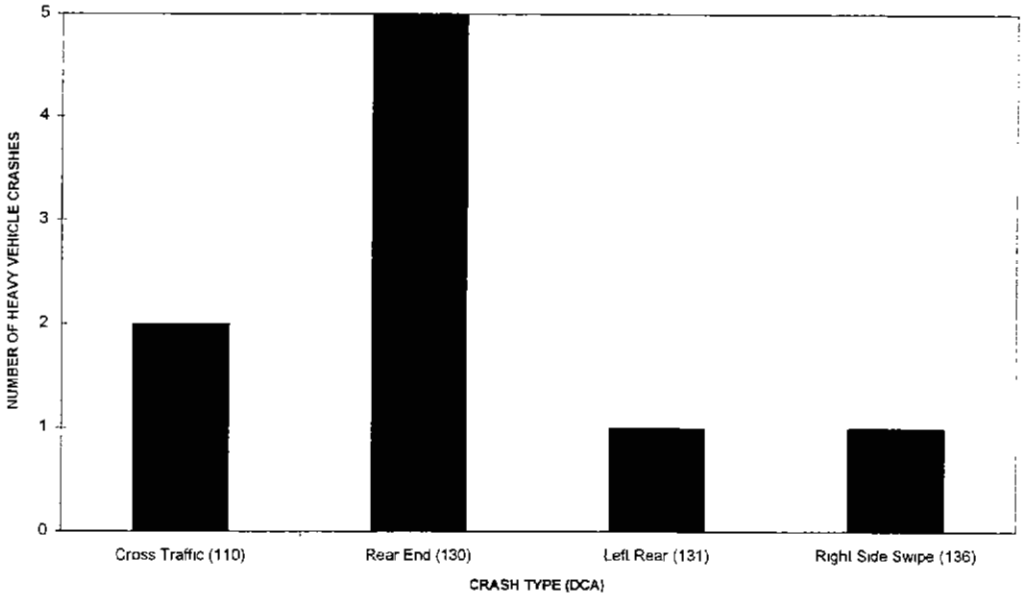
Street Names: Burke Rd/South Eastern Arterial.
Suburb and Local Government Area: Glen Iris, City of Malvern.
Melway Map Reference: 59 H6
Road Functional Classification: Both primary arterial roads.
Alignment/Topography: Generally flat, with downhill gradient from south to north. Gently curved approaches on the South Eastern Arterial.
Intersection Geometry (if applicable): Fully channelised cross intersection.
Traffic Control Type: Intersection signals. with full control of right turns from the South Eastern Arterial.
Surrounding Land Use: Residential/open space. with nearby commercial frontages and rail station.
Designated Heavy Vehicle Route: South Eastern Arterial carries high volumes of heavy vehicles.
Speed Zone: South Eastern Arterial: 80 km/h: Burke Rd: 60 km/h.
Number of Traffic Lanes: Refer attached plan.
Pedestrian (or other vulnerable road user) Activity: Low to medium pedestrian volumes
Characteristics of Traffic (Control) Operation: Heavy vehicle volumes and speeds along the South Eastern Arterial are high. Intersection operates at or near capacity for much of the day.
Treatment History: n/a

Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: Long signal cycle times are common due to the linking of signals to other nearby signals and to the rail crossing boom barriers

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 0 **Serious Injury** - 8 **Other Injury** - 31 **Total** - 39
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 2 **Other Injury** - 7 **Total** - 9
Percentage of Heavy Vehicle to All Casualty Crashes: 23.1% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 5 **Rigid** - 7 **Bus** - 0

Predominant Heavy Vehicle Crash Types (DCA):

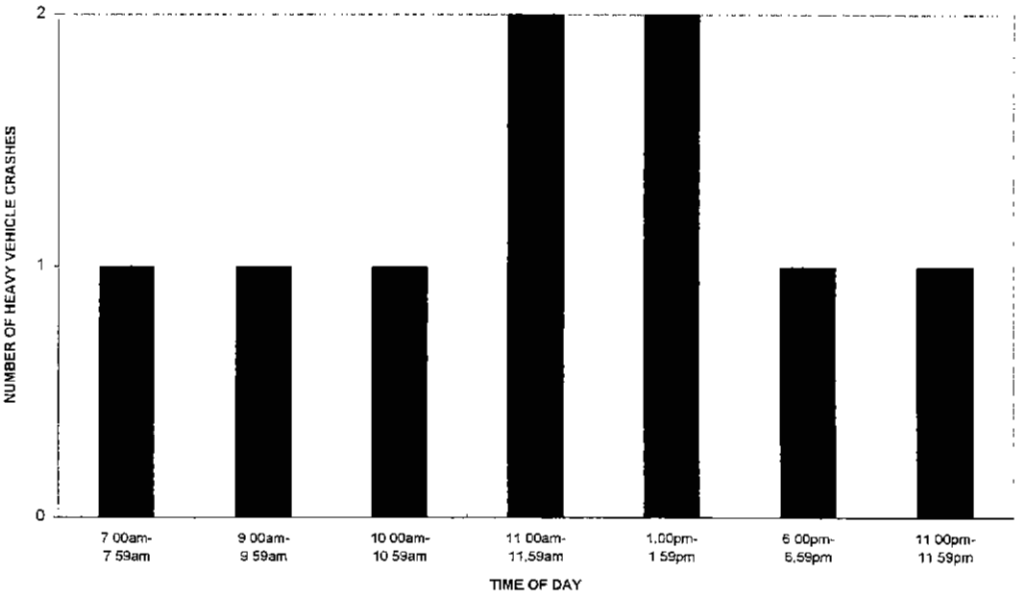


Predominant Heavy Vehicle Movements by DCA:

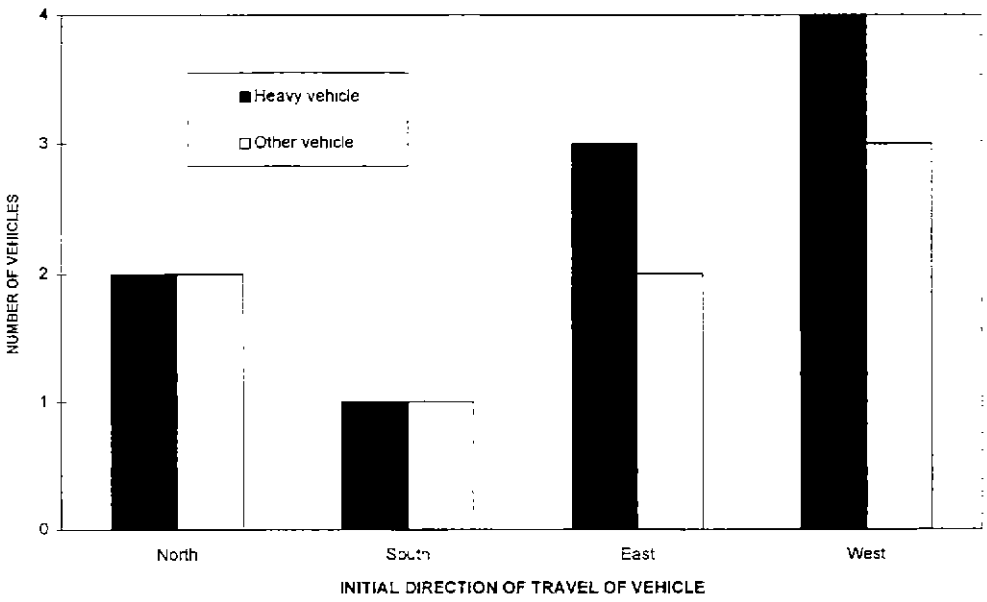
Rear End Type - 67%

Cross Traffic - 22%

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
Nine of the twelve heavy vehicles involved in crashes have been travelling either east or west on the South Eastern Arterial.

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably - speeds of at least 80 km/h on the South Eastern Arterial are high for safe operation of traffic signals, especially when heavy vehicle braking is required in congested traffic conditions.

Alignment/Topography:
Unlikely - there is no evidence in the crash histories that the downhill gradient for northbound traffic is contributing to crash occurrence.

Intersection Geometry (if applicable):
Unlikely.

Intersection Control (if applicable):
Rear-end crashes are characteristic of intersection signals but appear more pronounced for heavy vehicles in this instance. Signal displays appear adequate.

Road Surface (friction and roughness):
Unlikely - though skid resistance may be low given the very high traffic volumes, especially heavy vehicle volumes, using the intersection.

Roadside Features/Hazards: No.
Land Use: No.
Traffic Operation: There is a tendency for heavy vehicles travelling along the South Eastern Arterial to "run the red".
Delineation: Unlikely.
Street lighting: No.
Sight Distance: No.
Road Divided/Undivided: Unlikely - both roads fully divided.
Lane Configuration (e.g. lane drop/merge, etc.): Unlikely.
Lane Provision for Turning: Unlikely.
Road works: No.
Shoulder Condition: No.
Other: Police reports indicate that a number of crashes involved heavy vehicles striking the rear of stationary or near-stationary vehicles. Brake failure was mentioned in two cases while a fire truck on an emergency call entered on a red light before crashing with another vehicle.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Rear-End Crashes

- **high vehicle speeds and congested traffic conditions** add to the propensity for rear-end crashes to occur at intersection signals:

- the drivers of heavy vehicles being unable to stop in time to avoid colliding with stationary or near-stationary vehicles. **Brake failure of the heavy vehicles** was cited in two of the six cases, while in the other cases the cause may be due to the **inferior braking performance** of heavy vehicles compared to lighter vehicles and/or to **poor decision-making** by drivers of heavy vehicles when faced with a red or changing signal display. **Deteriorating skid resistance** on such a highly trafficked route is also a potential factor in rear-end crashes:

- there is evidence in Police reports of cross-traffic crashes of **the drivers of heavy vehicles "running the red"** - this could be a factor in rear-end crashes also

Cross-Traffic Crashes

- of the two cross-traffic crashes, one involved the driver of a heavy vehicle **"running the red"**, while the other involved a **fire truck on an emergency call** (lights flashing and siren operating) entering on a red light before crashing with another vehicle.

- a potential contributing factor in future cross-traffic crashes is the **signal inter-green times being too short** for the width of Burke Road at this point, and the additional time required by long/heavy vehicles to clear an intersection at the change of phase.

5. Countermeasure Options

State Government proposals to grade separate this intersection will eliminate the potential for most of the crash types found at Burke Road/South Eastern Arterial. However, the following countermeasure options are proposed as possible interim measures:

Rear-End Crashes

- reduce the speed limit on the SEA to 70 km/h and target Police enforcement of heavy vehicle speeds at this location until grade separation has been completed;
- improve the skid resistance of pavements on the SEA approaches which carry the higher volumes and speeds of heavy vehicles;
- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise.

Cross-Traffic Crashes

- increase the all-red periods to better provide for the dimensions, characteristics and the high proportion of heavy vehicles using the intersection.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: South Eastern Arterial/ Burke Road, Glen Iris, City of Malvern (LGA = 32)

Location Details											
ACCIDENT NUMBER	**DATE**	**TIME OF DAY**	**DAY OF WEEK**	**DCA CRASH TYPE**	**SEVERITY LEVEL**	**VEHICLE DIRECTION**	**VEHICLE TYPE**	**SPEED LIMIT**	**LIGHT CONDITION**	**WEATHER CONDITION**	**ROAD CONDITION**
H89023349	20-Apr-89	900	Thursday	Rear End	Other Injury	W /W /W	7/04/01	80	DAY	Clear	Dry
H89050495	8-Nov-89	1355	Wednesday	Rear End	Serious Injury	W /W /W	2/07/06	80	DAY	Clear	Dry
C90036841	8-Oct-90	1010	Monday	Right Side Swipe	Other Injury	N /N /	7/15/	60	DAY	Clear	Dry
C90039368	31-Oct-90	1817	Wednesday	Cross Traffic	Other Injury	W /N /	6/ 1/	80	DAY	Raining	Wet
C91007860	19-Feb-91	1100	Tuesday	Cross Traffic	Serious Injury	E /N /S	1/07/01	75	DAY	Clear	Dry
C91023393	2-Jun-91	2358	Sunday	Rear End	Other Injury	E /E /	7/ 1/	60	DARK	Raining	Wet
C92041363	2-May-91	1345	Thursday	Rear End	Other Injury	W /W /	6/ 1/ .	100	DAY	Unknown	Dry
G91032209	6-Sep-91	1100	Friday	Left Rear	Other Injury	S /S /	7/ 1/ .	60	DAY	Clear	Dry
C92004339	21-Jan-92	745	Tuesday	Rear End	Other Injury	E /E /E	7/06/06	75	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 8
Prepared 11/5/94

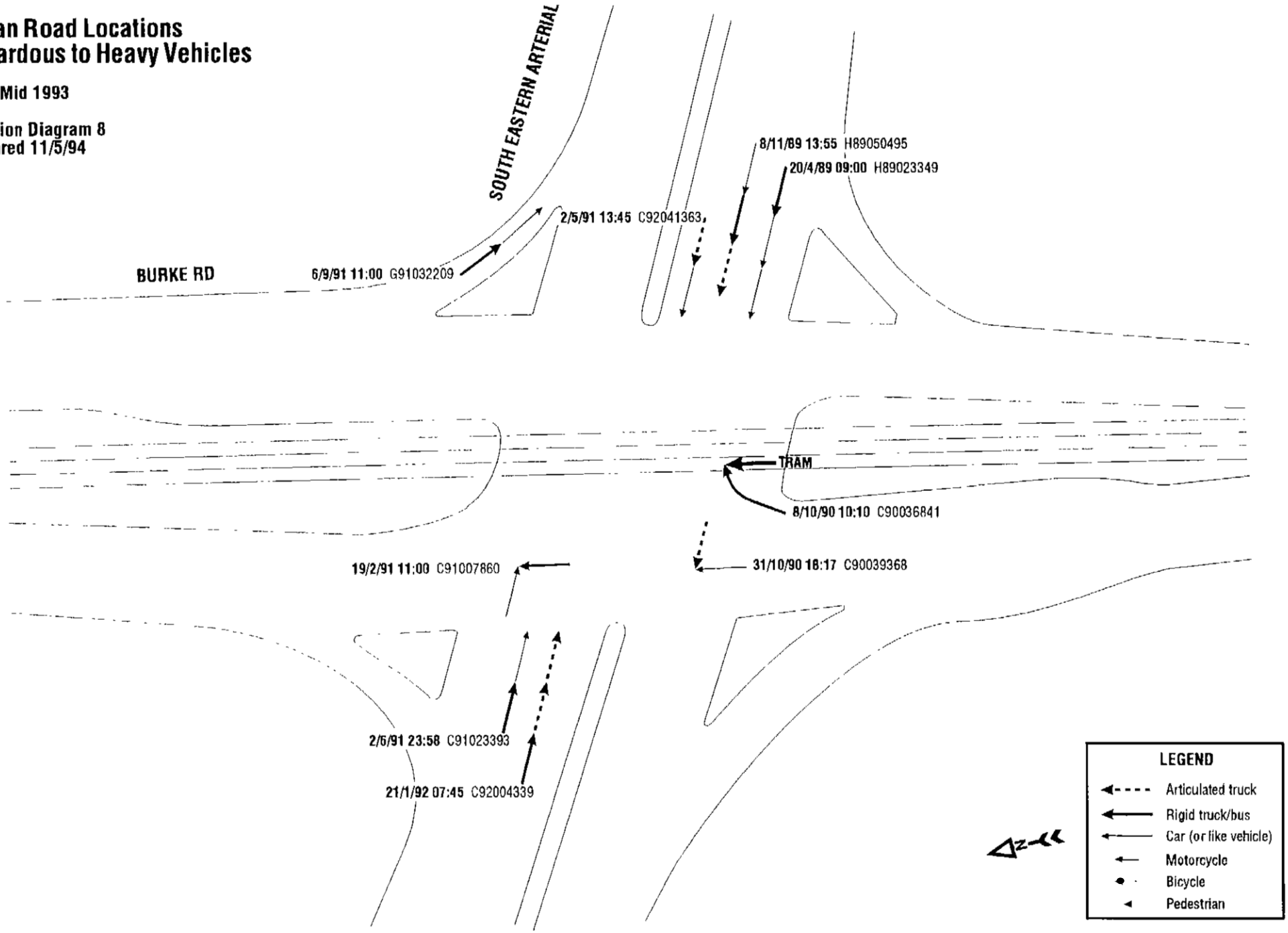


PHOTO 1 OF 4 - FACING WEST

PHOTO 2 OF 4 - FACING NORTH

PHOTO 3 OF 4 - FACING SOUTH

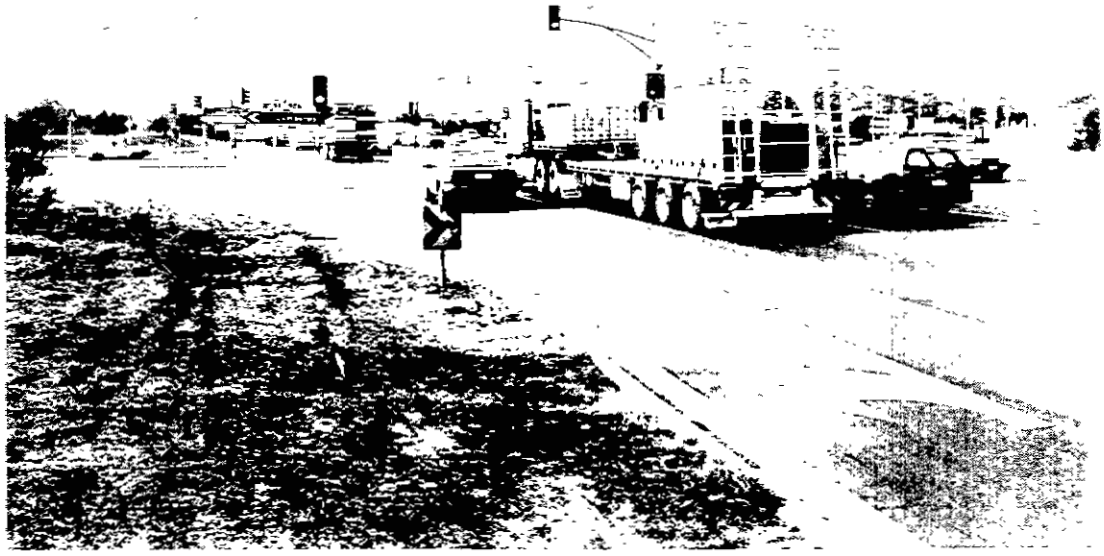


PHOTO 4 OF 4 - FACING EAST

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

INTERSECTION SOUTH EASTERN - MULGRAVE ARTERIAL ROAD LINK / BURKE ROAD No 2845

MUNICIPALITY CITY OF MALVERN REPROGRAM DESIGNER C. EER DATE 19/4/93 27/1/89

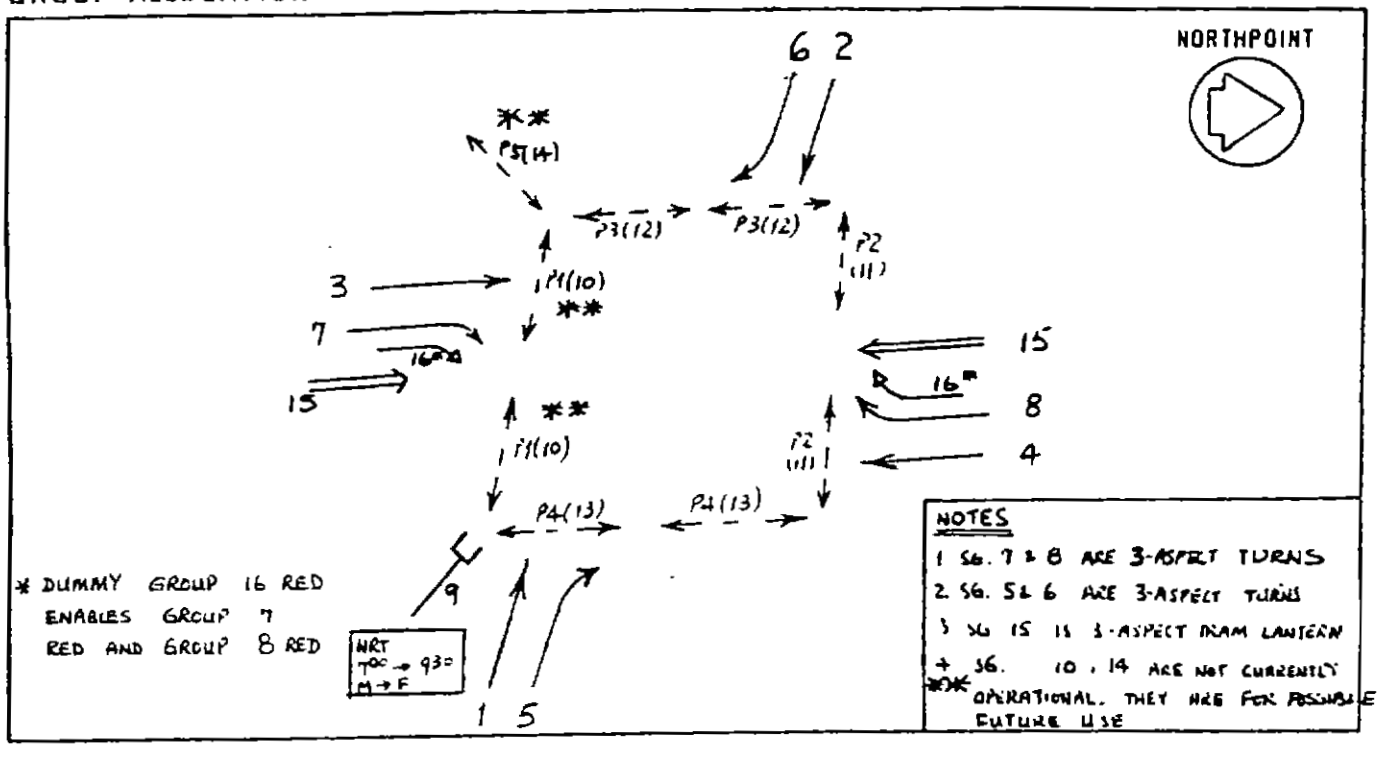
RE PROGRAM HOAN NGO DATE 07/10/93

CONTROLLER CAPACITY 16 GROUPS RE-DESIGN CHECKED Francis J. Woodland DATE 8/10/93

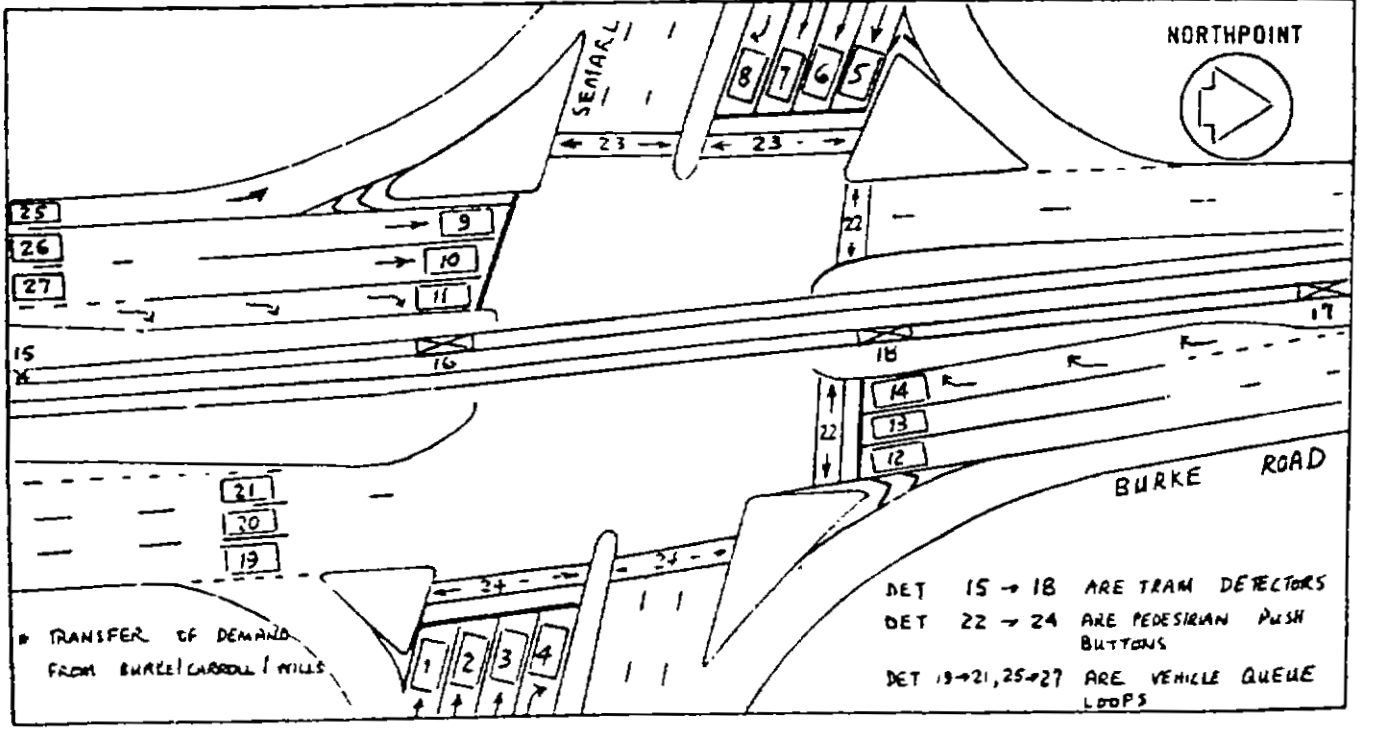
PLAN NO 85 0577 RE PROGRAM CHECKED [signature] DATE 13/10/93

MODIFICATION OF OPERATION OF SIGNAL GROUP 9.
PREVIOUSLY, SG 9 WAS PROVIDED FOR LEFT TURN FROM SOUTH TO WEST AND WAS INTERLOCKED AGAINST PS(14).
NOW, SG 9 CONTROLS NRT SIGN FROM WEST TO SOUTH (REFER TO PAGE 3F)

GROUP ALLOCATION



DETECTOR MAP



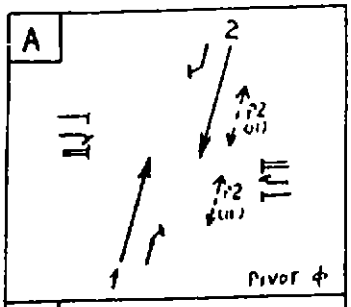
DRG NO 87 5075LV

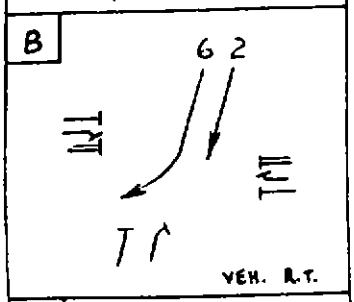
C - PERS

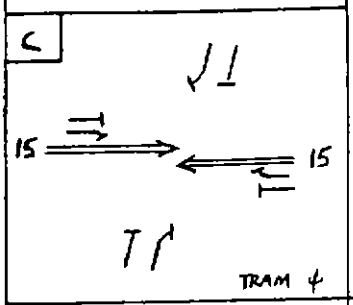
PHASING DIAGRAM

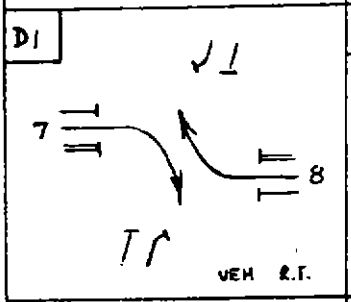
INTERSECTION SEMARL / BURKE ROAD NO 2845

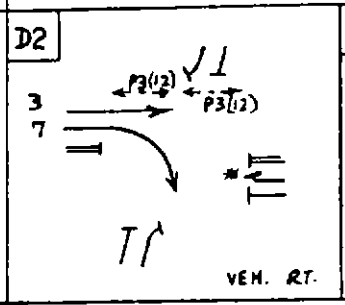
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION
A			
B			
C			
D			
E	D		
F	D		
G			

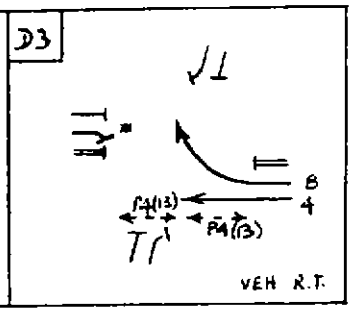


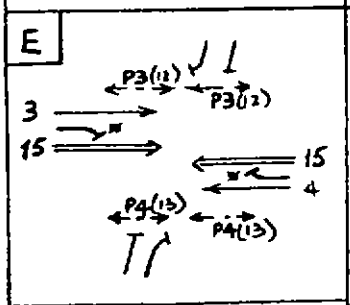


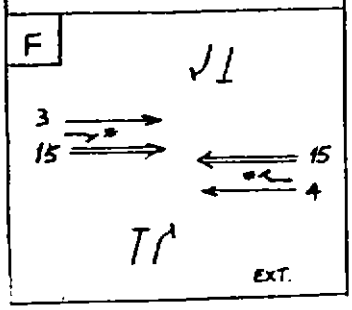


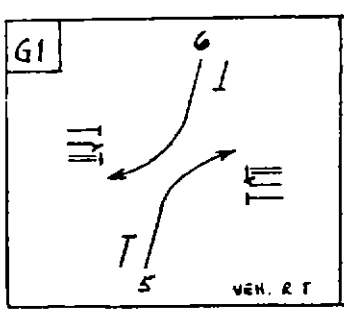


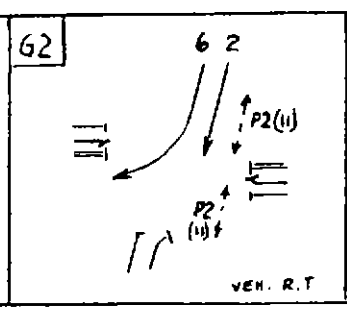


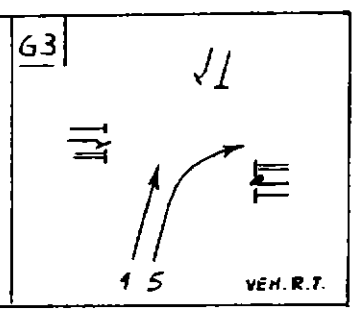












* SG 7 and SG 8 are conditional on Tram Group 15 Refer to notes on page 3a (cont)

V.A. SEQUENCE : ADEG

DESIGNED : C EER

DATE : 1/9/88

DRG NO BY SOTELY

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Cooper Street/Hume Highway/Somerton Road, Campbellfield

Case No: M9

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 17 June, 1994 **Case No:** M9

1. Location Details

Street Names: Cooper Street/Hume Highway/Somerton Road.
Suburb and Local Government Area: Campbellfield, Cities of Whittlesea and Broadmeadows and Shire of Bulla
Melway Map Reference: 180 E9
Road Functional Classification: All primary arterial roads.
Alignment/Topography: Flat, straight approaches.
Intersection Geometry (if applicable): Cross
Traffic Control Type: Intersection signals with fully controlled right turn phases for the north and south approaches and partially controlled right turn phases for the east and west approaches. The right-turn phases from Hume Highway occur twice/cycle.
Surrounding Land Use: Industrial/open space.
Designated Heavy Vehicle Route: The Hume Highway is the designated National Highway to Sydney.
Speed Zone: 80 km/h all approaches (previously 75 km/h).
Number of Traffic Lanes: Refer attached plan.
Pedestrian (or other vulnerable road user) Activity: Very light.
Characteristics of Traffic (Control) Operation: Refer plan for phasing.
Treatment History: Major signal remodel, involving new phasing and signal hardware carried out in 1991 (refer plan for details).

Location Plan Attached:
Yes.

Photographs Attached:
Yes.

Other Observations/Comments:
The all-red period provided following the right-turn movements from the Hume Highway appears to be inadequate in comparison to the time required by heavy vehicles to complete the manoeuvre.

2. Crash Details

Period of Crash Analysis:
1987 to mid-1993

Total Number of Crashes:
Fatal - 0
Serious Injury - 9
Other Injury - 38
Total - 47

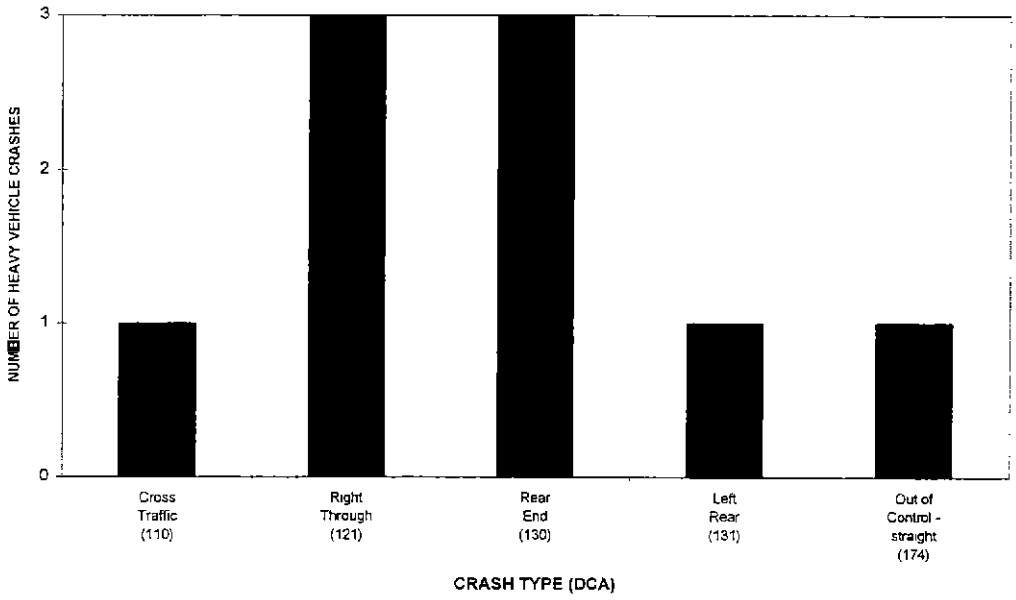
Total Number of Heavy Vehicle Crashes:
Fatal - 0
Serious Injury - 1
Other Injury - 8
Total - 9

Percentage of Heavy Vehicle to All Casualty Crashes: 19.2%

Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections: 8.3%

Number of Crashes by Heavy Vehicle Type:
Articulated - 6
Rigid - 3
Bus - 0

Predominant Heavy Vehicle Crash Patterns (DCA):

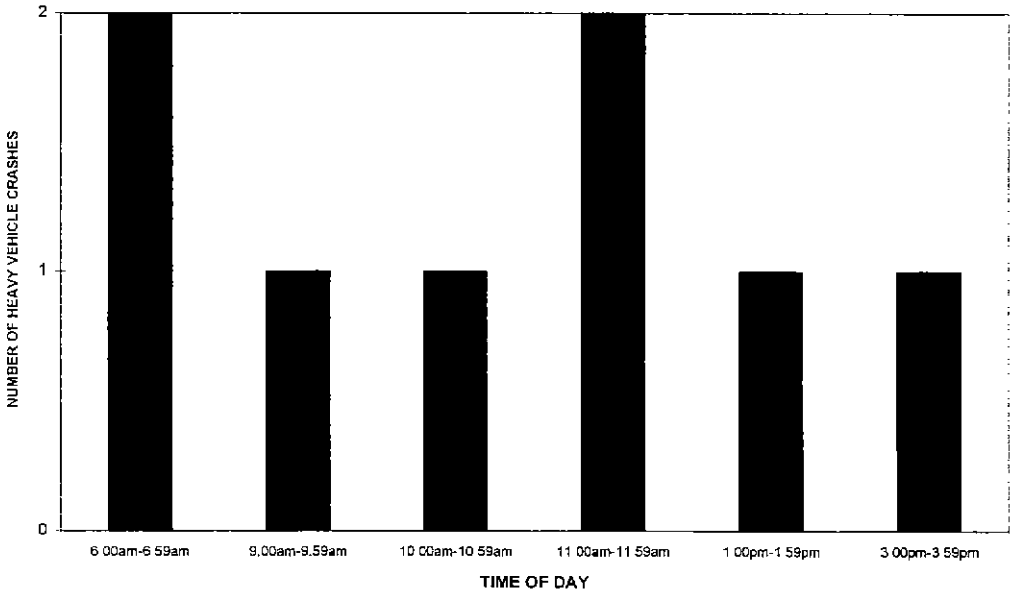


Predominant Heavy Vehicle Movements by DCA:

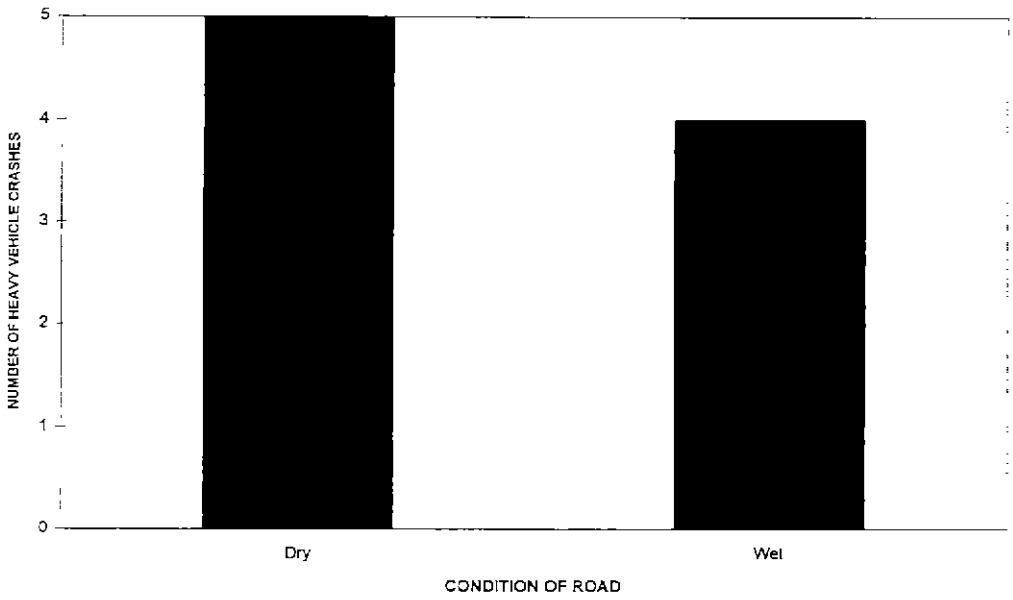
Rear-End Type - 44%

Right-Through - 33%

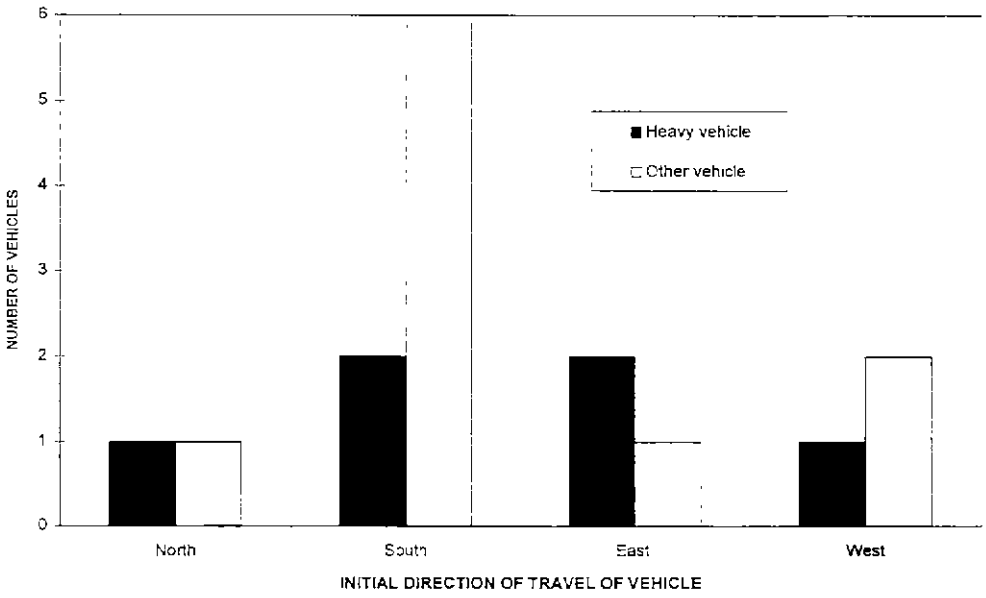
Time of Day Crash Patterns:



Condition of Road Crash Patterns:



Initial Direction of Travel Crash Patterns



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
Cooper Street/Hume Highway/Somerton Roads represents the first set of intersection signals encountered as drivers enter the Melbourne Metropolitan Area after long periods of travel in rural highway/freeway conditions. Four of the nine crashes involved Melbourne bound heavy vehicles - more than any other approach.

3. Road Environment Factors Contributing to Crash Occurrence

Speed: Speeds are high, especially for Melbourne bound vehicles. Adjusting to urban traffic conditions/lower speeds could present difficulties for motorists in general, and for drivers of heavy vehicles in particular.
Alignment/Topography: No.
Intersection Geometry (if applicable): No.
Intersection Control (if applicable): Most of the crashes are characteristic of intersection signal operation.
Road Surface (friction and roughness): Four of the nine crashes occurred while the pavement was wet. Skid resistance at intersection signals, where heavy vehicles queue while waiting for a green signal, may be affected by oil dropped near the stop line. There is evidence in the crash characteristics and site observations that this may be a factor in crashes involving Melbourne bound traffic.
Roadside Features/Hazards: No.
Land Use: No.
Traffic Operation: There is an observable tendency for heavy vehicles to have difficulty braking to avoid stationary or near stationary vehicles at the traffic signals.
Delineation: No.
Street lighting: No.
Sight Distance: No.
Road Divided/Undivided: No - all approaches fully divided.
Lane Configuration (e.g. lane drop/merge, etc.): No.
Lane Provision for Turning: No
Road works: No.

Shoulder Condition:
No.

Other:
Crash patterns for heavy vehicles at this intersection are generally not well defined, with a wide variety of heavy vehicle movements and circumstances involved

4. Conclusions

Although crash patterns for heavy vehicles at this intersection are generally not well defined, the following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Rear-End Type Crashes

- **high vehicle speeds and congested traffic conditions**. Adjusting to urban traffic conditions and lower speeds could present some difficulties in judgement for motorists in general, and for drivers of heavy vehicles in particular, given that many drivers would have been travelling for long periods in rural highway/freeway conditions before encountering this set of intersection signals;

- the drivers of heavy vehicles being unable to stop in time to avoid colliding with stationary or near-stationary vehicles (rear-end collisions are characteristic of traffic signal crash patterns generally). The cause may be due to the **inferior braking performance** of heavy vehicles compared to lighter vehicles and/or to **poor skid resistance** of the highly trafficked pavement (or perhaps due to oil dropped by passing or queued vehicles together with wet pavement) and/or to **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display.

Right-through Crashes

- drivers in general **failing to comply with right turn phases**, i.e. red signals or arrow displays, though there is no evidence to suggest that heavy vehicles are over-involved in right-through crashes compared to other vehicle types;

- **inadequate gap selection** by the driver of a heavy vehicle may have been a factor in one of the three crashes of this type.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection

Rear-End Type Crashes

- reduce the speed limit on the Hume Highway to 70 km/h and target Police enforcement of heavy vehicle speeds at this location;
- improve the skid resistance of pavements on the Hume Highway approaches which carry the higher volumes and speeds of heavy vehicles;
- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise.

Right-through Crashes

- target Police enforcement at compliance by all drivers with right turn phases, i.e. red signals or arrow display;
- increase the all-red period which follows the operation of the right-turn phases from the Hume Highway to better provide for the dimensions, characteristics and the high proportion of heavy vehicles using the intersection.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Cooper Street/ Somerton Road, City of Broadmeadows (LGA = 5)

Location Details

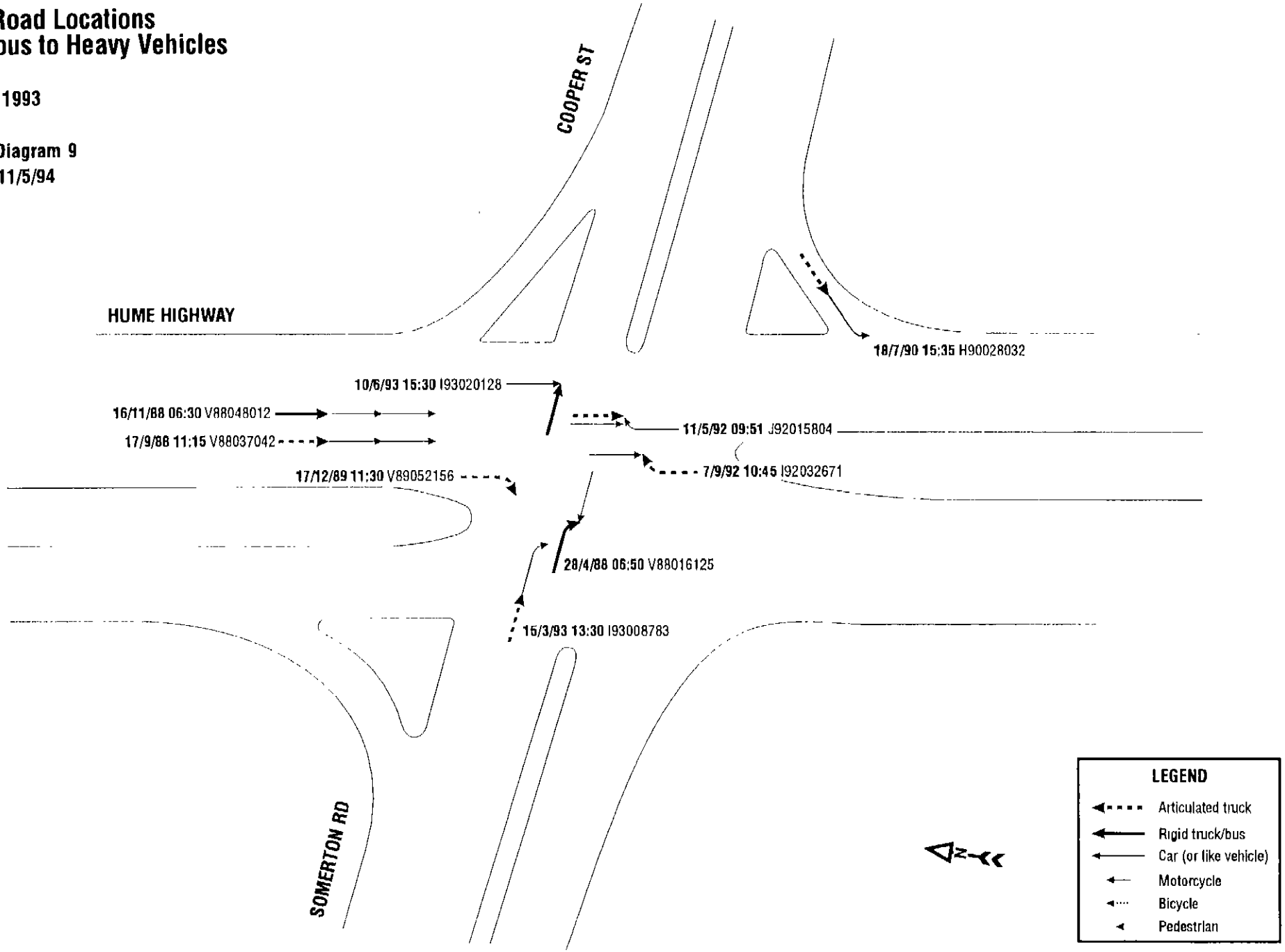
ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
V88016125	28-Apr-88	650	Thursday	Right Through	Other Injury	E /W /	7/ 1/ .	100	DAWN	Clear	Dry
V88037042	17-Sep-88	1115	Saturday	Rear End	Serious Injury	S /S /S	1/1/06	100	DAY	Clear	Wet
V88048012	16-Nov-88	630	Wednesday	Rear End	Other Injury	S /S /S	7/1/01	90	DAY	Clear	Wet
V89052156	19-Dec-89	1130	Tuesday	Out of Control	Other Injury	S / /	6/ ./ .	90	DAY	Clear	Dry
H90028032	18-Jul-90	1535	Wednesday	Left Rear	Other Injury	W /W /	6/ 1/ .	unknown	DAY	Clear	Dry
I92015804	11-May-92	950	Monday	Right Through	Other Injury	N /S /S	1/1/06	75	DAY	Clear	Dry
I92032671	7-Sep-92	1045	Monday	Right Through	Other Injury	N /S /	6/ 4/ .	75	DAY	Raining	Wet
I93008783	15-Mar-93	1330	Monday	Rear End	Other Injury	E /E /	6/ 1/ .	75	DAY	Clear	Dry
I93020128	10-Jun-93	1530	Thursday	Cross Traffic	Other Injury	S /E /	1/ 7/ .	75	DAY	Raining	Wet

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 9
Prepared 11/5/94



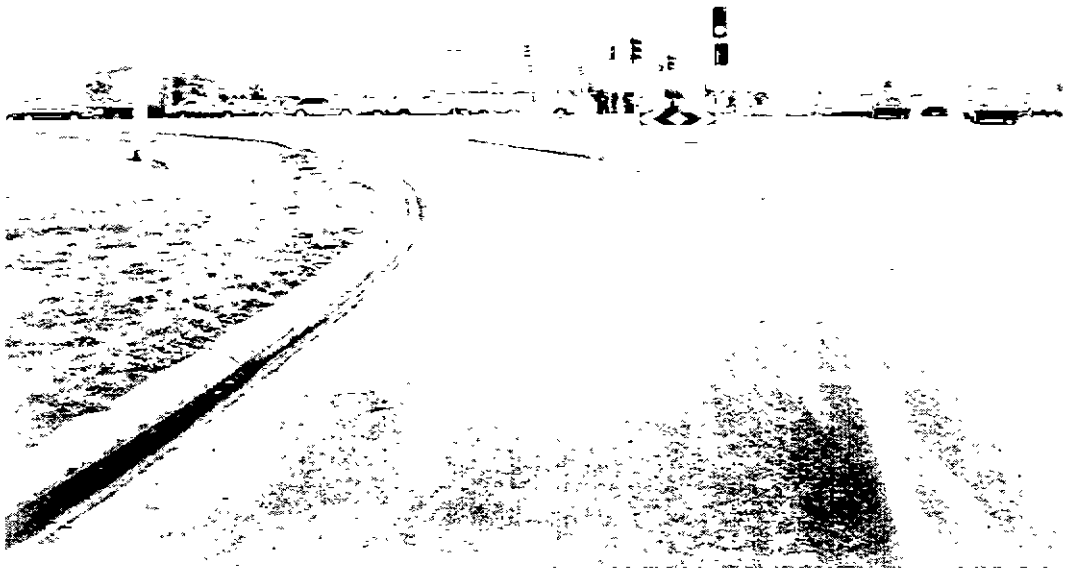


PHOTO 1 OF 4 - FACING WEST

PHOTO 2 OF 4 - FACING NORTH

PHOTO 3 OF 4 - FACING SOUTH

PHOTO 4 OF 4 - FACING EAST

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

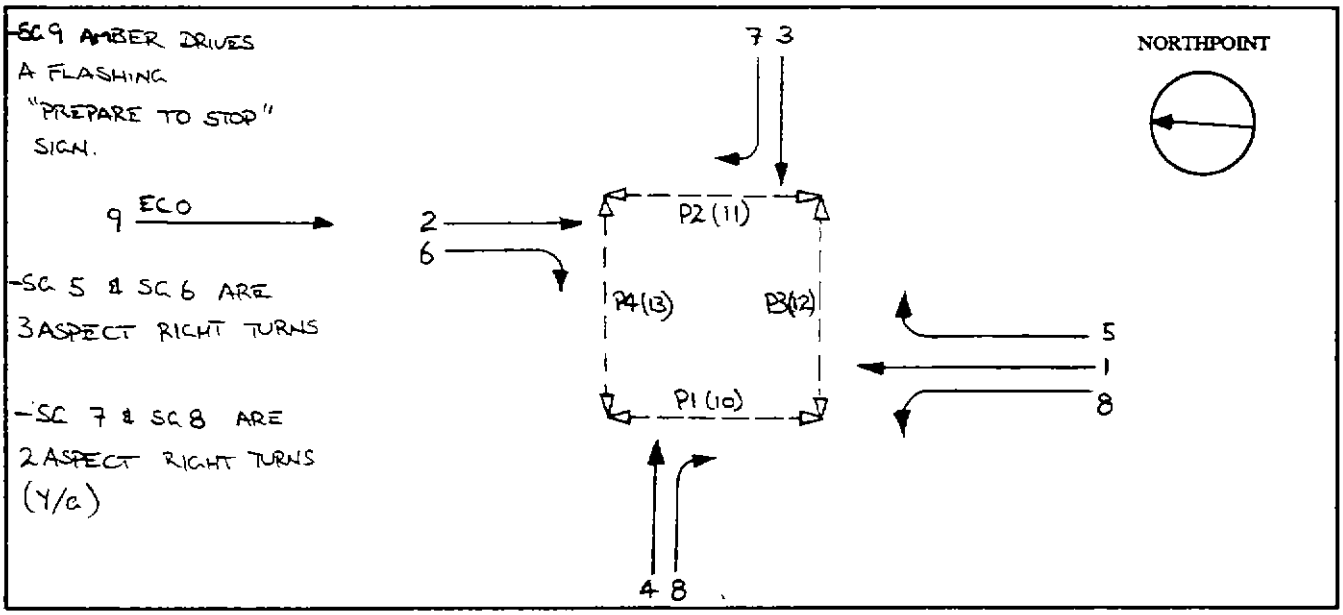
INTERSECTION HUME HIGHWAY / SOMERTON RD / COOPER ST No 2161

MUNICIPALITY CITIES OF WHITTLESEA, BROADMEADOWS & THE SHIRE OF BULLA DESIGNER BRIAN SHERRITT DATE 18-3-92

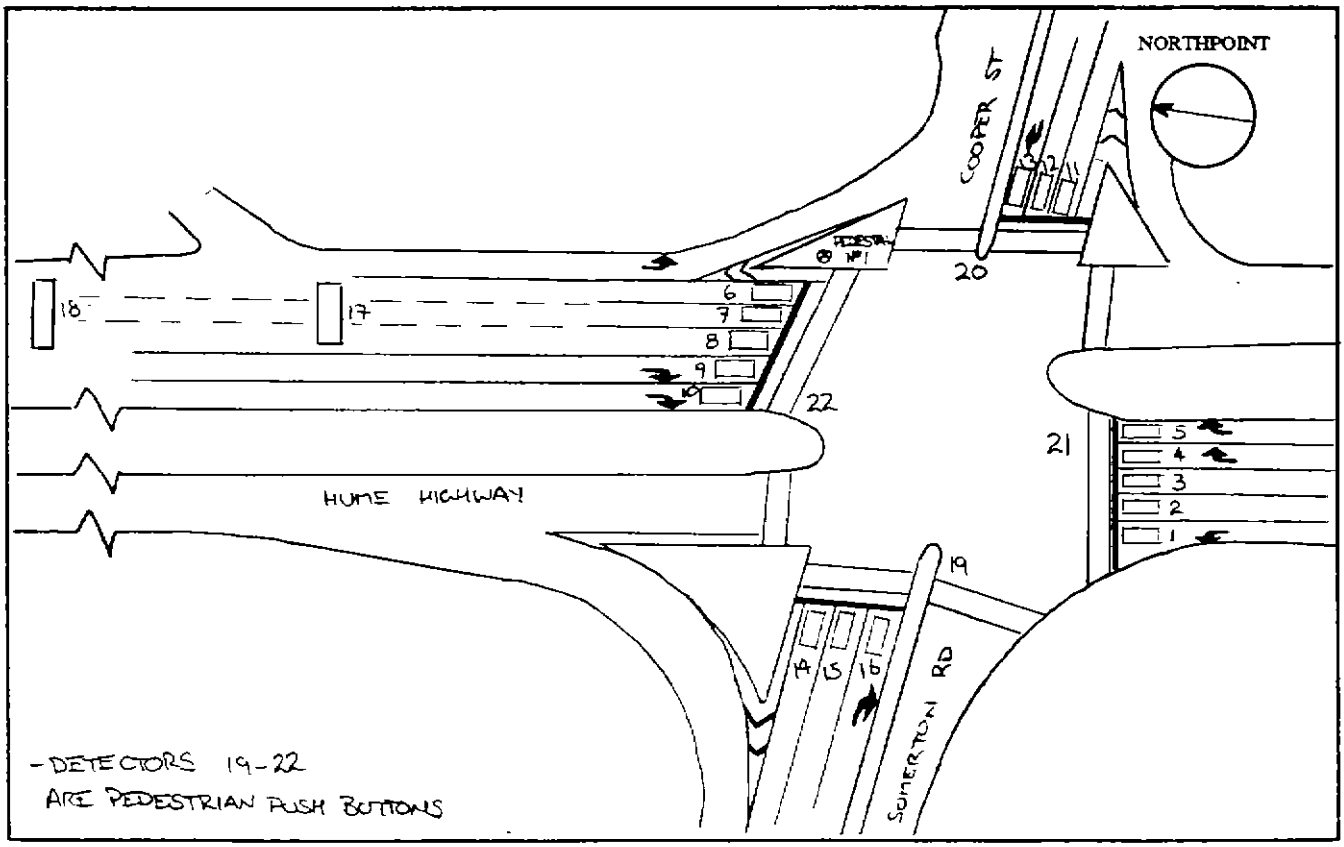
CONTROLLER CAPACITY _____ GROUPS DESIGN CHECKED [signature] DATE 30/3/92

PLAN No 364 692 PROGRAM CHECKED [signature] DATE 6/4/92.

GROUP ALLOCATION

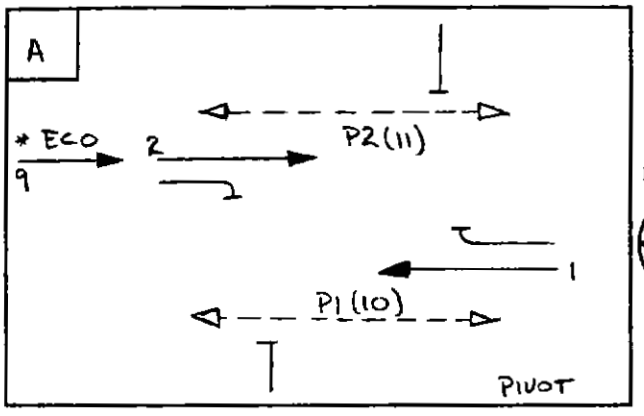


DETECTOR MAP



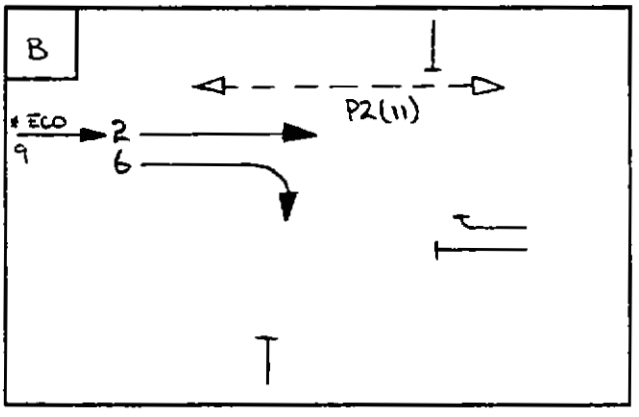
PHASING DIAGRAM

ERSECTION HUME HIGHWAY / SOMERTON RD / COOPER ST No 2161

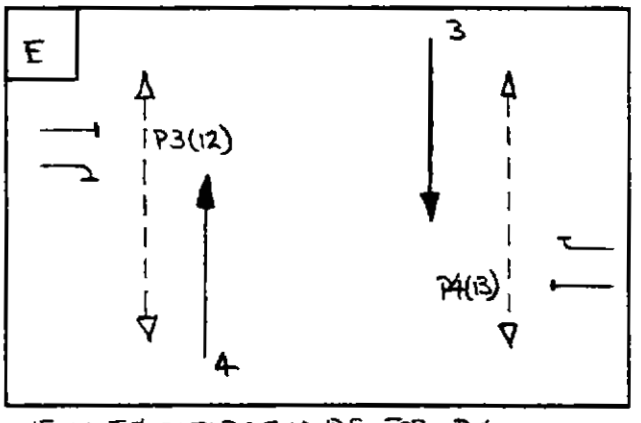


NORTHPOINT

PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION
E	D		



IF IN Bø CLEAR DEMANDS FOR Cø



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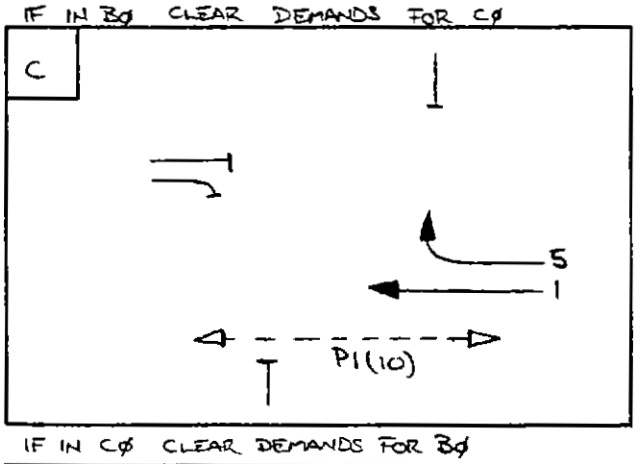

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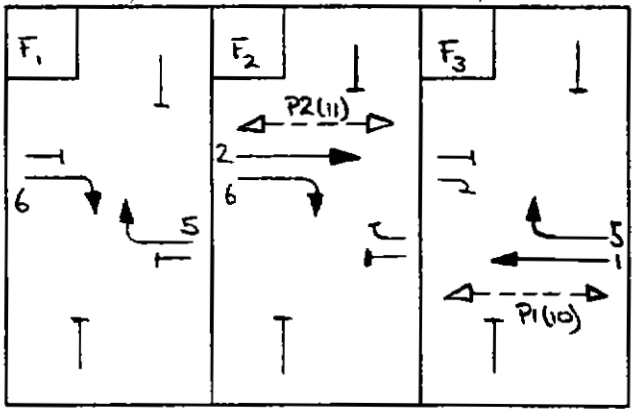
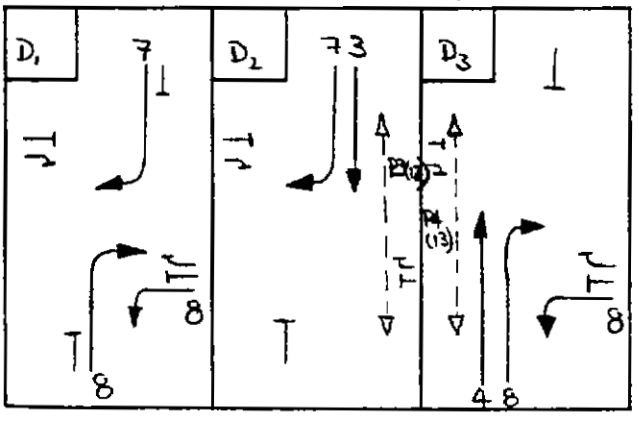


-P1 & P2 ARE SECRET IN Fø

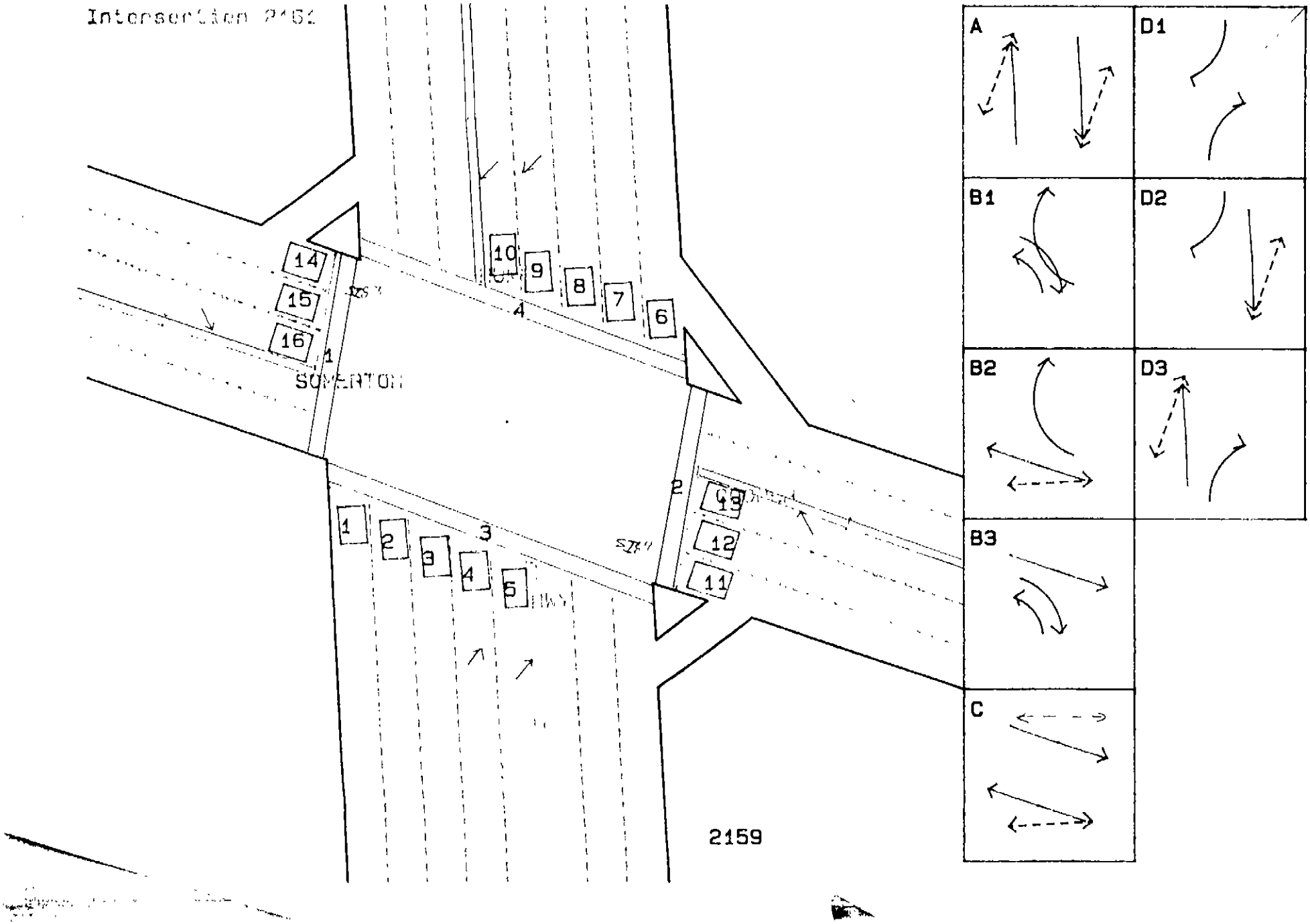


* REFER TO SPECIAL NOTES PAGE

V.A. SEQUENCE: A D E F

DESIGNED: BRYAN SHERRITT

DATE: 19-3-92


Intersection 2161
14
15
16
1
SOMERTON
10
9
8
7
6
4
1
2
3
4
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3
2
13
12
11
2159
A
D1
B1
D2
B2
D3
B3
C

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Doncaster Road/Elgar Road/Tram Road/Williamson's Road, Doncaster

Case No: M10

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 9 May 1994 **Case No: M10**

1. Location Details

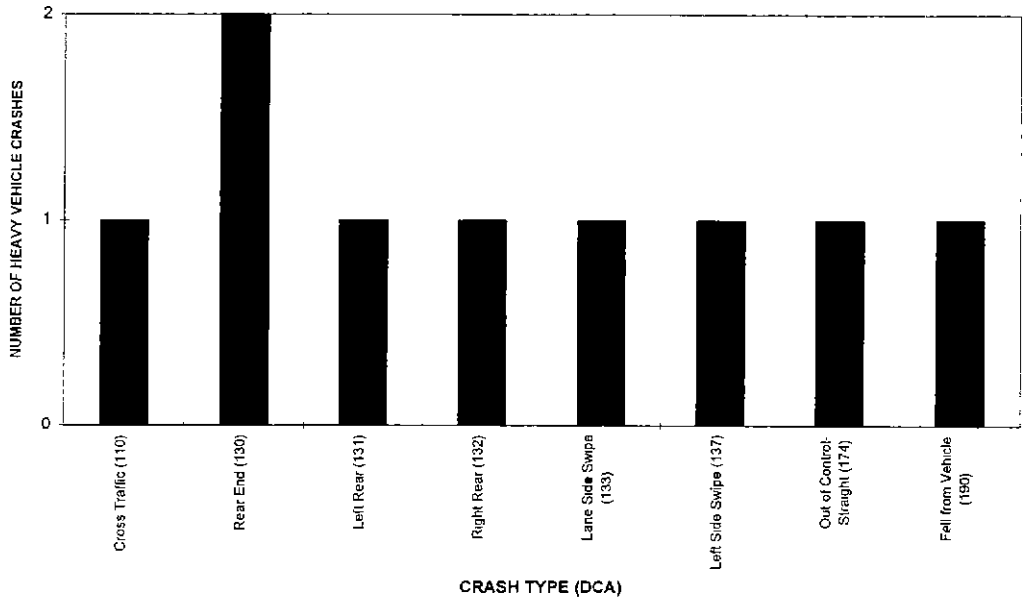
Street Names: Doncaster Road/Elgar Road/Tram Road/Williamson's Road.
Suburb and Local Government Area: Doncaster, City of Doncaster and Templestowe.
Melway Map Reference: 47 D1
Road Functional Classification: All roads are primary arterial roads except for Tram Road which is a secondary arterial road.
Alignment/Topography: Generally straight approaches in the vicinity of the intersection, with downhill gradients approaching the intersection from east to west, south to north (Elgar Road) and uphill from south to north (Tram Road).
Intersection Geometry (if applicable): Two separate but closely spaced intersections in the form of a six-leg layout
Traffic Control Type: Intersection signals with complex phasing (refer to signal design plan attached).
Surrounding Land Use: Commercial/business/major regional shopping centre.
Designated Heavy Vehicle Route: Major route for heavy vehicles, linking the eastern area of Melbourne with the Eastern Freeway and northern suburbs
Speed Zone: Doncaster Road and Williamson's Road: 70 km/h; Tram Road and Elgar Road: 60 km/h.
Number of Traffic Lanes: Multiple lanes including exclusive turning lanes (refer attached plan).
Pedestrian (or other vulnerable road user) Activity: Light to medium pedestrian activity some of which is associated with PTC bus services passing through the intersection.
Characteristics of Traffic (Control) Operation: Complex signal phasing operating to control traffic at both intersections. Carnarvon Street operates one way from south to north.

Treatment History: Numerous improvements made to signal hardware and phasing in 1985/86.
Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: Sign exists for the drivers of heavy vehicles turning right from the eastern approach, warning of adverse super-elevation for vehicles with a high centre of gravity.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 1 **Serious Injury** - 18 **Other Injury** - 32 **Total** - 51
Total Number of Heavy Vehicle Crashes: **Fatal** - 1 **Serious Injury** - 3 **Other Injury** - 5 **Total** - 9
Percentage of Heavy Vehicle to All Casualty Crashes: 17.7% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 3 **Rigid** - 2 **Bus** - 3

Predominant Heavy Vehicle Crash Types (DCA):

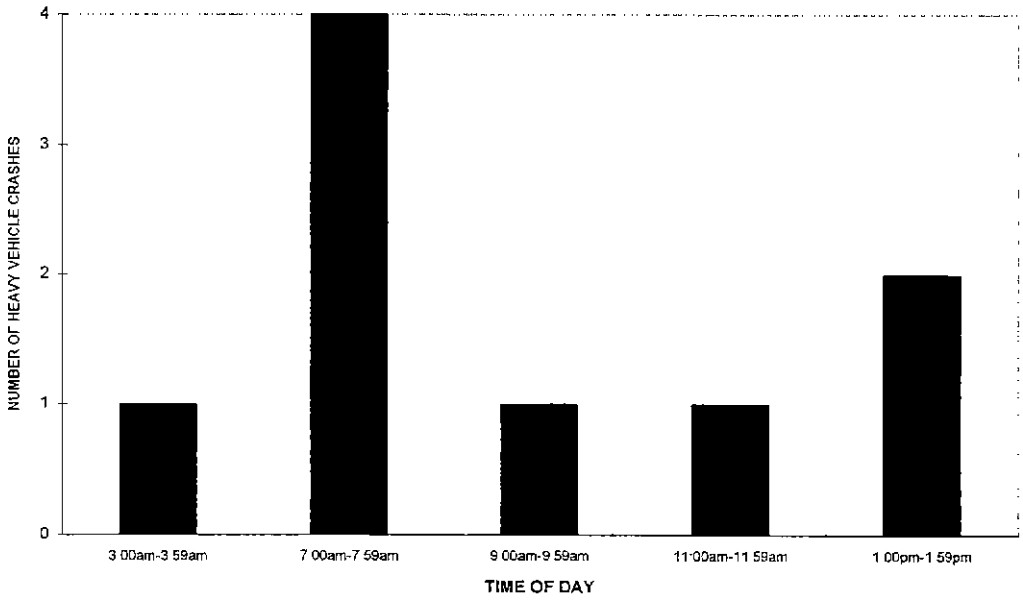


Predominant Heavy Vehicle Movements by DCA:

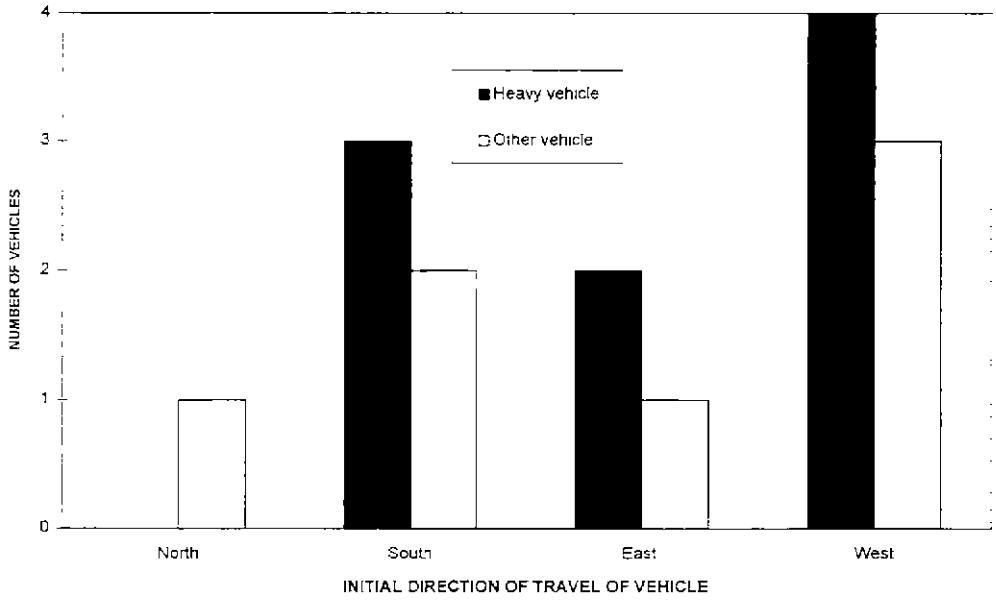
Rear End Type - 44%

Side Swipe - 22%

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
In general, crashes are not well defined either in terms of crash types or in spatial terms. A clear majority of crashes involved heavy vehicles on Doncaster Road.

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably - vehicle speeds on Doncaster Road tend to be high, given the requirement for heavy vehicles to stop (on a downhill gradient for west bound traffic) at the signals

Alignment/Topography:
Downhill gradient from east to west in Doncaster Road may have contributed to three or four of the crashes which have occurred on this approach. One crash involved a heavy vehicle failing to comply with the red signals and another involved an articulated vehicle turning right at too high a speed for the combination of downhill gradient and adverse super-elevation for a right turner.

Intersection Geometry (if applicable):
The nature of the left turn lane geometry on the north-east corner of the intersection tends to encourage high entry and exit speeds, while the generous width for a single lane turn encourages vehicles to negotiate the turn side by side.

Intersection Control (if applicable):
Yes. Intersections signals by their very nature contribute to the occurrence of rear-end type collisions.

Road Surface (friction and roughness): Unlikely, though reduced skid resistance due to high traffic volumes could be a factor in crashes in which vehicles have difficulty stopping for red signals.
Roadside Features/Hazards: No.
Land Use: No.
Traffic Operation: Traffic volumes tend to be high throughout the day, while intersection signal displays tend to be complex for drivers, especially when speeds are high.
Delineation: No.
Street lighting: No.
Sight Distance: No.
Road Divided/Undivided: No.
Lane Configuration (e.g. lane drop/merge, etc.): No.
Lane Provision for Turning: No.
Road works: No.
Shoulder Condition: No.
Other: No.

4. Conclusions

While crash patterns at this intersection are not well defined, the following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location.

Rear-end Crashes

- **high vehicle speeds and congested traffic conditions** on Doncaster Road:
- in two of the three rear-end crashes involving heavy vehicles on Doncaster Road, the heavy vehicle was struck from behind by another vehicle. In the other case, the heavy vehicle skidded on a **wet pavement** when braking in response to a red signal (rear-end collisions are characteristic of traffic signal crash patterns generally);
- **left turn slip lane geometry** of the type situated on the N-E corner may, because of its relatively long sweeping path, generous width for a single lane and low angle of intersection with conflicting through lanes, cause safety problems for left turners using them. Vehicle speeds tend to be high and detection of conflicting traffic is made more difficult by drivers having to look backwards as they approach the conflict area. **Brake failure** was cited as a possible factor in one instance, while in the other case both vehicles attempted to enter the lane side by side.

Other Crashes

Two other crashes, though of different types, are noteworthy because of their characteristics and/or their severe consequences:

- one crash (fatal) involved the driver of a heavy vehicle **failing to comply with the red signals**. Signal displays appear adequate, as do the inter-green/all-red periods. The downhill gradient on the west bound approach to the intersection may have been a factor in this crash;
- another crash involved a right turning articulated vehicle whose speed was excessive for the **combination of downhill gradient and adverse super-elevation** for a right turner. Advisory warning signs for the drivers of heavy vehicles are already in place.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Rear-end Crashes

- improve the skid resistance of pavements on the Doncaster Road approaches which carry the higher volumes and speeds of heavy vehicles;
- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise;
- modify the geometry of the left turn slip lane situated on the N-E corner to reduce vehicle speeds, improve lane discipline and assist left-turning drivers looking to the right as they approach the conflict area. This could be achieved by reducing the width of the lane and by "squaring up" the angle of intersection with the conflicting through lanes in Doncaster Road;
- a reduction in the speed limit from 70 to 60 km/h, together with appropriate enforcement, would improve safety generally and reduce the risk and severity of rear-end crashes.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Doncaster Road/ Williamsons Road, City of Doncaster and Tempelstowe (LGA = 17)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
Q88012292	9-Mar-88	1308	Wednesday	Fell from Vehicle	Serious Injury	E / /	8/ ./ .	60	DAY	Clear	Dry
Q89014258	16-Jan-89	330	Monday	Rear End	Other Injury	W /W /	1/ 7/ .	60	DARK	Unknown	Dry
Q89023326	8-May-89	1355	Monday	Left Side Swipe	Other Injury	S /S /	6/10/ .	60	DAY	Clear	Dry
G90012880	5-Apr-90	1135	Thursday	Right Rear	Serious Injury	W /W /	1/ 6/ .	60	DAY	Clear	Dry
G90020835	7-May-90	735	Monday	Left Rear	Other Injury	S /S /	8/ 1/ .	60	DAY	Clear	Dry
G92006800	22-Feb-92	720	Saturday	Out of Control	Serious Injury	S / /	6/ ./ .	60	DAY	Clear	Dry
G93005023	5-Feb-93	700	Friday	Cross Traffic	Fatality	W /N /N	6/02/01	60	DAY	Clear	Dry
G90029715	10-Aug-90	910	Friday	Rear End	Other Injury	E /E /	1/ 7/ .	60	DAY	Raining	Wet
G93002814	18-Jan-93	720	Monday	Lane Side Swipe	Other Injury	W /W /	8/13/ .	60	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 10
Prepared 11/5/94

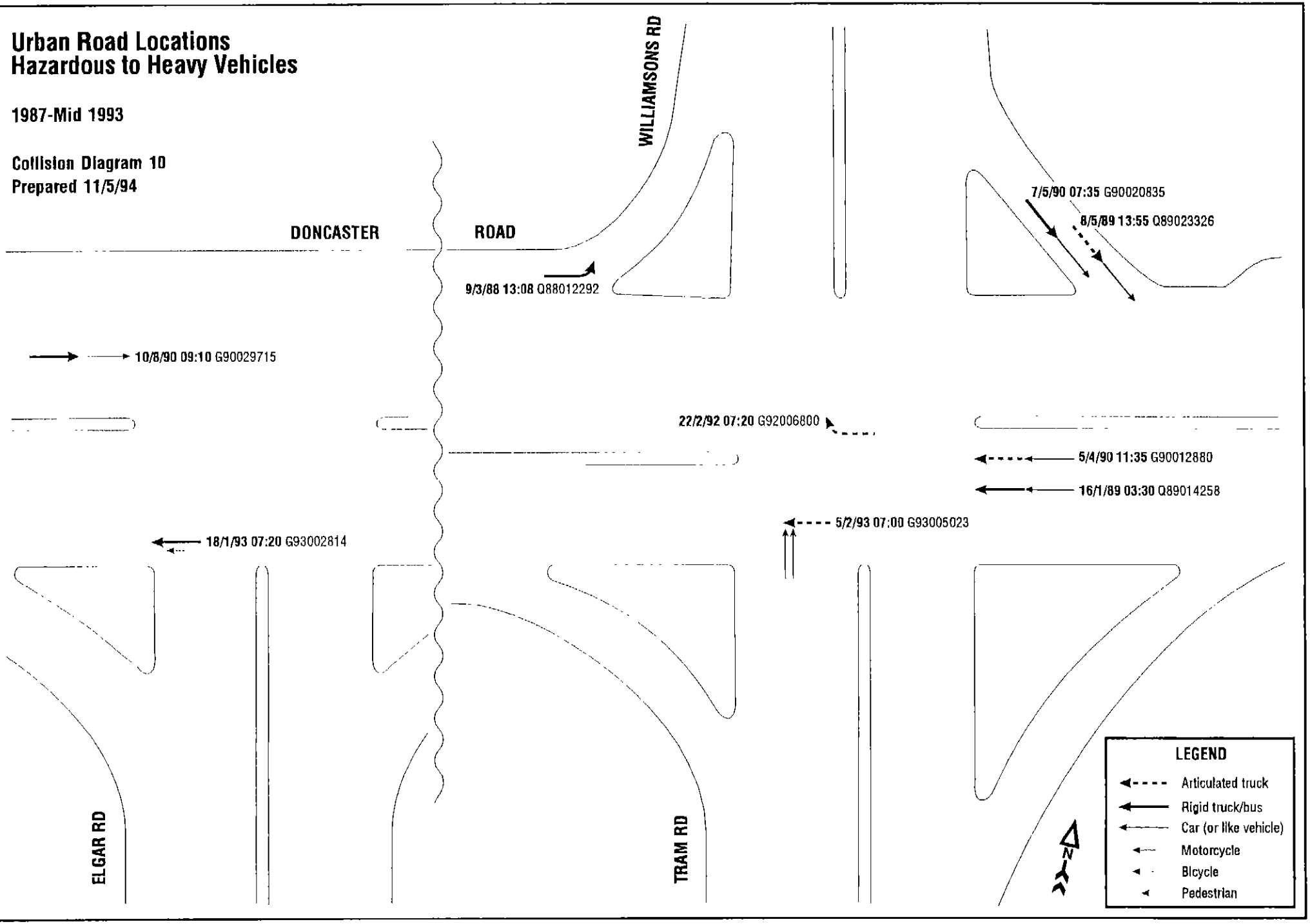


PHOTO 1 OF 6 - FACING WEST AT ELGAR ROAD

PHOTO 2 OF 6 - FACING WEST AT TRAM ROAD

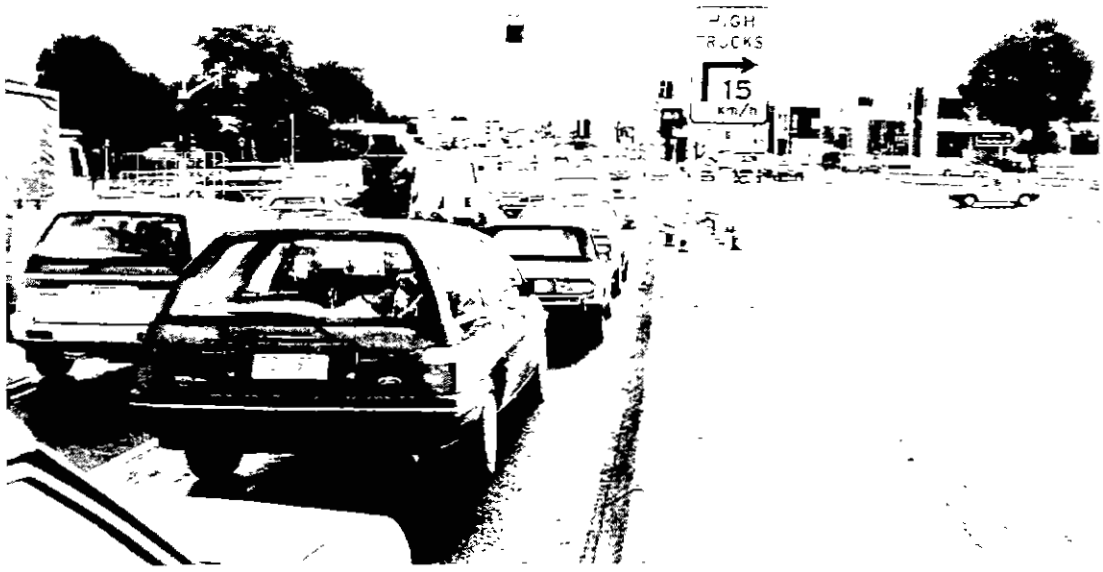


PHOTO 3 OF 6 - FACING WEST AT TRAM ROAD

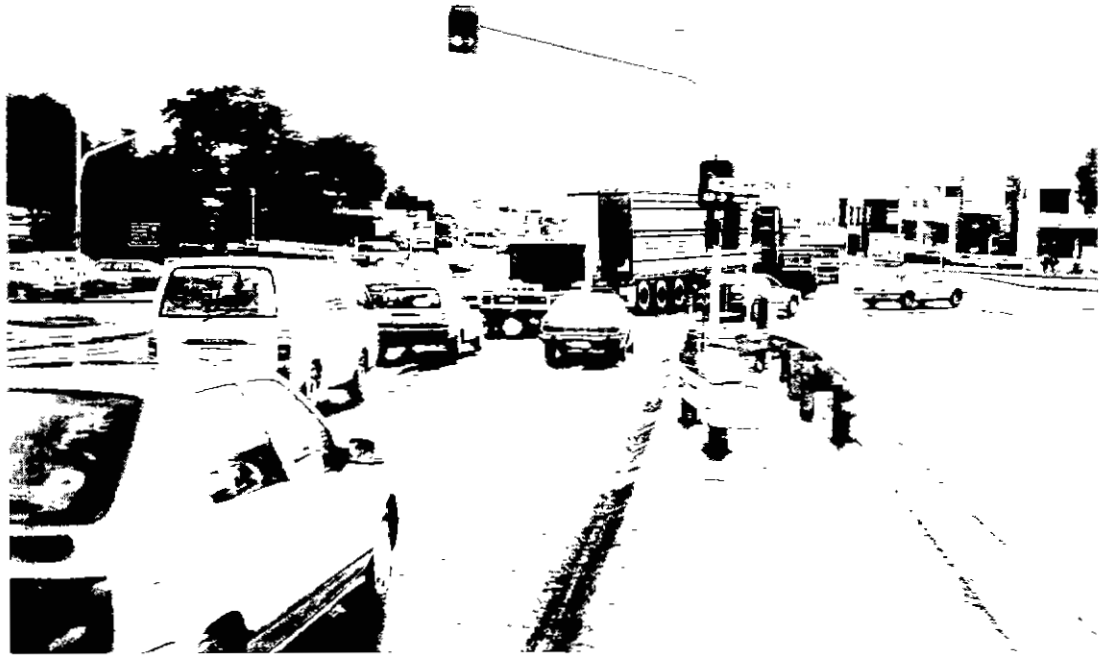


PHOTO 4 OF 6 - FACING WEST AT TRAM ROAD

PHOTO 5 OF 6 - FACING EAST AT TRAM ROAD

PHOTO 6 OF 6 - FACING SOUTH (LEFT TURN SLIP LANE)

CONTROLLER OPERATIONS SHEETS - C PERSONALITY

REPROGRAM

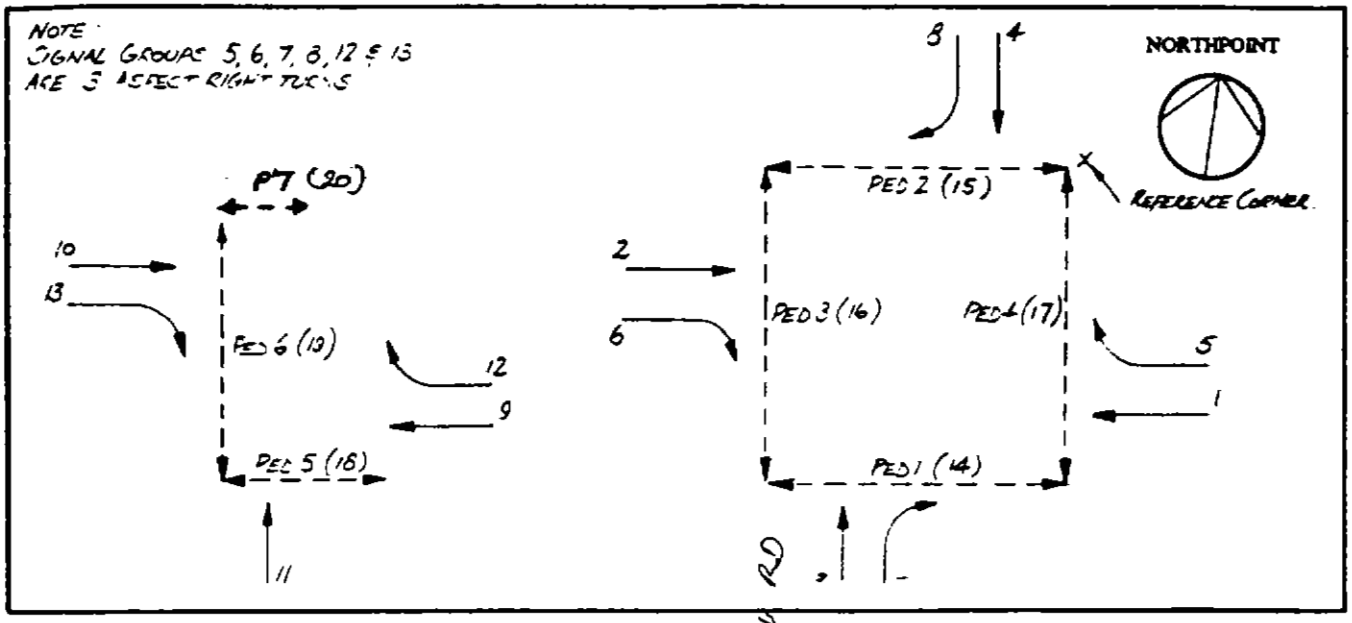
INTERSECTION DONCASTER ROAD / WILLIAMSONS ROAD / TRAM ROAD / ELGAR ROAD No 325

MUNICIPALITY CITY OF DONCASTER & TEMPLESTOWE DESIGNER ANDREW RASOLO DATE 31/5/94

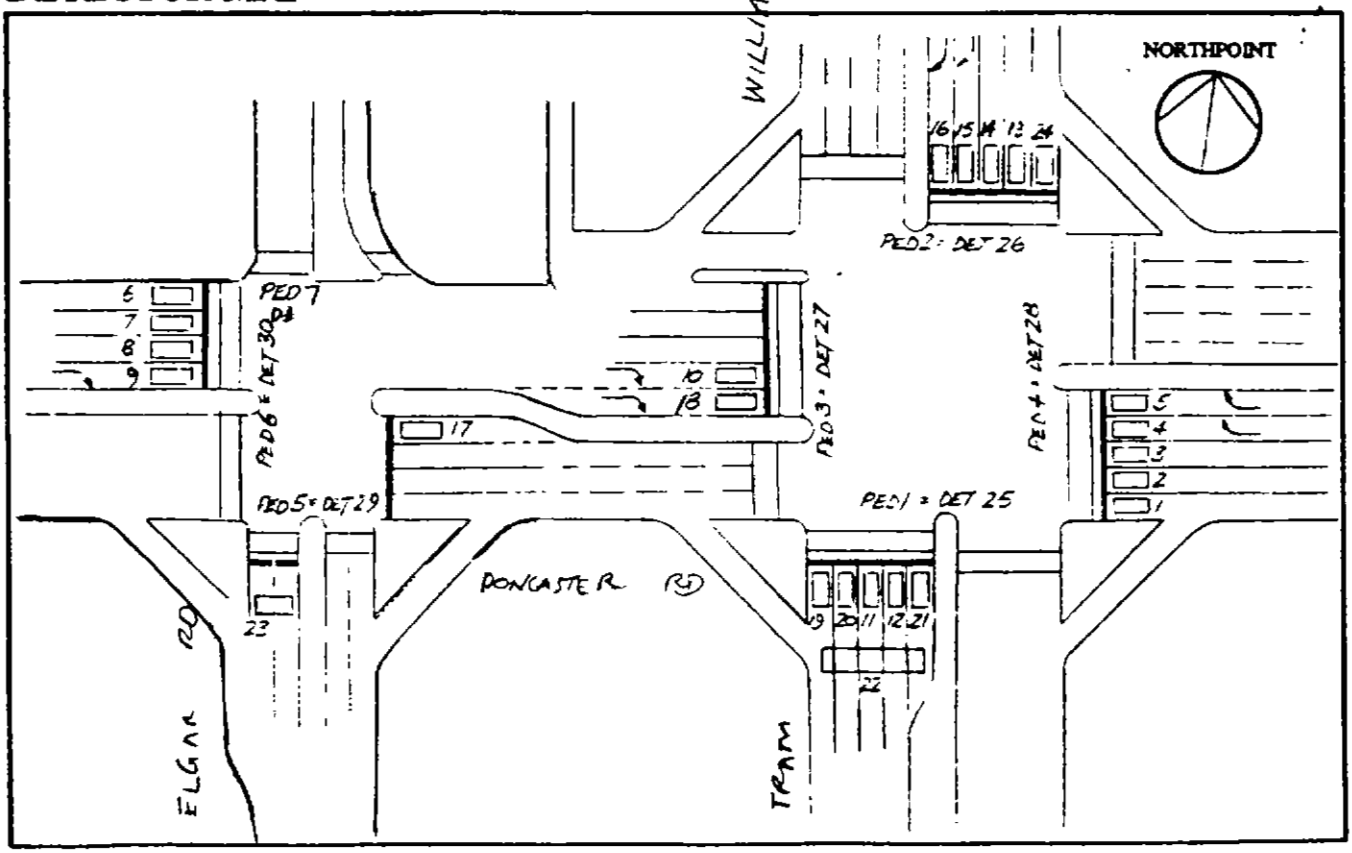
CONTROLLER CAPACITY 24 GROUPS DESIGN CHECKED DATE 7-6-94

PLAN No 850404, 850435 PROGRAM CHECKED DATE 15-6-94

GROUP ALLOCATION

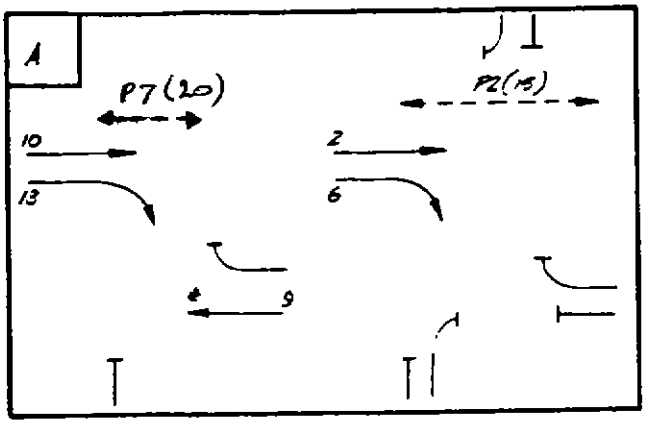


DETECTOR MAP



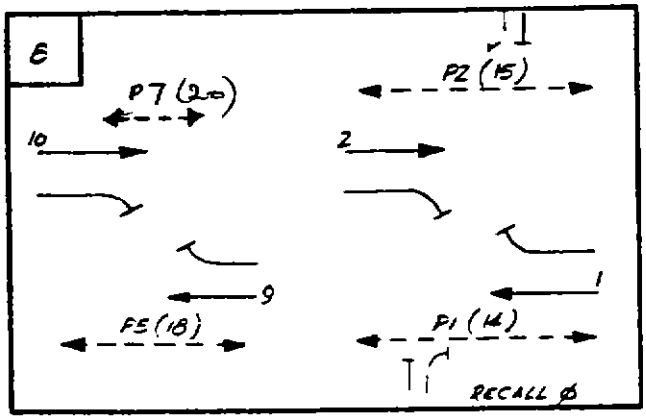
PHASING DIAGRAM

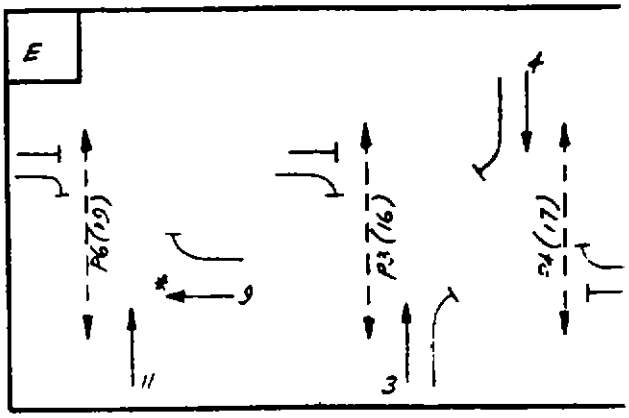
INTERSECTION: DONCASTER ROAD / WILLIAMSONS ROAD / TEAM ROAD / ELGAR ROAD No: 325

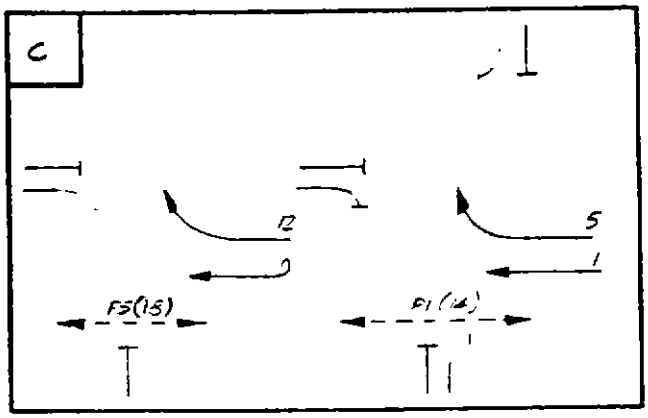


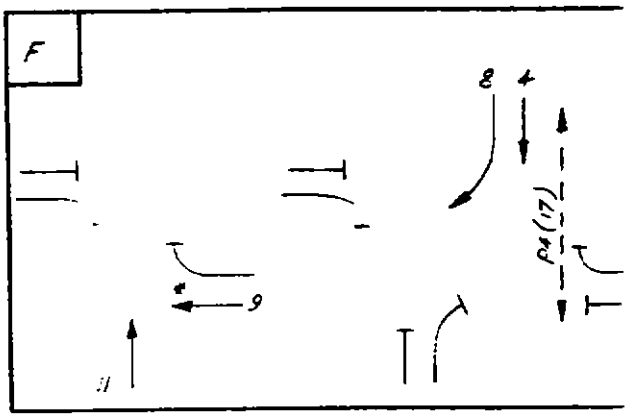
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION

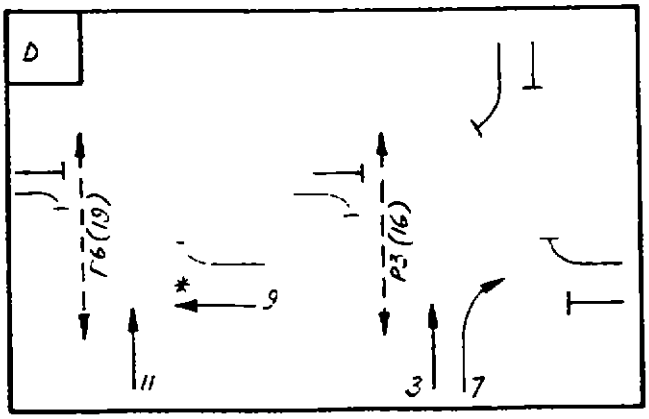
NORTHPOINT









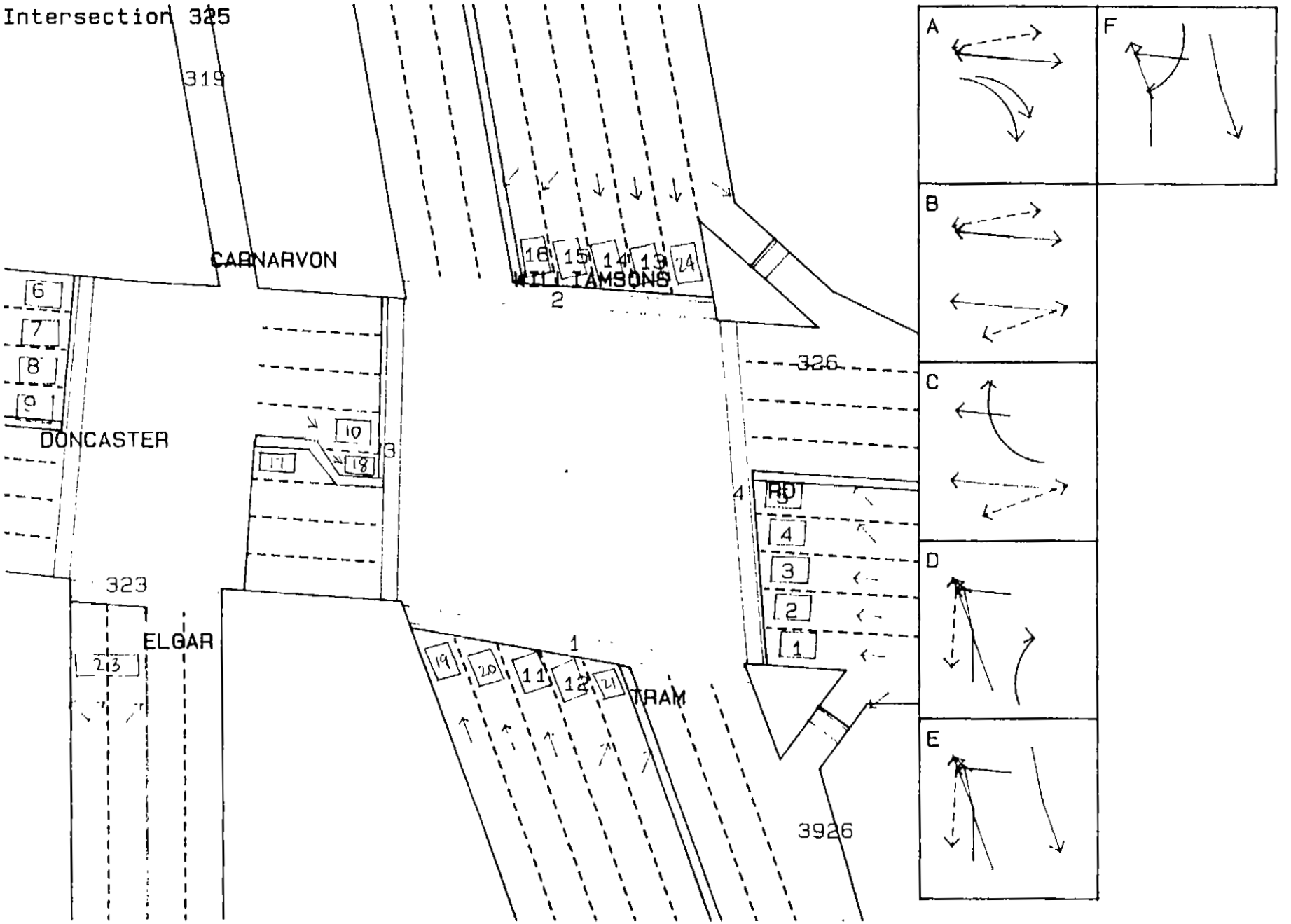


V.A. SEQUENCE: A E C D E F

31/5/94

DESIGNED: CHRIS McNALLY

DATE:


Intersection 325
319
CARNARVON
DONCASTER
323
ELGAR
WILLIAMSONS
2
326
RD
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3
1
TRAM
3926
A
B
C
D
E
F

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Geelong Road/Roberts Street/Somerville Road, Footscray West

Case No: M11

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 17 June, 1994 **Case No:** M11

1. Location Details

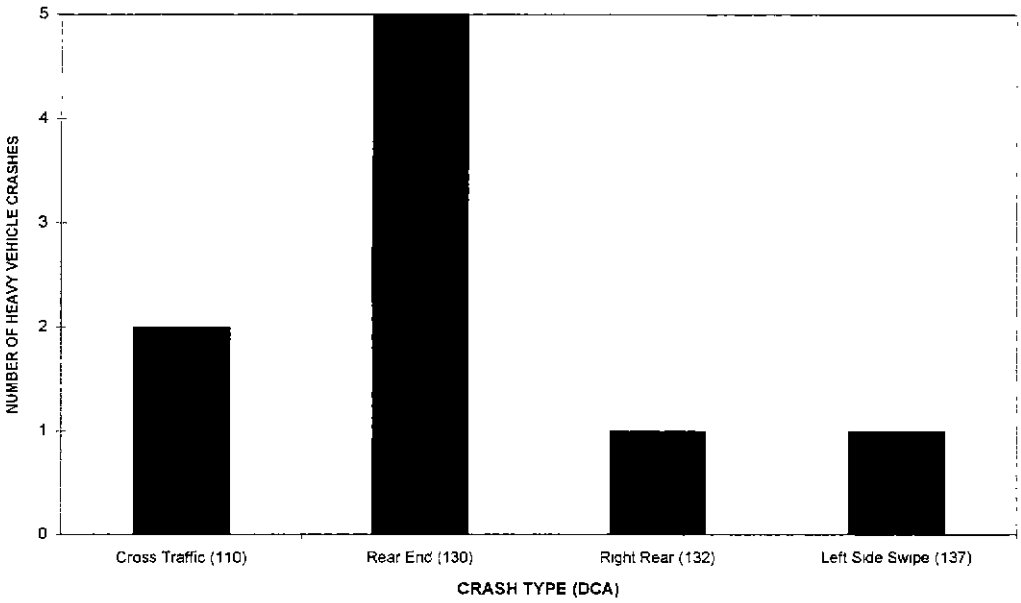
Street Names: Geelong Road/Roberts Street/Somerville Road.
Suburb and Local Government Area: Footscray West, City of Footscray.
Melway Map Reference: 41G7
Road Functional Classification: Geelong Road: primary arterial road, Roberts Street: local crossing road; Somerville Road: secondary arterial road.
Alignment/Topography: Gently curved approach along Geelong Road, gentle downhill slope from south-west and north-east rising near stop line.
Intersection Geometry (if applicable): Complex, multi-leg (6), fully channelised.
Traffic Control Type: Multi-phase intersection signals (refer plan for layout)
Surrounding Land Use: Commercial/parkland/residential.
Designated Heavy Vehicle Route: Princes Highway West linking Melbourne with Geelong, Warrnambool, Portland and South Australia.
Speed Zone: Geelong Road: 80 km/h; Others: 60 km/h.
Number of Traffic Lanes: Multi-lane (refer attached plan)
Pedestrian (or other vulnerable road user) Activity: Light-medium. Bus stops nearby.
Characteristics of Traffic (Control) Operation: Generally high approach speeds on Geelong Road. High proportion of heavy vehicles in traffic stream.

Treatment History: No significant changes since prior to 1987.
Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: No right turn permitted for movement from Geelong Road into Roberts Street to head north-west.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 1 **Serious Injury** - 8 **Other Injury** - 26 **Total** - 35
Total Number of Heavy Vehicle Crashes: **Fatal** - 1 **Serious Injury** - 2 **Other Injury** - 6 **Total** - 9
Percentage of Heavy Vehicle to All Casualty Crashes: 25.7% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 9 **Rigid** - 3 **Bus** - 0

Predominant Heavy Vehicle Crash Patterns (DCA):

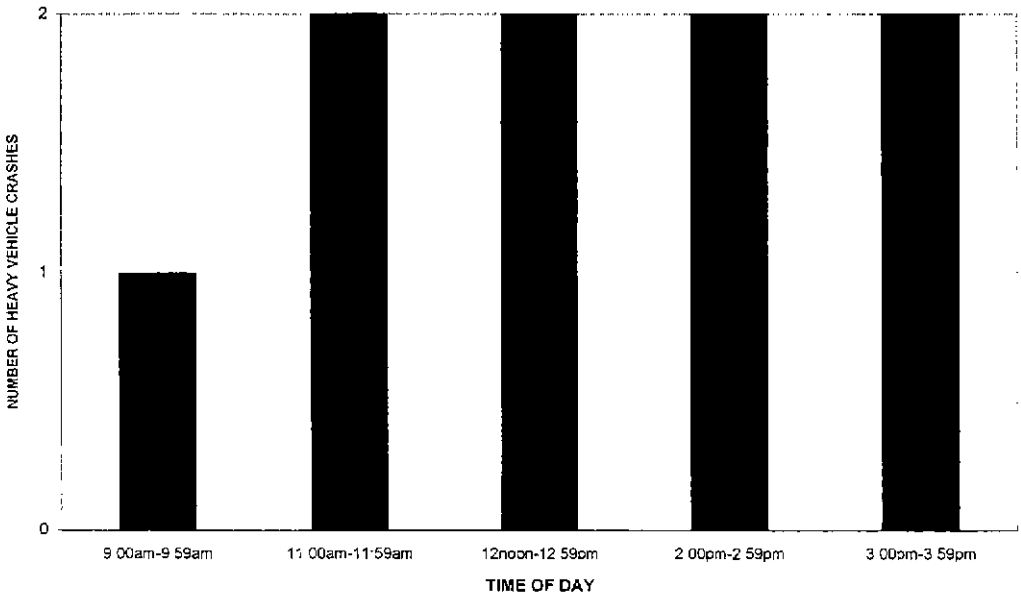


Predominant Heavy Vehicle Movements by DCA:

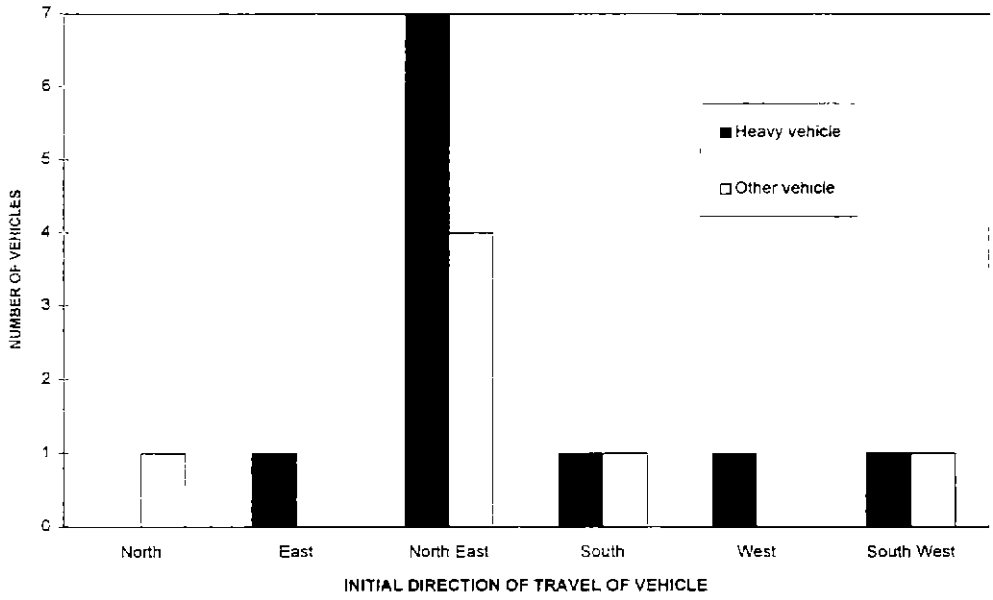
Rear-End Type - 67%

Cross-Traffic - 22%

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:
Yes

Other Patterns/Comments:
All crashes involve heavy vehicles travelling along Geelong Road, heading either north-east (seven) or south-west (four) before the crash occurred

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably - 80 km/h may be excessively high for safe heavy vehicle operation at traffic signals. Note that 64% of heavy vehicles involved have come from a direction of higher speed zones and 36% from a direction of lower speed zones. Many Melbourne-bound drivers will not have encountered more than four or five sets of intersection signals since entering the Metropolitan area.

Alignment/Topography:
The generally downhill slopes on both Geelong Road approaches to the intersection may add to the difficulty heavy vehicles experience in stopping at red/changing traffic signals

Intersection Geometry (if applicable):
Unlikely.

Intersection Control (if applicable):
Rear-end type and cross-traffic crashes are characteristic of intersection signals. All six rear-end type crashes involved heavy vehicles striking the rear of other vehicles. Police reports indicate that the struck vehicle was always stationary at red or changing signals when struck. Given the high numbers of heavy vehicles in the traffic stream, which obscure signal lanterns from other drivers, signal displays on the north-east approach are considered inadequate (i.e. there are no mast arms).

In both cross-traffic crashes the heavy vehicle was reported by Police to have run a red signal. This may be related to the clearance phase which requires Melbourne bound traffic to stop at the Somerville Road stop line, while a green signal continues to be displayed to clear the section between Somerville Road and Roberts Street. The immediate incentive to clear both stop lines and thereby avoid delays may encourage drivers (of heavy vehicles in particular) to run the red signal at both stop lines. This situation is a possible contributing factor in Melbourne bound rear-end crashes.

Road Surface (friction and roughness):
Possibly - the pavement on Geelong Road is generally well worn due to the high volumes of heavy vehicles. This may result in significantly lower skid resistance and therefore greater difficulty for the drivers of heavy vehicles braking as they approach red or changing signals.

Roadside Features/Hazards:
No.

Land Use:
No.

Traffic Operation:
Refer Intersection Control above.

Delineation:
Unlikely.

Street lighting:
No.

Sight Distance:
Possible problems in viewing signal displays may be caused by obstruction by other heavy vehicles.

Road Divided/Undivided:
No - divided all round.

Lane Configuration (e.g. lane drop/merge, etc.):
No.

Lane Provision for Turning:
No.

Road works:
No.

Shoulder Condition:
Not applicable.

Other:
No.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Rear-End Type Crashes

There is an **inherent risk of rear-end collisions at traffic signals**, given the need for vehicles to stop for red signals (i.e. an unavoidable characteristic of traffic signal operation) **Heavy vehicles** appear to have a **particular propensity to be the striking vehicle** in such collisions.

This is the case in each of the six rear-end crashes at this intersection whereby the drivers of heavy vehicles were unable to stop in time to avoid colliding with stationary or near-stationary vehicles.

Possible contributing factors are:

- the **relatively high speeds** of heavy vehicles for safe traffic signals operation;
- the **inferior braking performance** of heavy vehicles compared to lighter vehicles;
- **poor skid resistance** of the highly trafficked pavement;
- **minimum standard signal displays** on the north-east approach;
- the effects of the **downhill approach gradients** on Geelong Road on the braking performance of heavy vehicles (in combination with other factors), and/or
- **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display (i.e. the driver of the front (lighter) vehicle decides to stop while the driver of the rear (heavy) vehicle decides to proceed through the intersection as the signals change from green to red).

Cross-Traffic Crashes

In both cross-traffic crashes the heavy vehicle was reported by Police to have run a red signal. Possible contributing factors are:

- a tangible and immediate time saving incentive, to "**run the red**" **signal.** This may be related to the **clearance phase** which requires Melbourne bound traffic to stop at the Somerville Road stop line, while a green signal continues to be displayed at the nearby Roberts Street stop line to enable traffic not stopped by this red signal at Somerville Road to clear the section of Geelong Road between Somerville Road and Roberts Street (this situation might also be a contributing factor to Melbourne bound rear-end crashes), and/or
- other factors related to **heavy vehicle braking performance,** as listed above.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Rear-End Type Crashes

- improve the skid resistance of pavements on the Geelong Road approaches which carry the higher volumes and speeds of heavy vehicles;
- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise;
- reduce the speed limit from 80 to 70 km/h, together with appropriate enforcement, to improve safety generally and reduce the risk and severity of rear-end crashes;
- upgrade the standard of traffic signal displays on the north-east approach by erecting mast arms to reduce problems caused by larger heavy vehicles themselves obscuring signal displays and to generally improve signal visibility and conspicuity.

Cross-Traffic Crashes

- increase the all-red periods to address the higher likelihood of Melbourne bound vehicles attempting to clear the Roberts Street stop line at the end of the Geelong Road green phase. This will better provide for the dimensions, characteristics and the high proportion of heavy vehicles using the intersection.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Geelong Road/ Somerville Road, City of Footscray (LGA = 22)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
M88023025	14-Jun-88	925	Tuesday	Cross Traffic	Serious Injury	N /E /	1/ 6/ .	75	DAY	Clear	Dry
M89033107	2-Aug-89	1400	Wednesday	Rear End	Other Injury	NE/NE/NE	6/07/01	75	DAY	Clear	Dry
M89045985	13-Oct-89	1115	Friday	Rear End	Serious Injury	NE/NE/NE	6/01/05	60	DAY	Clear	Dry
J91025178	18-Jul-91	1230	Thursday	Left Side Swipe	Other Injury	NE/NE/	1/ 6/ .	75	DAY	Unknown	Unknown
J91035994	22-Oct-91	1130	Tuesday	Right Rear	Other Injury	NE/NE/	7/ 2/ .	60	DAY	Clear	Dry
M88030645	8-Aug-88	1428	Monday	Rear End	Other Injury	SW/SW/	5/ 6/ .	75	DAY	Raining	Wet
J91006993	25-Feb-91	1221	Monday	Cross Traffic	Fatality	W /NE/E	6/06/01	75	DAY	Clear	Dry
J91012571	15-Mar-91	1530	Friday	Rear End	Other Injury	S /S /S	7/02/06	75	DAY	Clear	Dry
J91011419	20-Mar-91	1545	Wednesday	Rear End	Other Injury	NE/NE/NE	6/04/01	75	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar; 6 - Articulated Truck; 7 - Rigid Truck; 8 - Bus/Coach; 10 - Motorcycle; 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 11
Prepared 11/5/94

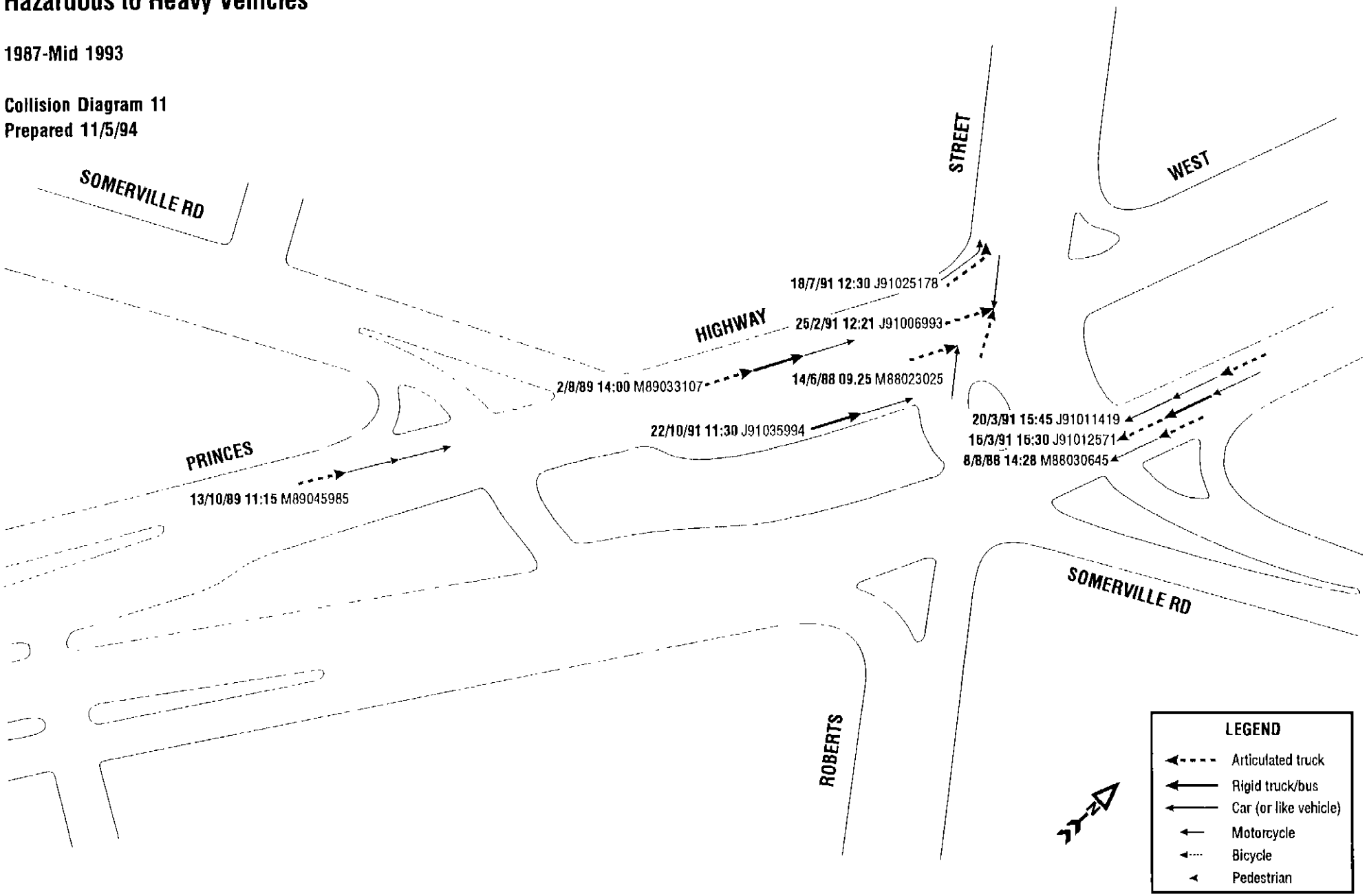


PHOTO 1 OF 4 - FACING SOUTH WEST

PHOTO 2 OF 4 - FACING NORTH EAST AT SOMERVILLE ROAD

PHOTO 3 OF 4 - FACING NORTH EAST AT SOMERVILLE ROAD

PHOTO 4 OF 4 - FACING NORTH EAST AT ROBERTS STREET

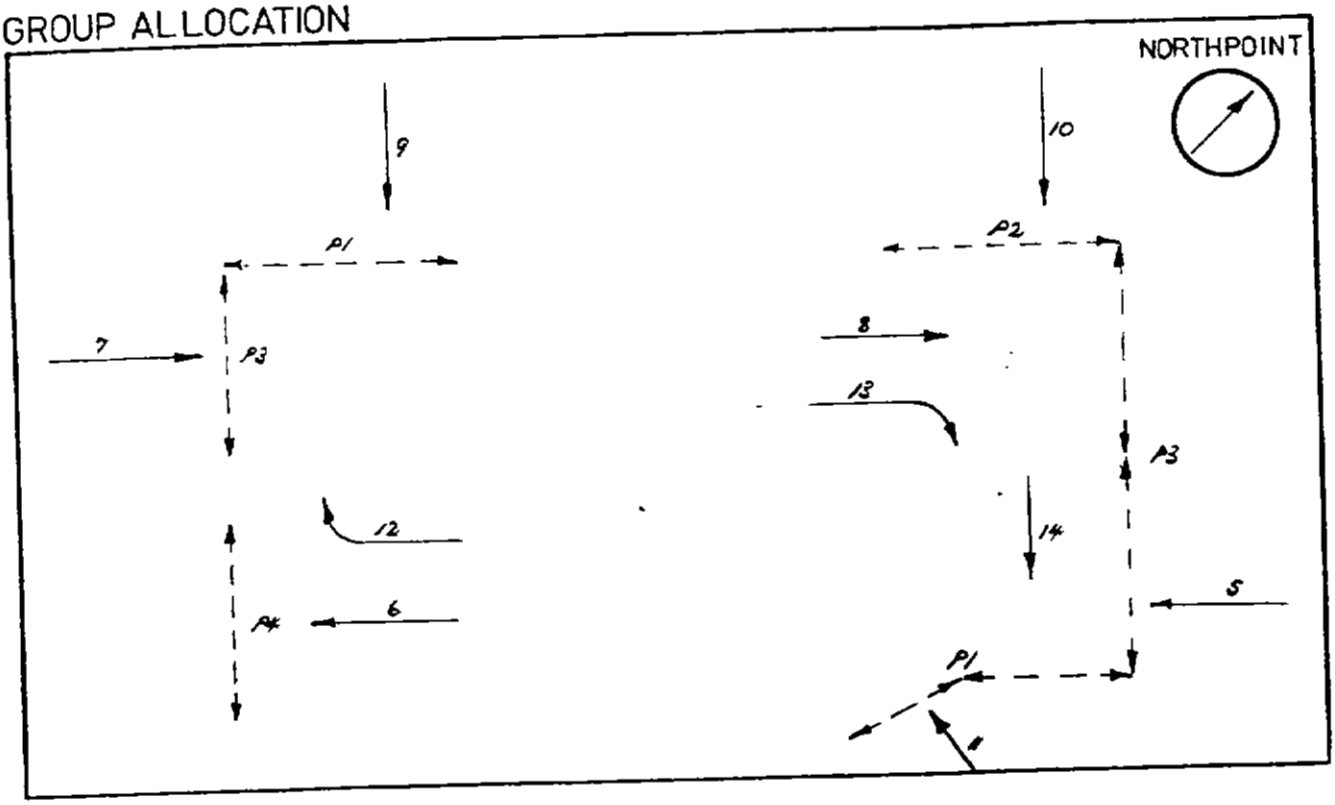
INTERSECTION: PHN / Moorerville Rd / Roberts St No 2508

MUNICIPALITY: Footscray DESIGNER: O. Znaniecki DATE: 18/3/85

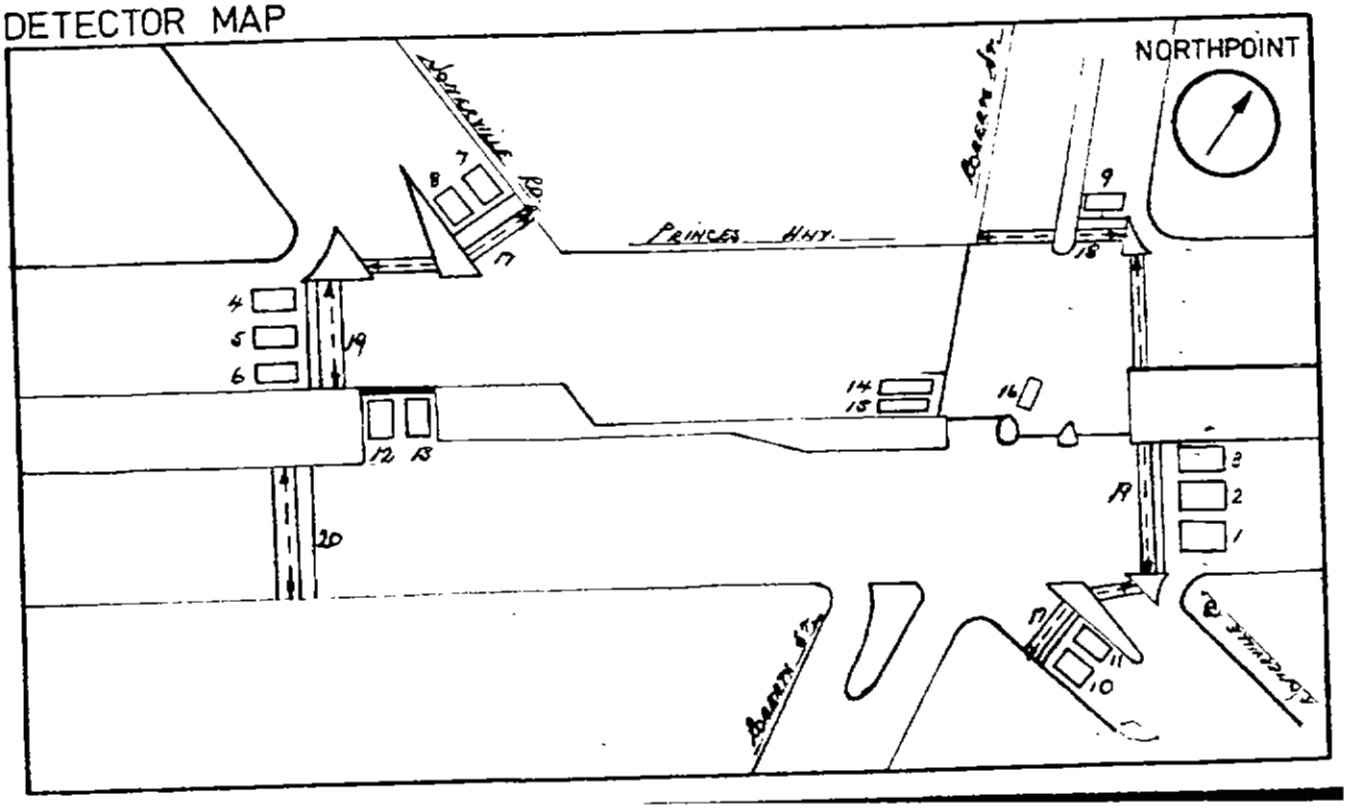
CONTROLLER: Phillips PTC VTM SECTION LEADER: D. Noll DATE: 29-3-85

PLAN No. 299081 PROGRAM CHECKED: DG Zahayeh DATE: 3/4/85

GROUP ALLOCATION



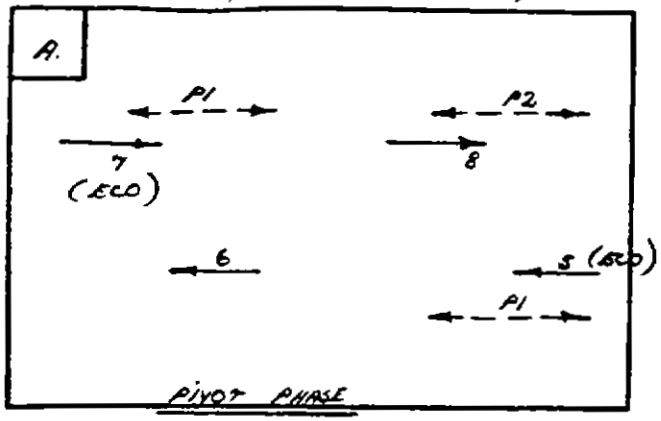
DETECTOR MAP



PHASING DIAGRAM

INTERSECTION PHN / SOMERVILLE RD. / ROBERTS ST. NO 2508.

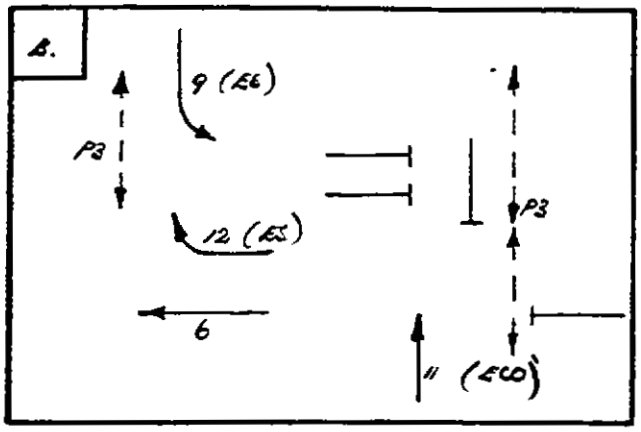
A.



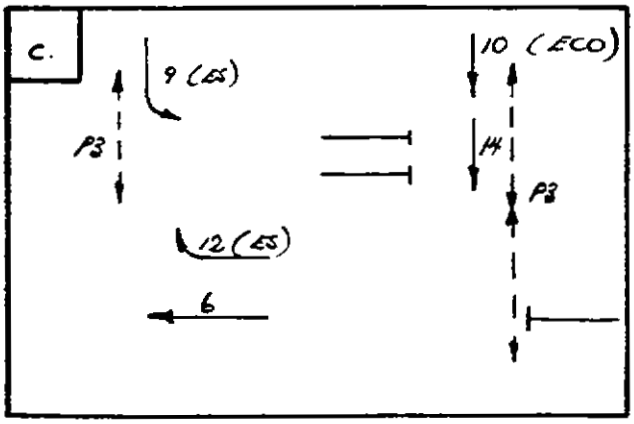
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G ON REVERSION
A			
B			
C			
D			
E			
F			
G			

NORTHPOINT

B.



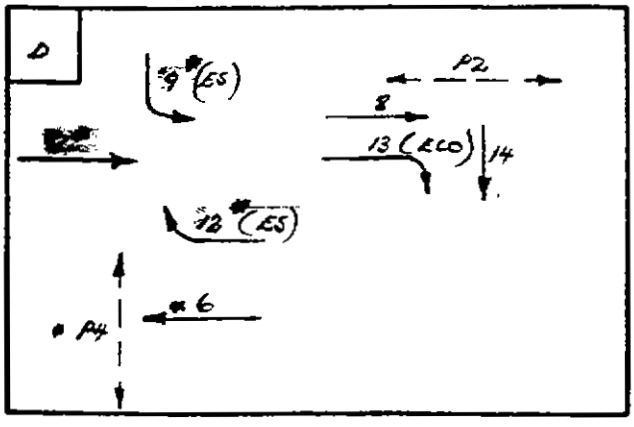
C.



AØ :- ECO ON AG 5 ONLY IF TO AØ AND P4 CHANGED. IF FROM AØ TO BØ OR AØ TO CØ, AG5 STAYS GREEN THROUGH ECO.

BØ :- AG 11 STAYS GREEN THROUGH ECO IF FROM BØ TO CØ.

D



* AG 6 GOES TO GREEN 3 SECS AFTER PED. & CLEARANCE

* IF GOING TO AØ FROM BØ OR CØ, AND AG 9 + AG 12 HAVE GAPPED, INTRO. GROUP 7 IN AØ INSTEAD OF EXTENDING GROUPS 9 + 12.

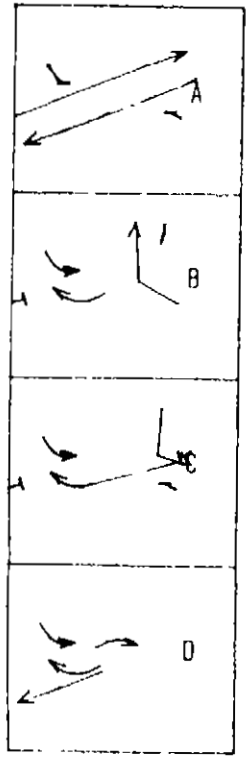
* IF GROUPS 9 + 12 GAPPED OUT IN AØ, INTRO. GROUP 7 + CLOSE GROUPS 9 + 12.

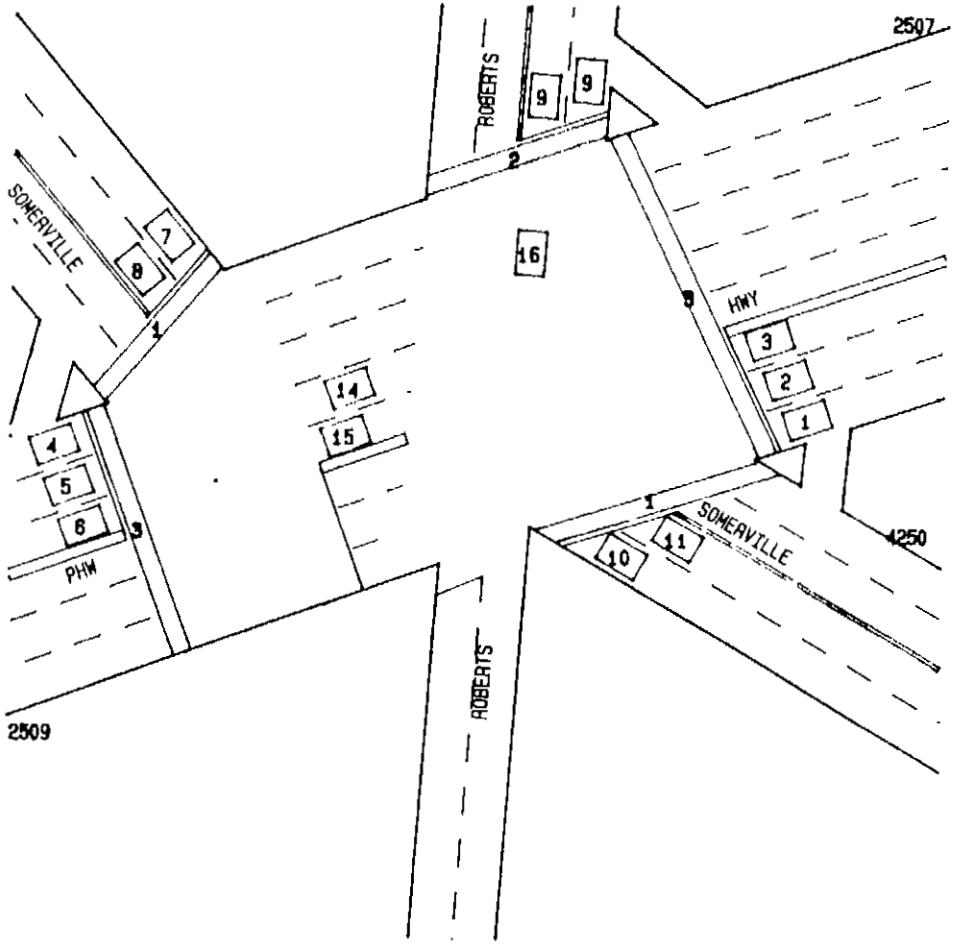
V.A SEQUENCE. ABCD.

Designed D.Z

SUBURB - FOO UBD REFERENCE - 041G07
CONTROLLER TYPE - PTF DIVISION - A
CONNECTED TO REGIONAL COMPUTER - FTS

4 PHASES





5-MAY-1986

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Napier Street/Whitehall Street, Footscray

Case No: M12

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 17 June 1994 **Case No: M12**

1. Location Details

Street Names: Napier Street/Whitehall Street.
Suburb and Local Government Area: Footscray. City of Footscray.
Melway Map Reference: 42 D6
Road Functional Classification: Napier Street: primary arterial road, Whitehall Street: secondary arterial road.
Alignment/Topography: Straight approaches, with downhill gradients on all approaches except the east approach which has a slight uphill gradient to the intersection.
Intersection Geometry (if applicable): Cross intersection.
Traffic Control Type: Intersection signals with fully controlled right turn phases on north and south approaches. and partially controlled right-turn phases for the east and west approaches.
Surrounding Land Use: Commercial/residential/hotel.
Designated Heavy Vehicle Route: Yes - Napier Street links Melbourne's dock area with the Princes Highway West. Both are "Over Dimensional" Vehicle Routes.
Speed Zone: Napier Street: 70 km/h; Whitehall Street: 60 km/h
Number of Traffic Lanes: Refer plan.
Pedestrian (or other vulnerable road user) Activity: Light.
Characteristics of Traffic (Control) Operation: Continuous, concentrated flows of large, heavy vehicles within the traffic stream. Turning movements by heavy vehicles are common.

Treatment History:
In April 1993, fully controlled right-turn phases were installed on the north and south approaches, and partially controlled right-turn phases on the east and west approaches.

Location Plan Attached:
Yes.

Photographs Attached:
Yes.

2. Crash Details

Period of Crash Analysis:
1987 to mid-1993

Total Number of Crashes:
Fatal - 1
Serious Injury - 8
Other Injury - 18
Total - 27

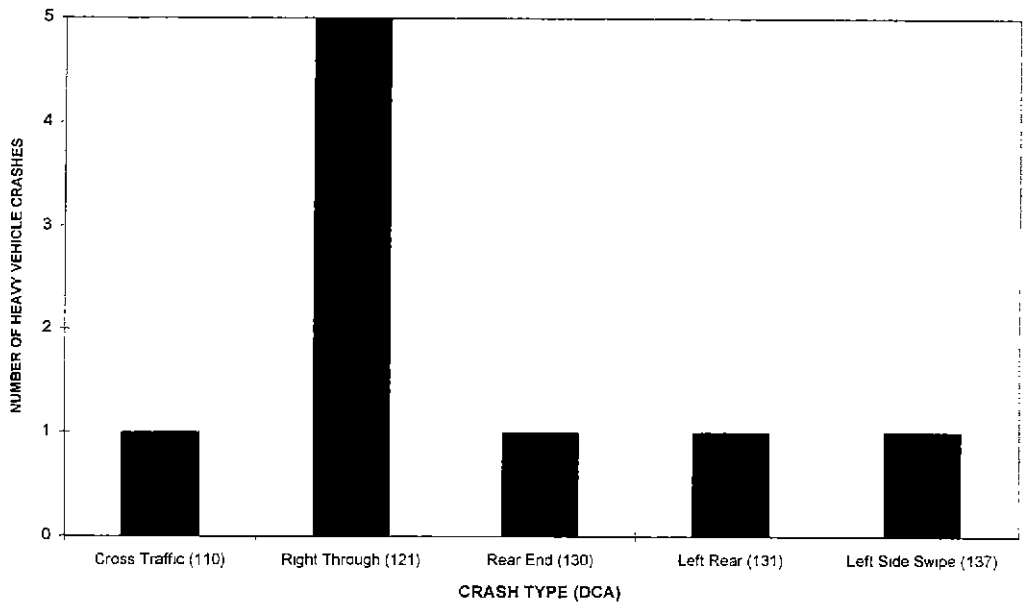
Total Number of Heavy Vehicle Crashes:
Fatal - 0
Serious Injury - 1
Other Injury - 8
Total - 9

Percentage of Heavy Vehicle to All Casualty Crashes: 33.3%

Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections: 8.3%

Number of Crashes by Heavy Vehicle Type:
Articulated - 6
Rigid - 3
Bus - 0

Predominant Heavy Vehicle Crash Types (DCA):

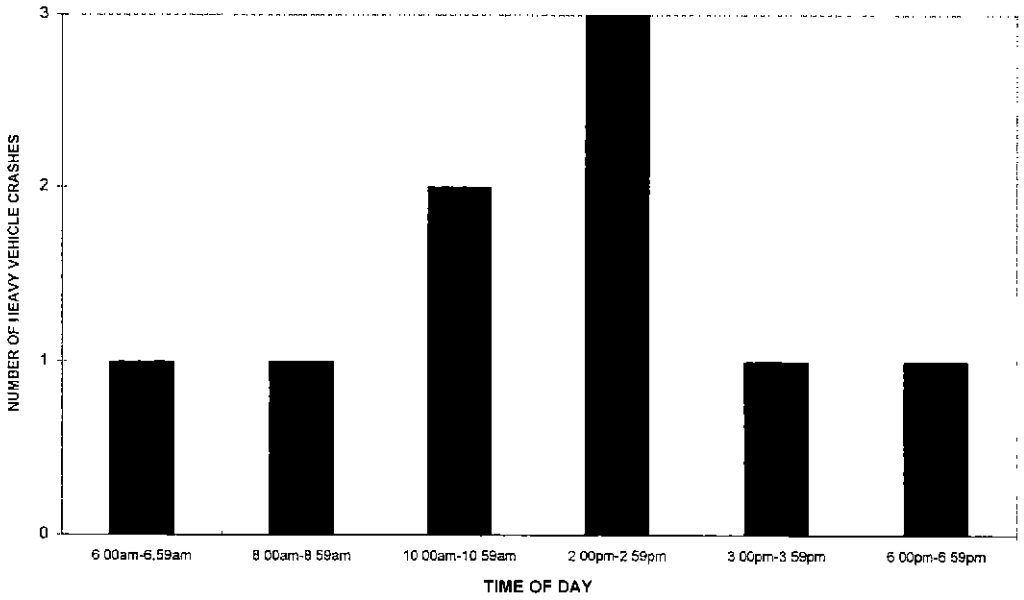


Predominant Heavy Vehicle Movements by DCA:

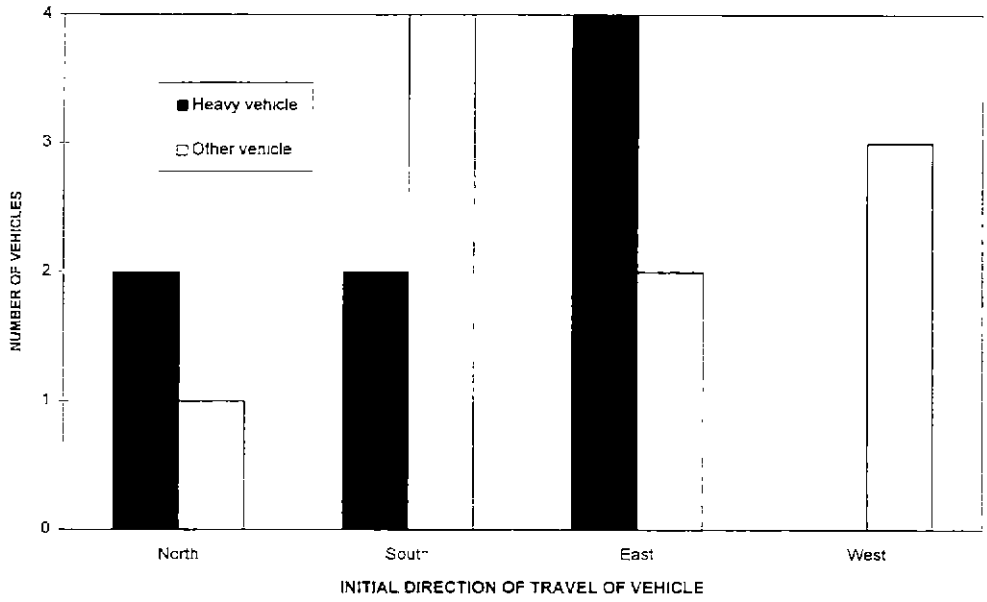
Right-Through - 56%

Rear-End Type - 22%

Time of Day Crash Patterns:



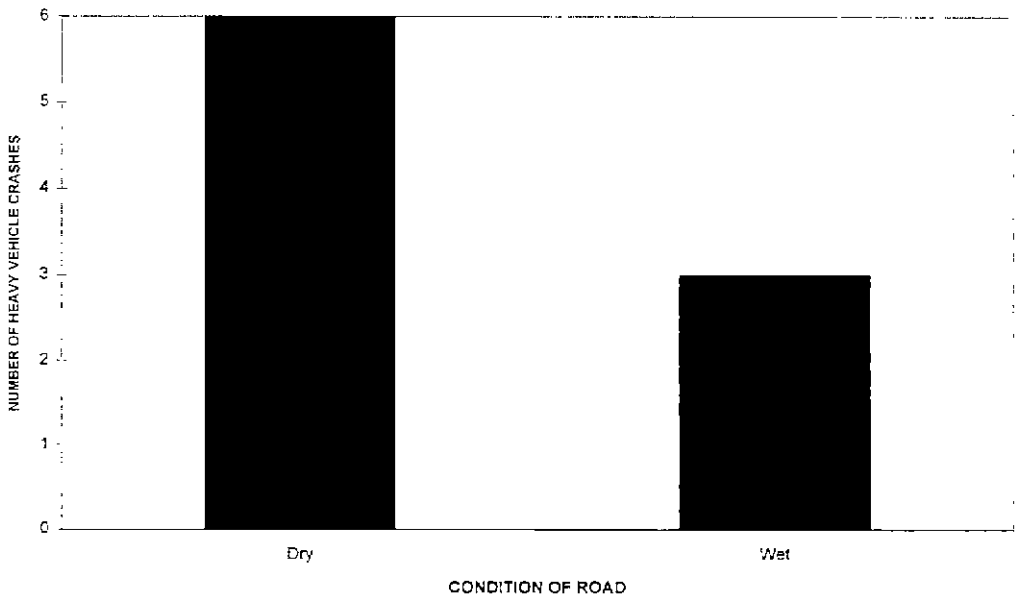
Initial Direction of Travel of Vehicle Crash Patterns



Collision Diagram Attached:
Yes.

Other Patterns/Comments:

CONDITION OF ROAD CRASH PATTERNS



3. Road Environment Factors Contributing to Crash Occurrence

Speed: Unlikely to be a significant factor in this instance.
Alignment/Topography: Probably - heavy vehicles are more difficult to stop on downhill gradients, which may contribute to the occurrence of rear-end and right-through crashes.
Intersection Geometry (if applicable): Unlikely.
Intersection Control (if applicable): Yes - right-through and rear-end type crashes are both characteristic of intersection signals. Crashes involving Napier Street right-turns are unlikely to be significantly assisted by partially controlled right-turn phases.
Road Surface (friction and roughness): Probably - the pavement condition is generally worn, due to the very high volumes of heavy vehicle usage. Skidding is mentioned in the Police reports of some crashes.
Roadside Features/Hazards: Unlikely.
Land Use: Unlikely.
Traffic Operation: Partially controlled right turn phases are not adequate in addressing known right-through crash problems.
Delineation: Unlikely.
Street lighting: Unlikely.
Sight Distance: Yes - sight distance restrictions due to opposing right-turners, especially when they are large vehicles, contributes to the risk of right-through crashes when filter turns are possible.
Road Divided/Undivided: Unlikely - both roads are fully divided.
Lane Configuration (e.g. lane drop/merge, etc.): Unlikely.
Lane Provision for Turning: Unlikely.
Road works: Unlikely.

Shoulder Condition: Unlikely.
Other: No.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Right-Through Crashes

- drivers of heavy vehicles (and of other vehicles) experiencing **difficulty in selecting safe gaps in opposing traffic flows** under partial right turn phase control. **Other heavy vehicles may be obscuring the view of opposing traffic** from the drivers of heavy vehicles or from drivers generally;

- **the additional clearance time required by right-turning heavy vehicles**, because of their overall length and reduced manoeuvrability.

Rear-End Type Crashes

- the drivers of heavy vehicles being unable to stop in time to avoid colliding with stationary or near-stationary vehicles (rear-end collisions are characteristic of traffic signal crash patterns generally). **Brake failure** was cited in one instance, while in the other case, the cause may be due to a number of factors, including the **inferior braking performance** of heavy vehicles compared to lighter vehicles, **poor skid resistance** of the highly trafficked pavement, **downhill gradients** to the intersection reducing the braking capability of heavy vehicles, and/or to **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display.

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Right-Through Crashes

- install fully controlled right turn phases on the east and west approaches to the intersection, as partially controlled right-turn phases (existing) have been found to not reduce right-through crash frequency;

- increase the all-red periods following the operation of the right-turn phases to provide the additional clearance times required by right-turning heavy vehicles, because of their overall length and reduced manoeuvrability.

Rear-End Type Crashes

- improve the skid resistance of pavements on all approaches to the intersection to better provide for the special needs and shortcomings of heavy vehicles braking at traffic signals;

- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Napier Street/ Whitehall Street, City of Footscray (LGA = 22)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
M87013622	28-Apr-87	830	Tuesday	Cross Traffic	Other Injury	W /S /	1/ 6/ .	60	DAY	Raining	Wet
M87042026	27-Oct-87	1405	Tuesday	Right Through	Serious Injury	E /W /	7/ 1/ .	60	DAY	Clear	Dry
M88015082	9-Apr-88	610	Saturday	Right Through	Other Injury	W /E /	1/ 6/ .	60	DARK	Clear	Dry
M88040107	22-Sep-88	1000	Thursday	Left Side Swipe	Other Injury	E /E /	6/13/	60	DAY	Clear	Dry
J91014444	12-Mar-91	1800	Tuesday	Right Through	Other Injury	N /S /	6/ 1/ .	60	DAY	Clear	Dry
J91023978	1-Jul-91	1400	Monday	Right Through	Other Injury	S /N /E	1/06/01	60	DAY	Clear	Wet
J92028906	21-Aug-92	1425	Friday	Right Through	Other Injury	S /N /W	1/01/07	60	DAY	Clear	Dry
J92029497	2-Jun-92	1000	Tuesday	Left Rear	Other Injury	E /E /	7/ 1/ .	60	DAY	Clear	Wet
J93010168	16-Mar-93	1530	Tuesday	Rear End	Other Injury	S /S /	6/ 1/ .	60	DAY	Clear	Dry

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar. 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 12
Prepared 11/5/94

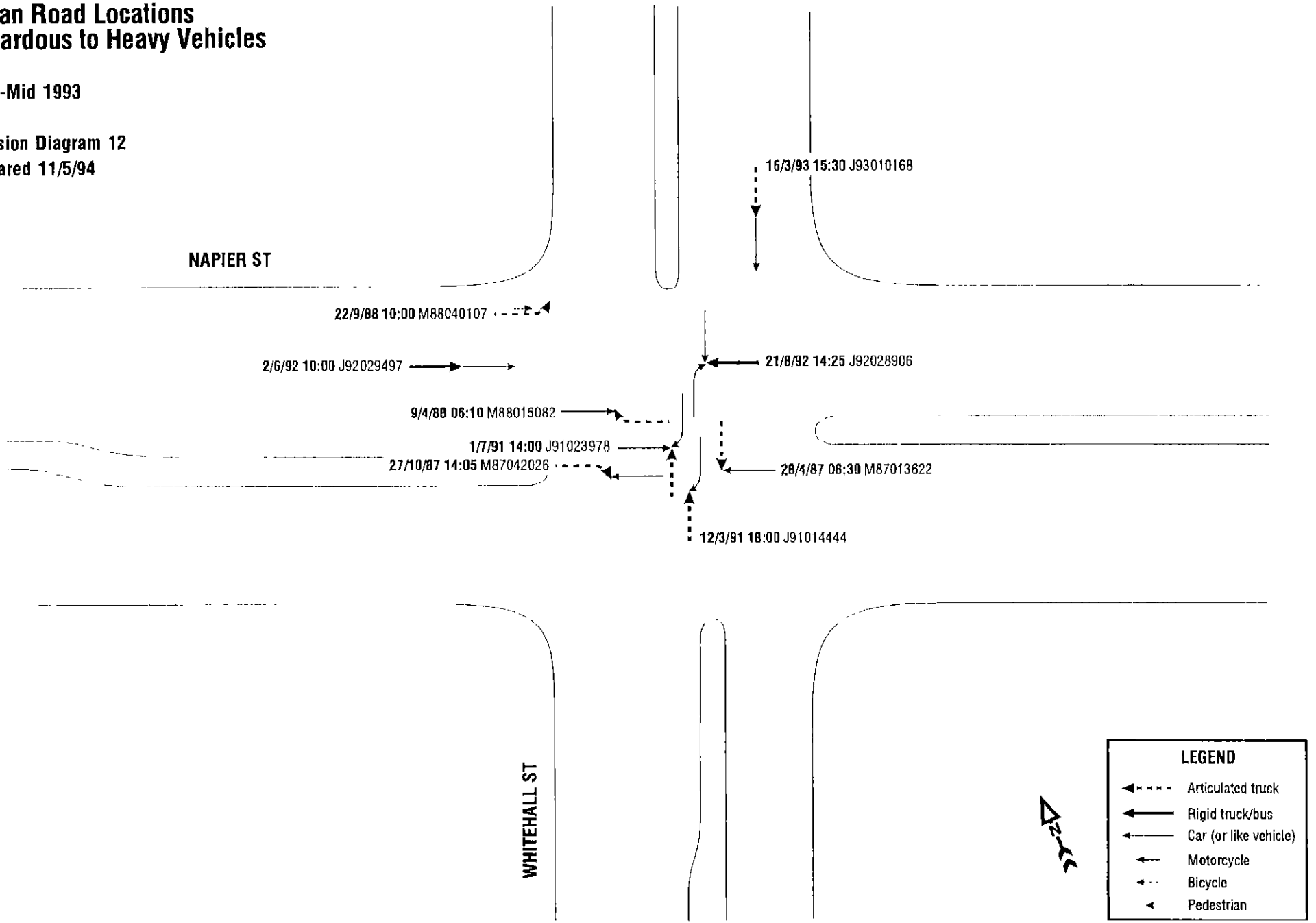


PHOTO 1 OF 4 - FACING WEST

PHOTO 2 OF 4 - FACING EAST

PHOTO 3 OF 4 - FACING NORTH

PHOTO 4 OF 4 - FACING SOUTH

CONTROLLER OPERATIONS SHEETS - 'C' PERSONALITY

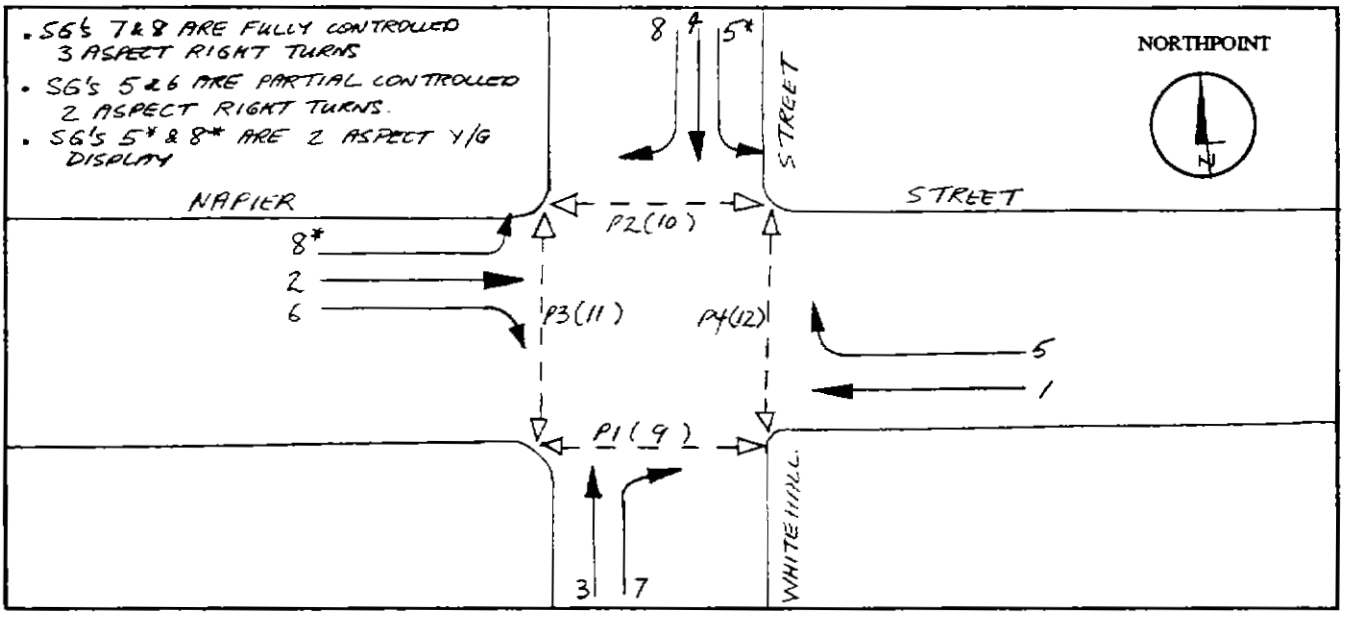
INTERSECTION NAPIER ST. / WHITEHALL ST. No 4231

MUNICIPALITY CITY OF FOOTSCRAY DESIGNER A. LOW DATE 31/5/93

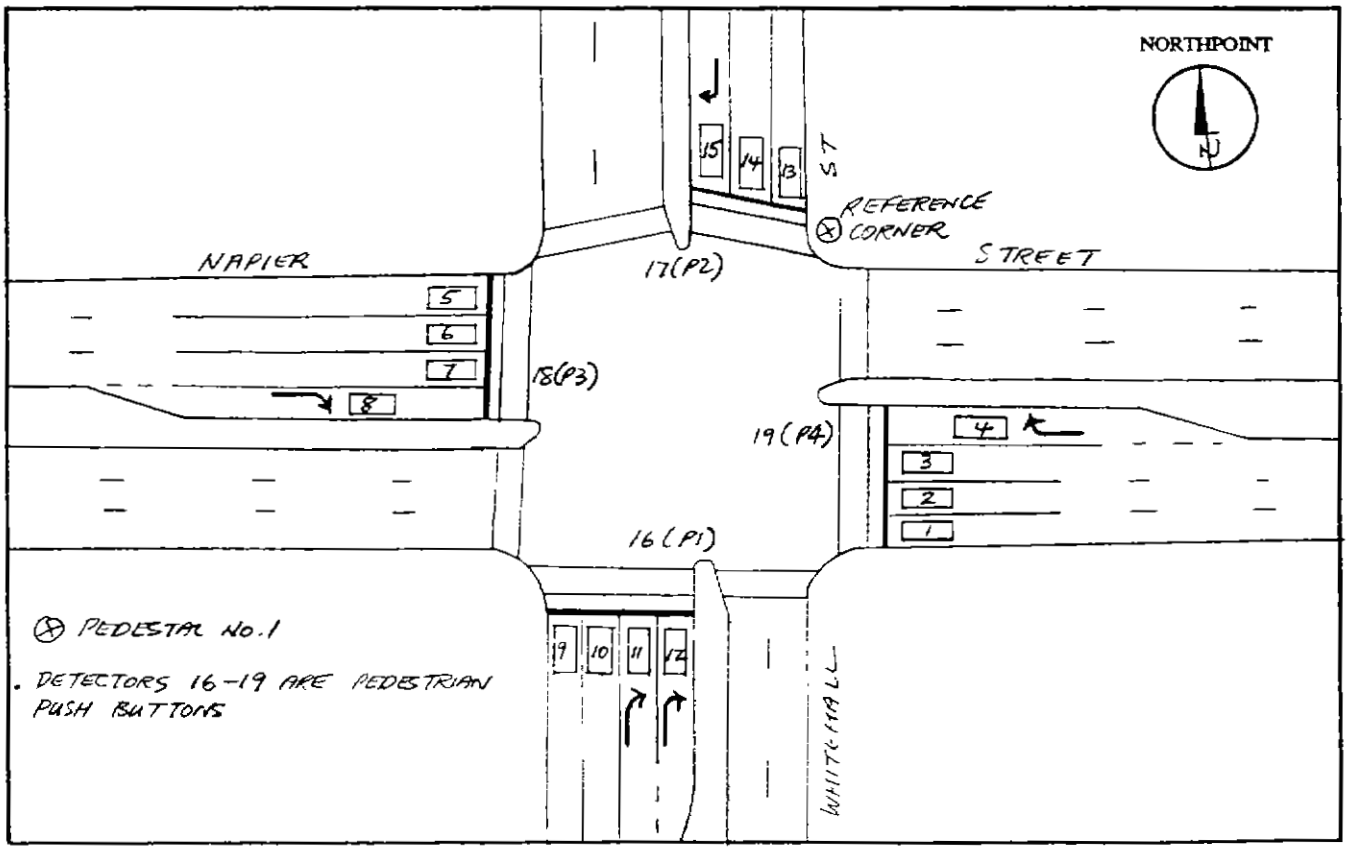
CONTROLLER CAPACITY _____ GROUPS DESIGN CHECKED [signature] DATE 4/6/93

PLAN No 232904 A PROGRAM CHECKED [signature] DATE 22/6/93

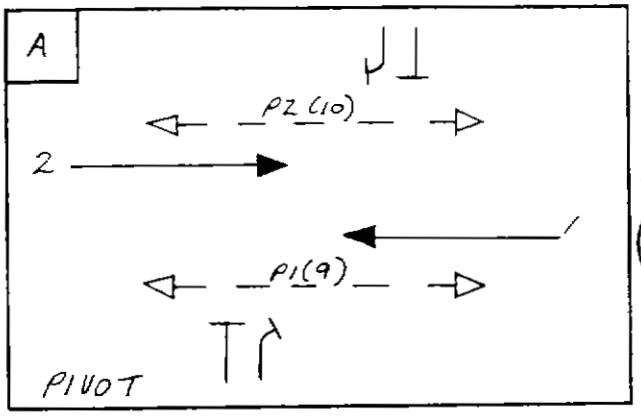
GROUP ALLOCATION



DETECTOR MAP

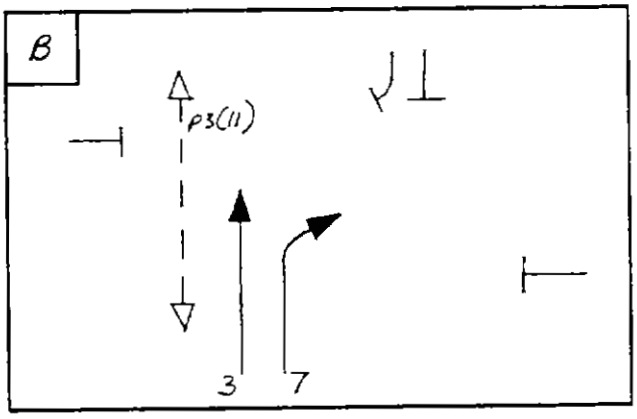


INTERSECTION NAPIER ST. / WHITEHALL ST. No 4231

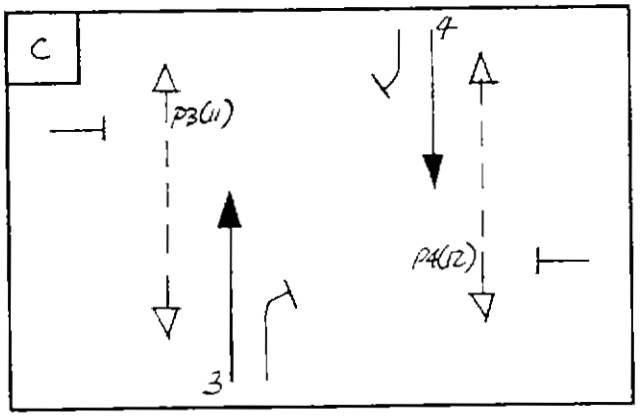


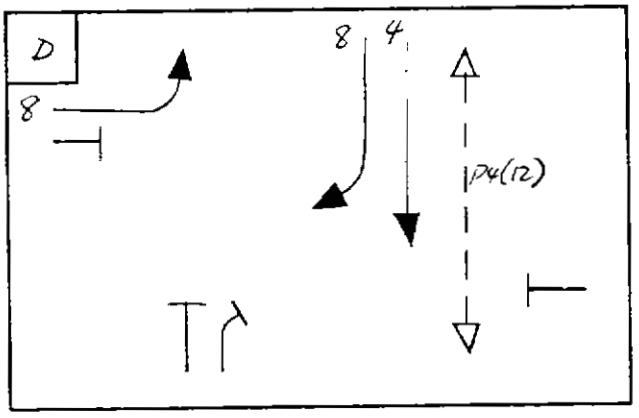
NORTHPOINT

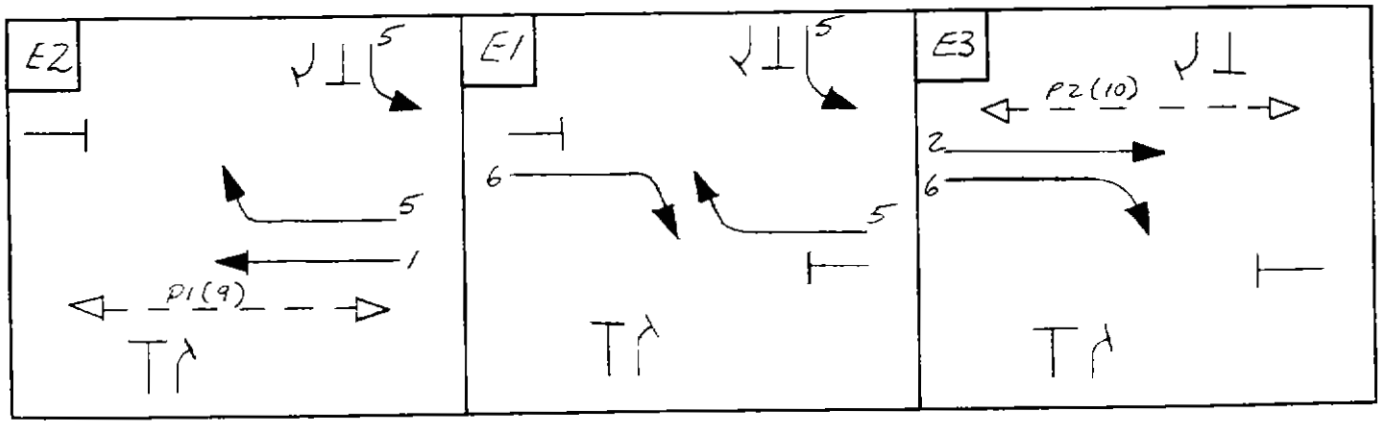
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM V.I.G. ON REVERSION
A	E		



. IF IN Aϕ CLEAR DEMAND FOR Eϕ







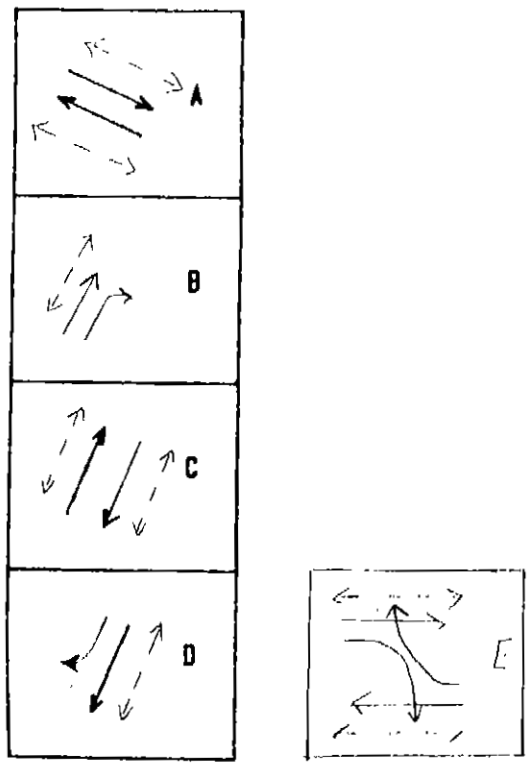
V.A. SEQUENCE: ABCDE

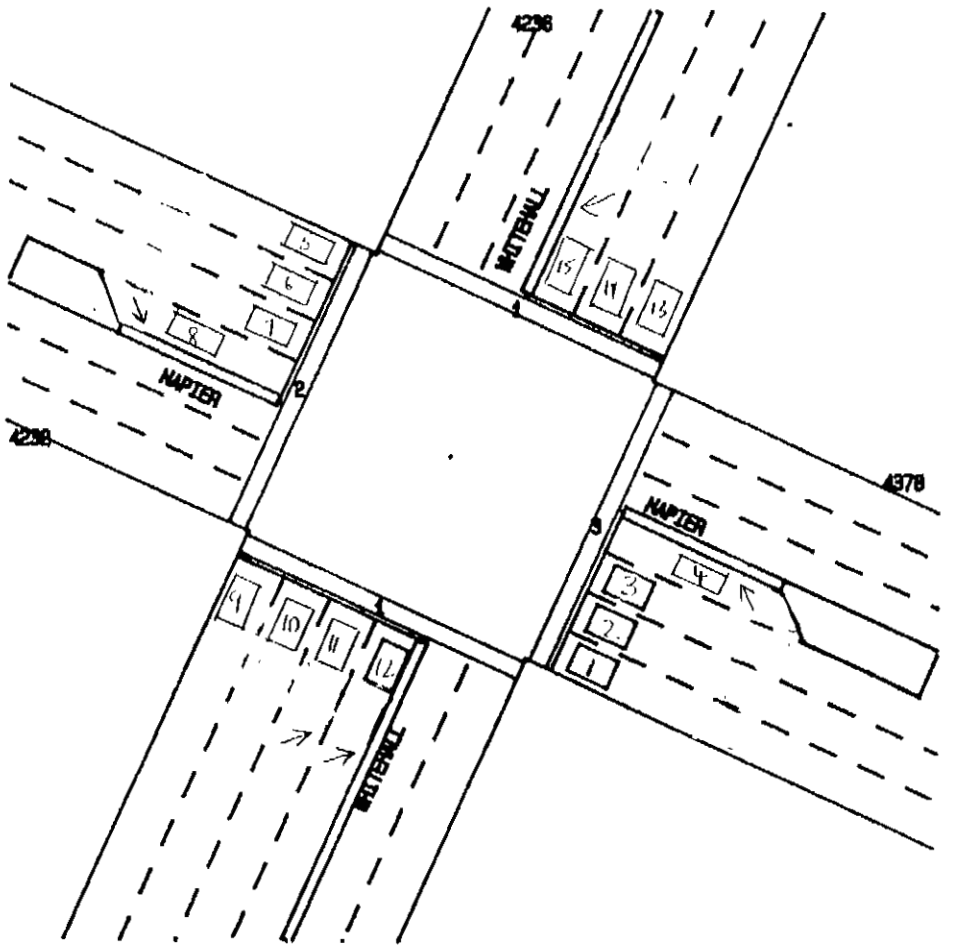
DESIGNED: A. LOW

DATE: 1/6/93

SUBURB - FOO UBD REFERENCE - 042D08
CONTROLLER TYPE - PTF DIVISION - A
CONNECTED TO REGIONAL COMPUTER - FTS

4 PHASES





10-MAR-1985

TCS 4231

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Stud Road/Brady Road, Dandenong North

Case No: M13

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 10 June 1994 **Case No: M13**

1. Location Details

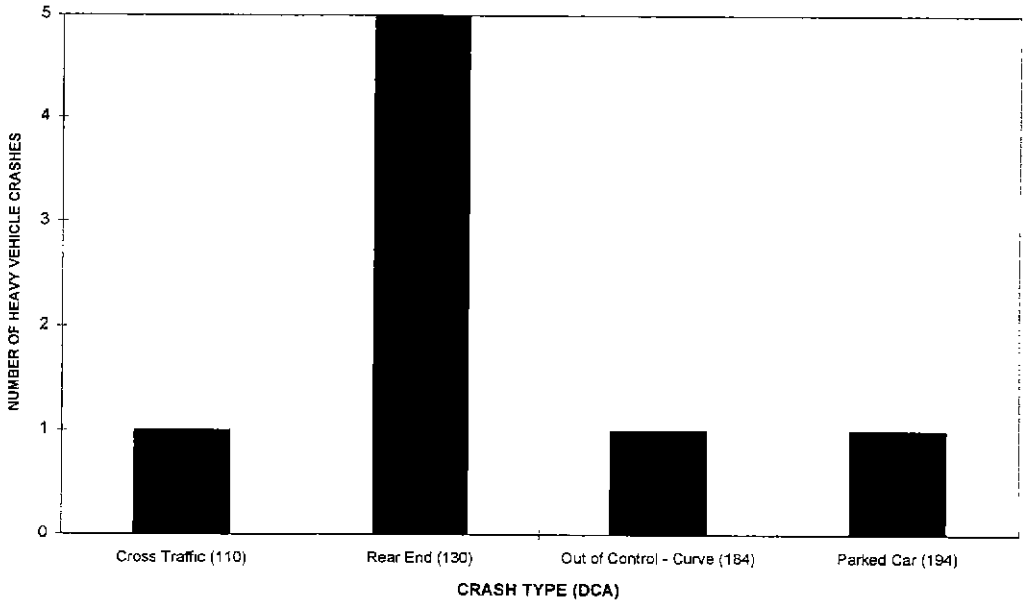
Street Names: Stud Road/Brady Road.
Suburb and Local Government Area: Dandenong North, City of Dandenong.
Melway Map Reference: 81 G11
Road Functional Classification: Stud Road: primary arterial; Brady Road: local crossing road/local road.
Alignment/Topography: Straight approaches, with substantial downhill gradients from north to south and from west to east.
Intersection Geometry (if applicable): Cross intersection with two way service road on one leg (refer plan)
Traffic Control Type: Signals, with partial right turn phase from the north converted to a fully controlled right turn in November 1989. There is a corresponding left turn overlap phase.
Surrounding Land Use: Residential/open space (horse agistment).
Designated Heavy Vehicle Route: Important north-south route for heavy vehicles, linking to South Eastern Arterial/Mulgrave Freeway.
Speed Zone: Stud Road: 80 km/h (previously 75 km/h); Brady Road: 60 km/h.
Number of Traffic Lanes: Stud Road: two through and two turning Brady Road: two on west and one on east approaches.
Pedestrian (or other vulnerable road user) Activity: Light pedestrian activity, bus stops in Stud Road.
Characteristics of Traffic (Control) Operation: Generally high, continuous flows, with a high percentage of heavy vehicles using Stud Road
Treatment History: Signalised in 1984 because of its black spot status, partial right turn phase converted to fully controlled right turn phase in late 1989.

Location Plan Attached: Yes
Photographs Attached: Yes
Other Observations/Comments: Form of access to two-way service road contributes to potential safety and operational problems.

2. Crash Details

Period of Crash Analysis: 1987 to mid- 1993
Total Number of Crashes: **Fatal** - 1 **Serious Injury** - 14 **Other Injury** - 23 **Total** - 38
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 5 **Other Injury** - 3 **Total** - 8
Percentage of Heavy Vehicle to All Casualty Crashes: 21.1% **Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 4 **Rigid** - 3 **Bus** - 1

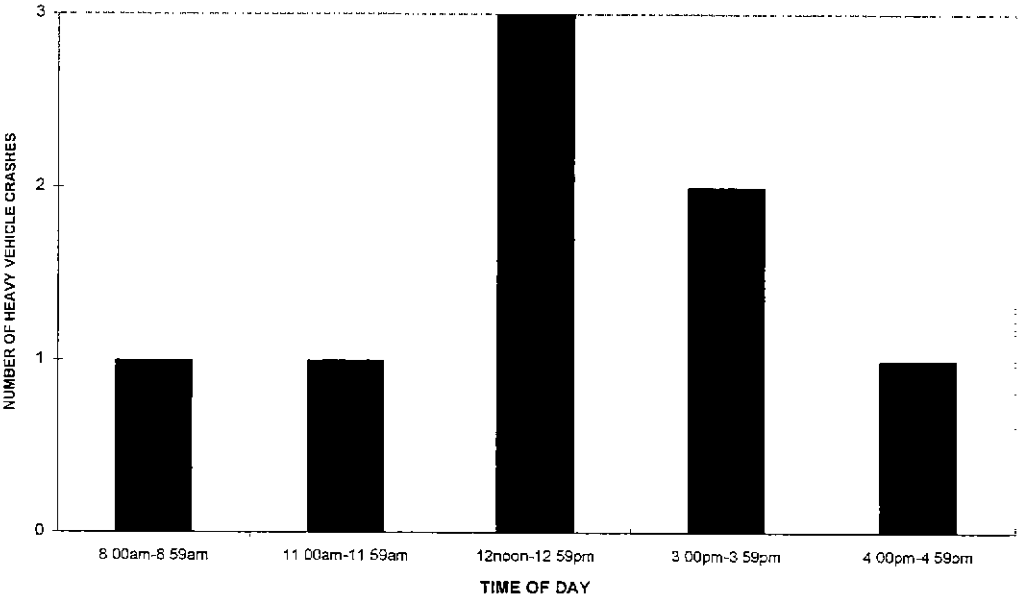
Predominant Heavy Vehicle Crash Types (DCA):



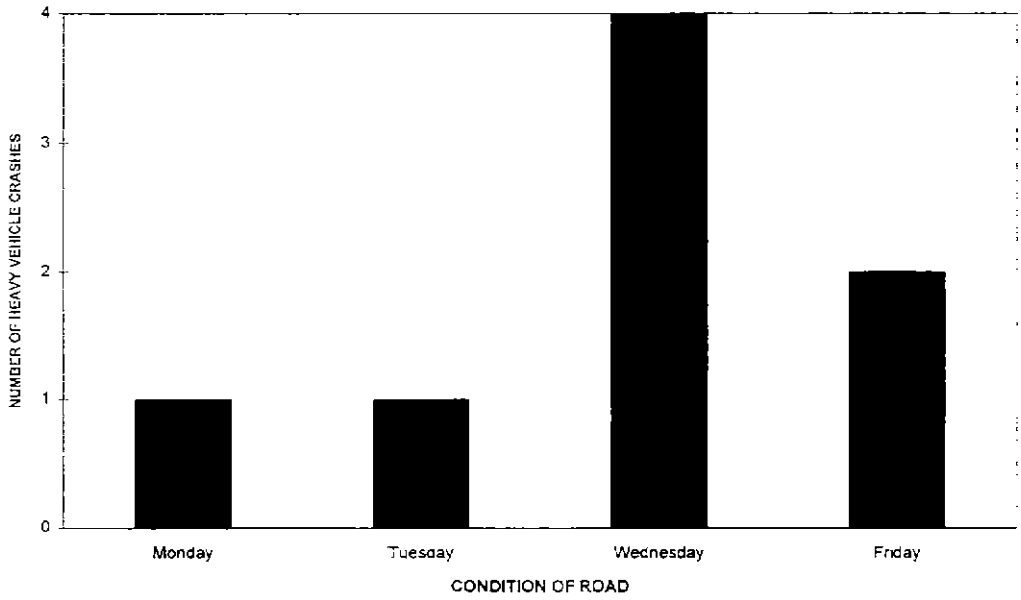
Predominant Heavy Vehicle Movements by DCA:

Rear End - 63%

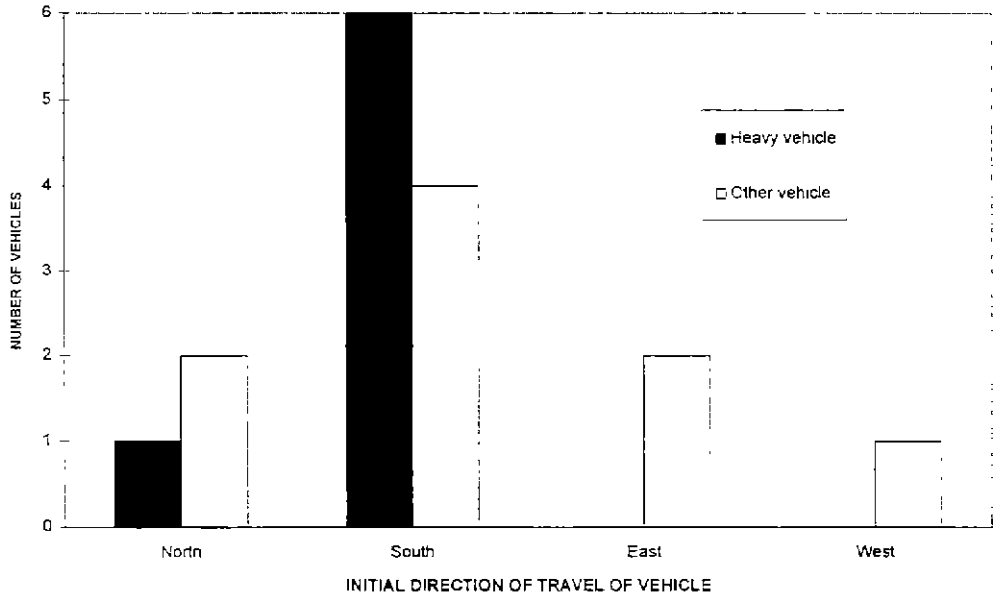
Time of Day Crash Patterns:



Day of Week Crash Patterns:



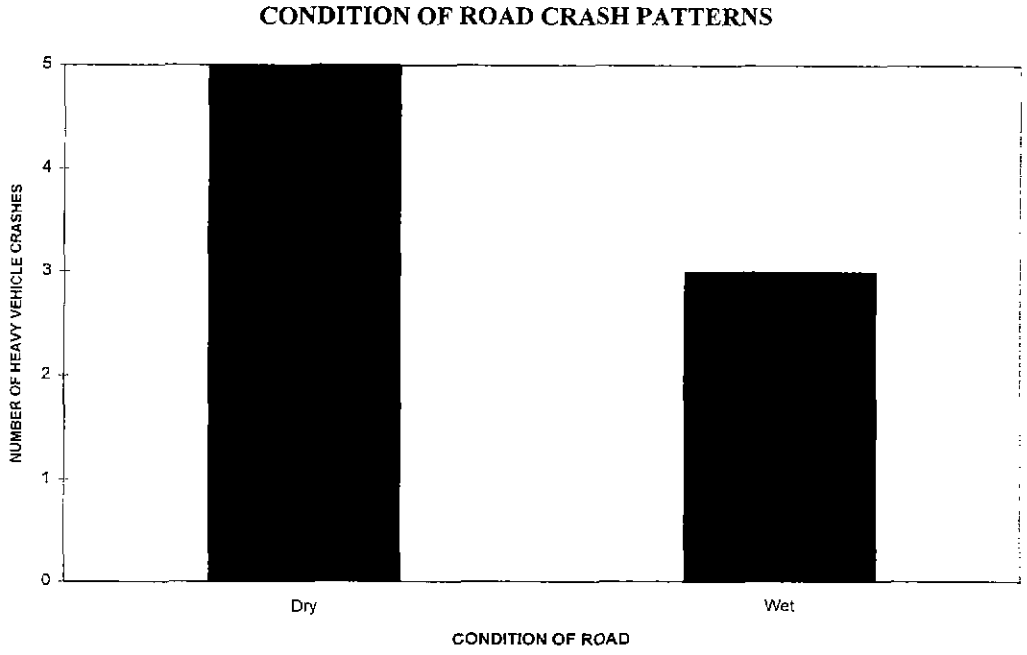
Initial Direction of Travel of Vehicle Crash Patterns



Collision Diagram Attached:

Yes

Other Patterns/Comments:



3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Probably

Alignment/Topography:
Probably - substantial downhill gradient from north to south is a probable factor in the high proportion of crashes (all rear-end) which have occurred on this approach.

Intersection Geometry (if applicable):
Service road access/egress a potential safety problem but not a factor in any of the recorded crashes.

Intersection Control (if applicable):
Yes, in combination with the downhill gradient on the north approach - rear-end crashes are characteristic of traffic signal operation. Signal displays appear adequate.

Road Surface (friction and roughness):
Possibly - surface appears well worn and may possess low skid resistance. Police report the pavement to be wet in three of the eight crashes.

Roadside Features/Hazards:
No.

Land Use:
No.

Traffic Operation: Probably - high vehicle speeds on Stud Road, in combination with traffic signal control, limited sight distance for southbound traffic and a downhill gradient to the signal stop line.
Delineation: Unlikely, though line markings were well worn at the time of inspection.
Street lighting: No.
Sight Distance: Possibly - site distance to the traffic signals for south bound vehicles is limited to about 250 m but is considered adequate if drivers are attentive
Road Divided/Undivided: Unlikely - Stud Road divided.
Lane Configuration (e.g. lane drop/merge, etc.): No.
Lane Provision for Turning: No.
Road works: No.
Shoulder Condition: No
Other: A large proportion of southbound heavy vehicles turn left onto the Mulgrave Freeway, immediately after negotiating the Brady Road intersection. There appears to be a substantial time incentive for the drivers of heavy vehicles to get through the intersection signals at Brady Road without stopping, as they then have an obvious, unimpeded movement onto the Freeway and little chance of further delays. This situation may be a factor in the occurrence of rear-end crashes on the northern approach.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Rear End (DCA 130) Crashes

There is an **inherent risk of rear-end collisions at traffic signals,** given the need for vehicles to stop for red signals (i.e. an unavoidable characteristic of traffic signal operation). Heavy vehicles appear to have a **particular propensity to be the striking vehicle** in such collisions. This is the case in each of the six rear-end crashes at this intersection whereby the drivers of heavy vehicles have been unable to stop in time to avoid colliding with stationary or near-stationary vehicles. Five of the six crashes have involved south bound vehicles.

Possible contributing factors are:

- relatively **high speeds** of traffic on Stud Rd, given the composition of traffic and nature of traffic control at Brady Road;
- **inferior braking performance** of heavy vehicles compared to lighter vehicles, a factor which appears to be accentuated by the **downhill gradient** for southbound vehicles;
- **poor skid resistance** (especially in wet weather) of the highly trafficked pavement;
- **limited sight distance**, due to vertical alignment, for south bound vehicles;
- a tangible and immediate incentive, in the form of a time saving, to **"run the red" signal** and thereby gaining clear access to the Mulgrave Freeway on-ramp;
- **incompatible decision-making** by drivers of light and heavy vehicles when faced with a red or changing signal display (i.e. the driver of the front (lighter) vehicle decides to stop while the driver of the rear (heavy) vehicle decides to proceed through the intersection as the signals change from green to red).

5. Countermeasure Options

The following countermeasure options are proposed for this intersection:

Rear End (DCA 130) Crashes

- improve pavement skid resistance on Stud Road, to compensate for the downgrade and limited sight distance on the north approach especially, and to better provide for the special needs and shortcomings of heavy vehicles braking at traffic signals;
- develop traffic signal technology to extend the green time displayed to the drivers of heavy vehicles so as to reduce the risk of heavy vehicles having to brake suddenly for a traffic signal changing to red. Clearly, this could not be used to prevent all such conflicts but would reduce the frequency with which they arise;
- reduce the speed limit from 80 to 70 km/h, together with appropriate enforcement, to improve safety generally and reduce the risk and severity of rear-end crashes.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Brady Road/Stud Road, City of Dandenong (LGA = 15)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
P88021280	10-May-88	1204	Tuesday	Out of Control	Serious Injury	S /S /	6/ 1/ .	75	DAY	Raining	Wet
P88022855	20-May-88	1510	Friday	Rear End	Serious Injury	N /N /	7/ 1/ .	60	DAY	Raining	Wet
P88043702	14-Oct-88	1505	Friday	Cross Traffic	Other Injury	N /W /E	5/01/08	75	DAY	Clear	Dry
E91000638	19-Dec-90	1230	Wednesday	Rear End	Other Injury	S /S /	6/ 1/ .	60	DAY	Raining	Wet
P90008026	26-Feb-90	1220	Monday	Rear End	Serious Injury	S /S /	7/ 1/ .	75	DAY	Clear	Dry
E91030081	28-Aug-91	1130	Wednesday	Rear End	Serious Injury	S /S /	6/ 1/ .	75	DAY	Clear	Dry
E91040410	4-Dec-91	1600	Wednesday	Rear End	Serious Injury	E /S /S	1/06/01	75	DAY	Clear	Dry
E93012103	7-Apr-93	820	Wednesday	Parked Car	Other Injury	S /E /E	7/01/01	60	DAY	Clear	Dry

Note: i) Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 13
Prepared 11/5/94

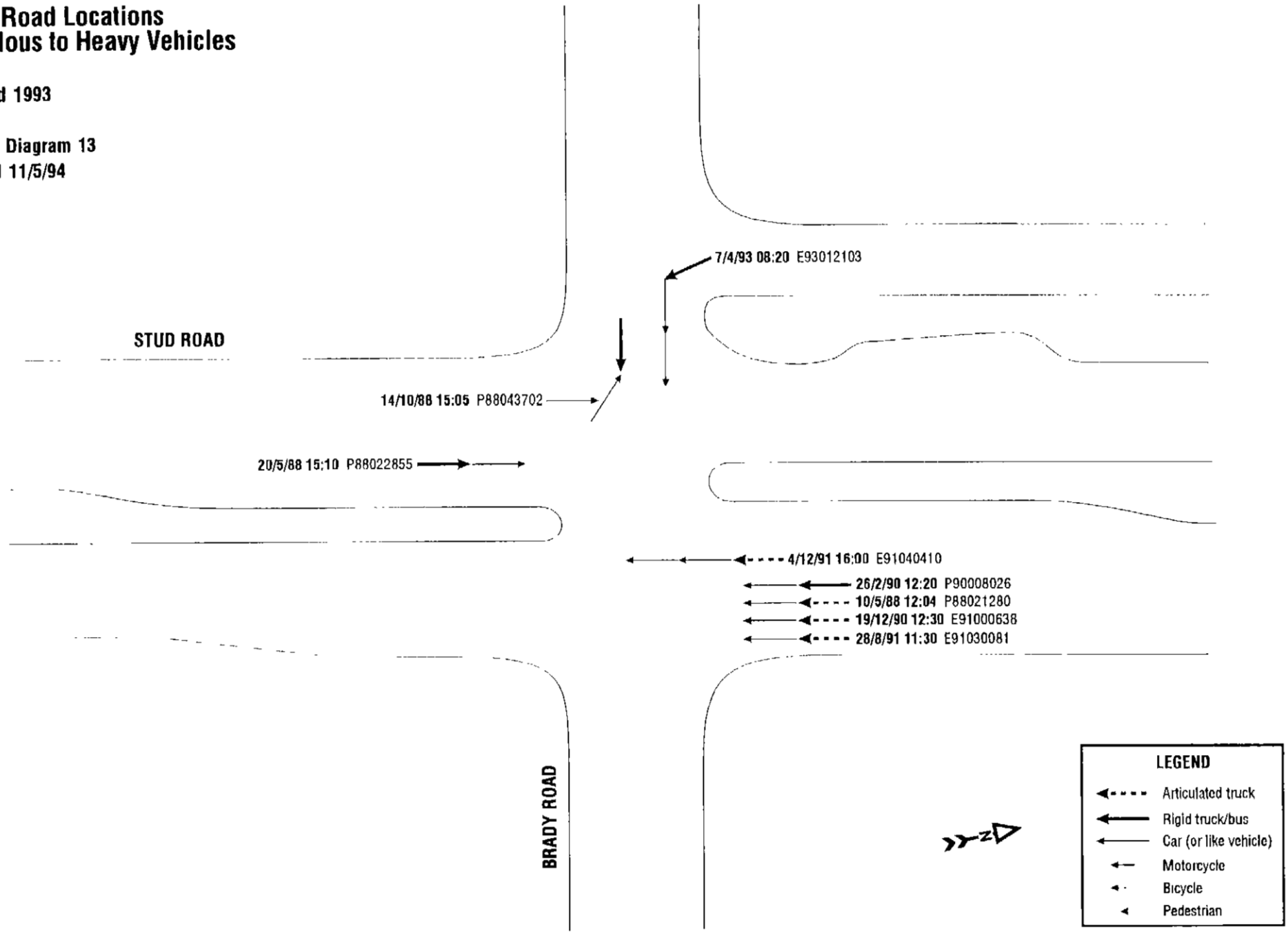


PHOTO 1 OF 4 - FACING EAST

PHOTO 2 OF 4 - FACING SOUTH

PHOTO 3 OF 4 - FACING NORTH

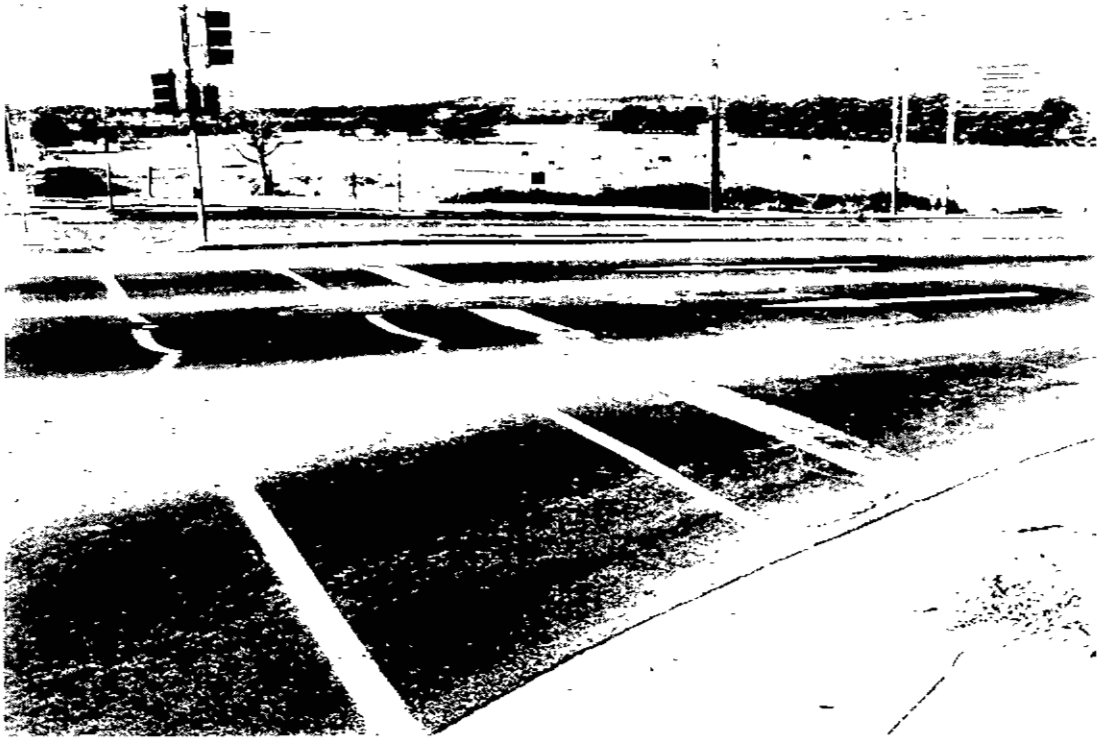


PHOTO 4 OF 4 - PAVEMENT CONDITION: SOUTHERN APPROACH

INTERSECTION STUD ROAD / BRADY ROAD — 662

REPROGRAM: A.J. FITTS — 5/7/94

MUNICIPALITY CITY OF DANDENONG — DESIGNER TONY DAMOULARIS — DATE 18/06/90

8-3-54

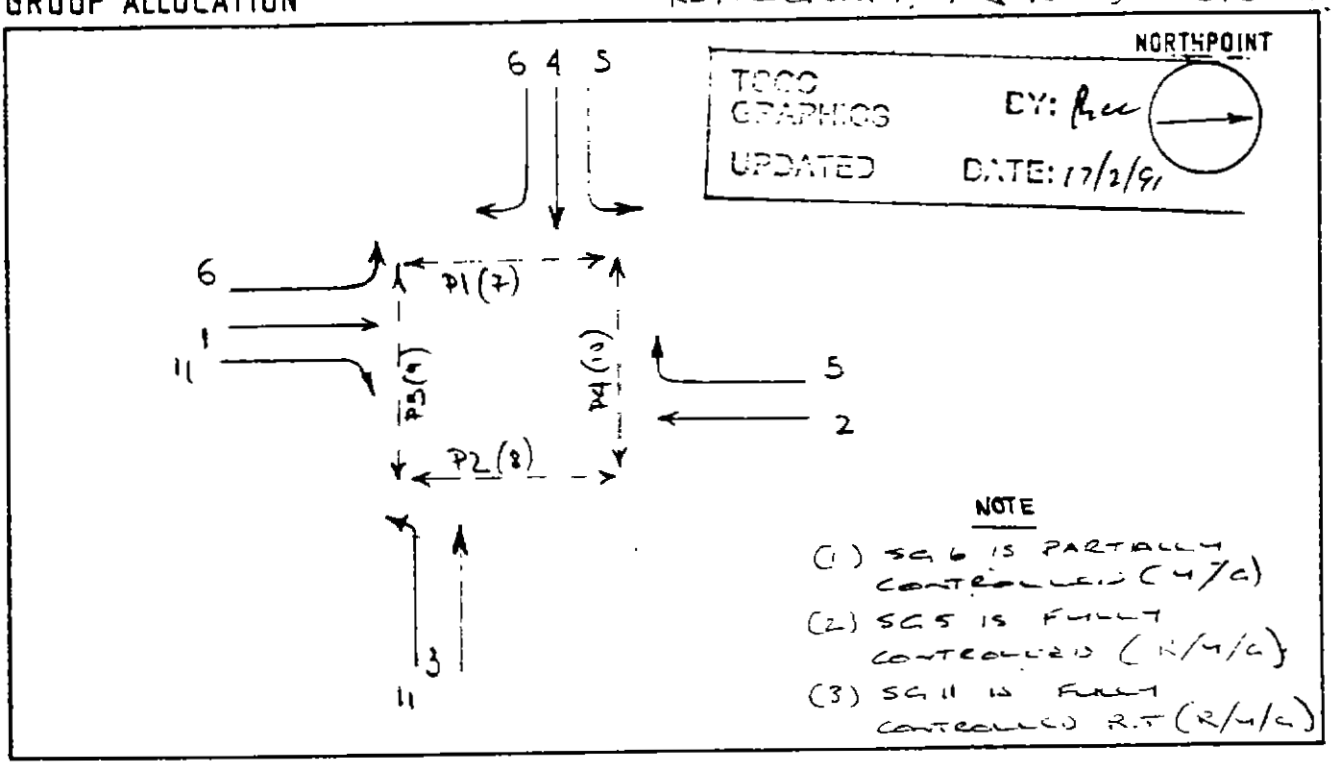
CONTROLLER CAPACITY 10 GROUPS — DESIGN CHECKED — DATE 28-6-90

PLAN No 540 009 — PROGRAM CHECKED Tony Damoularis — DATE 6/07/90

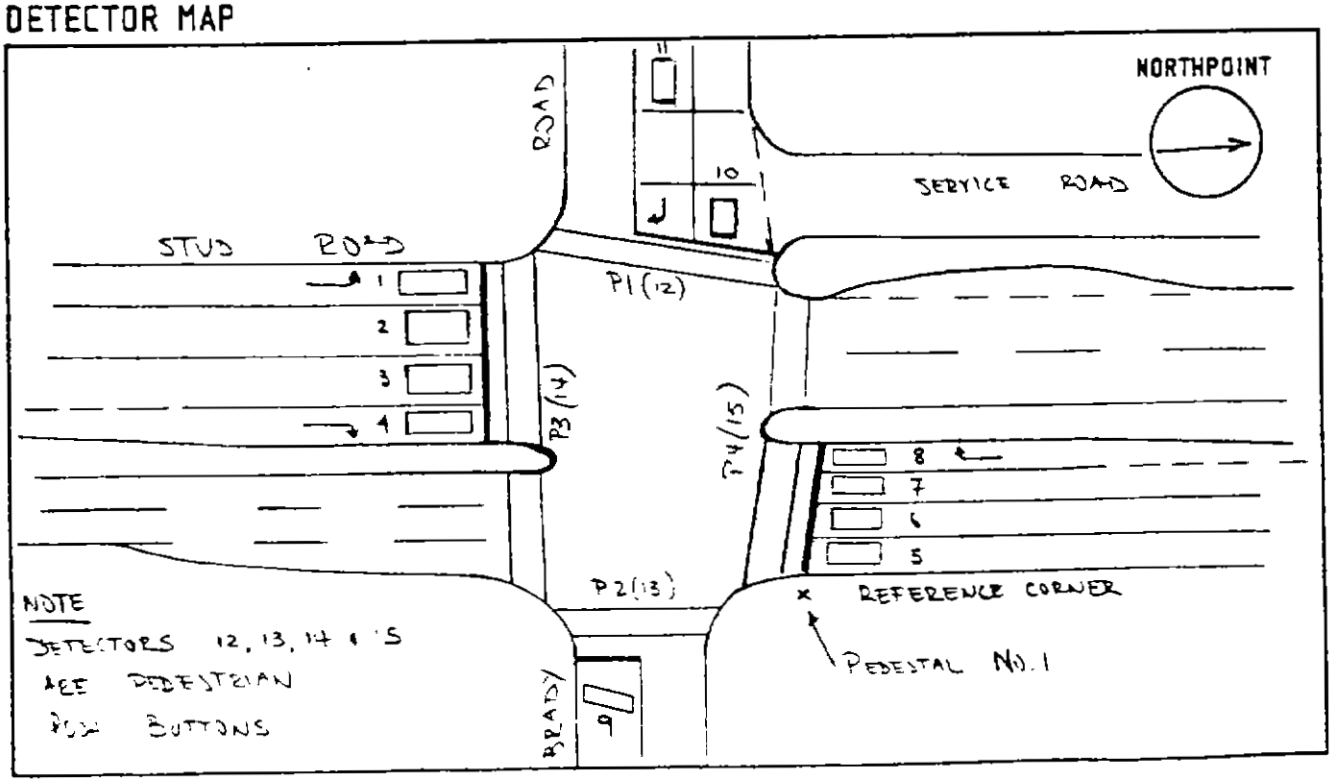
REPROGRAM: (TONY FITTS) — 10/3/94

REPROGRAM: — 23/6/94

GROUP ALLOCATION

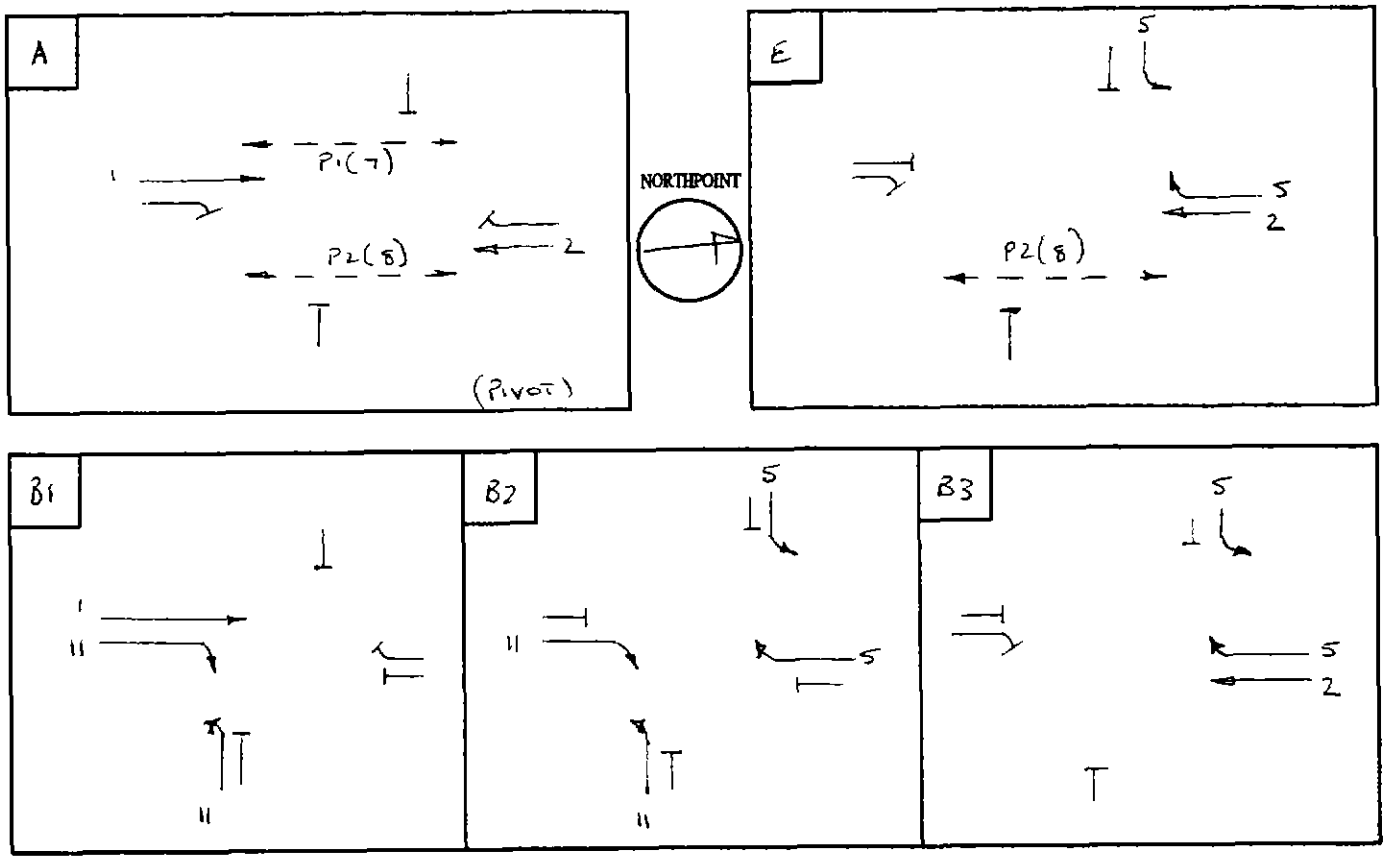


DETECTOR MAP



DRAWING NO OF SHEETS

INTERSECTION **STUD RD/BRADY RD** No **662**



NOTES:

1. In D clear calls for C (i.e. prohibited phase change from D->C).

2. Pedestrian Operation
   (a) P2 can introduce anytime in E and at the start of A and overlap E<->A.

   (b)P4 can introduce anytime in C and at the start of D and overlap C->D.

3. If Z-flag is set (refer VPT on pg.10) then run B1 only.
   If Z- flag is not set then run any demanded B sub-phase.
   B can start in any sub-phase but can not overlap.

4. Clear calls for B and E from det.8 if SG5 is green.

V.A. SEQUENCE: A B C D E

DESIGNED: A. J. FITTS.

DATE: 8/6/94.

STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Centre Road/Police Road/Princes Highway/Springvale Road, Springvale

Case No: M14

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 10 June 1994 Case No: M14

1. Location Details

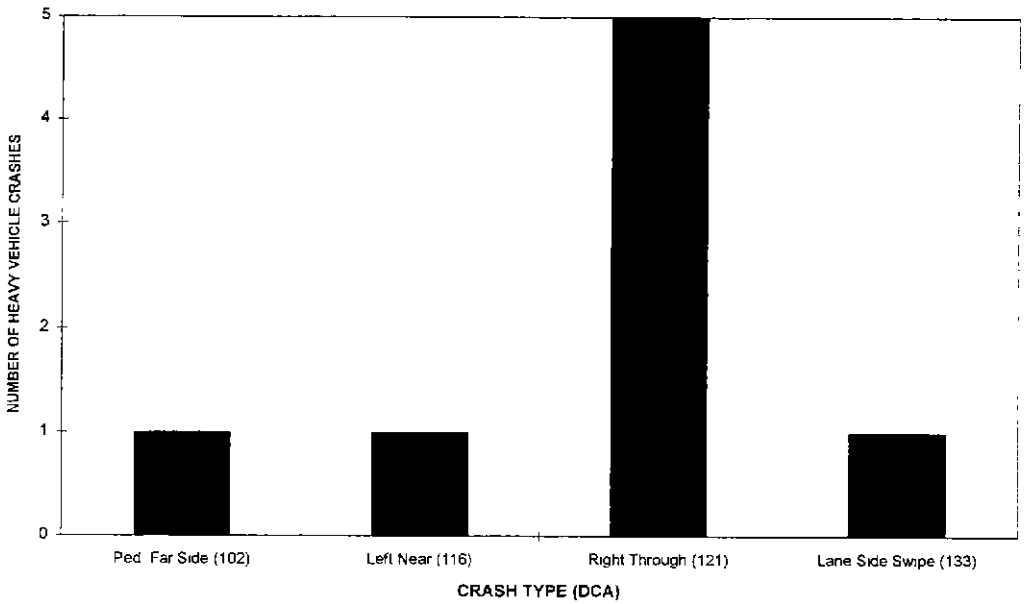
Street Names: Centre Road/Police Road/Princes Highway/Springvale Road.
Suburb and Local Government Area: Springvale, Cities of Springvale and Waverley.
Melway Map Reference: 80 A5
Road Functional Classification: Centre Road and Police Road: secondary arterial roads; Princes Highway and Springvale Road: primary arterial roads.
Alignment/Topography: Generally flat with straight approaches. Downhill approach to the intersection on Police Road.
Intersection Geometry (if applicable): Complex, fully channelised, six-leg intersection.
Traffic Control Type: Intersection signals, with complex multiple phasing of movements (refer plan for details).
Surrounding Land Use: Commercial
Designated Heavy Vehicle Route: All roads (particularly Princes Highway and Springvale Road) carry high volumes of heavy vehicles.
Speed Zone: Centre Road and Police Road: 60 km/h; Princes Highway: 80 km/h; Springvale Road: 70 km/h
Number of Traffic Lanes: Multi-lane approaches (refer attached plan).
Pedestrian (or other vulnerable road user) Activity: Moderate pedestrian volumes.
Characteristics of Traffic (Control) Operation: Heavy vehicle volumes and speeds along Princes Highway and Springvale Road are high. Signalling and geometric layout are highly complex with the intersection frequently operating at or near capacity

Treatment History: Numerous signal remodels and phasing/timing changes have been undertaken during the past decade.
Location Plan Attached: Yes.
Photographs Attached: Yes.
Other Observations/Comments: None.

2. Crash Details

Period of Crash Analysis: 1987 to mid-1993
Total Number of Crashes: **Fatal** - 1 **Serious Injury** - 31 **Other Injury** - 99 **Total** - 131
Total Number of Heavy Vehicle Crashes: **Fatal** - 0 **Serious Injury** - 4 **Other Injury** - 4 **Total** - 8
Ratio of Heavy Vehicle to All Casualty Crashes: 6.1% **Average Ratio of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections:** 8.3%
Number of Crashes by Heavy Vehicle Type: **Articulated** - 0 **Rigid** - 7 **Bus** - 1

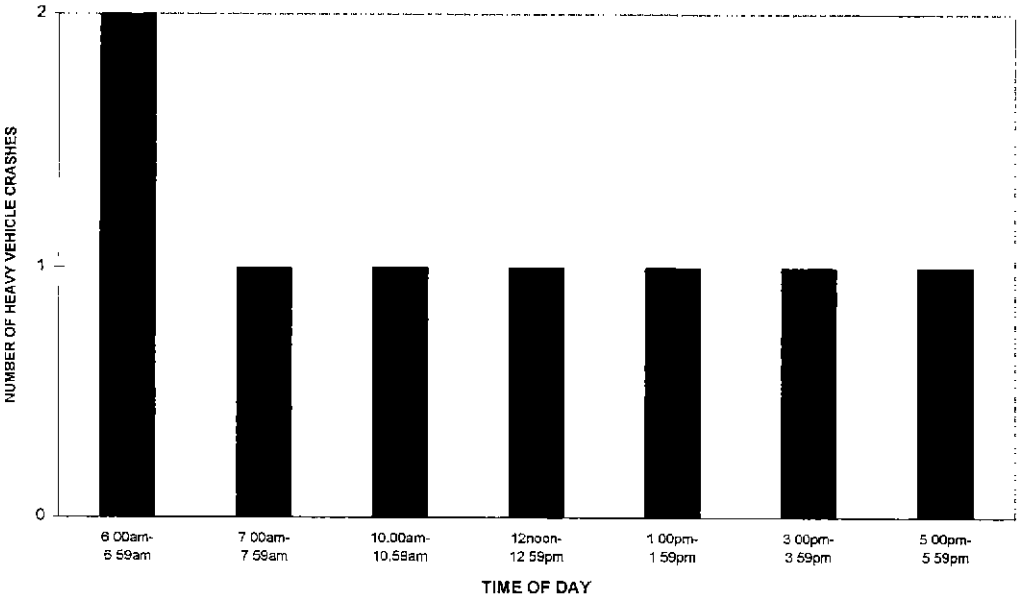
Predominant Heavy Vehicle Crash Patterns (DCA):



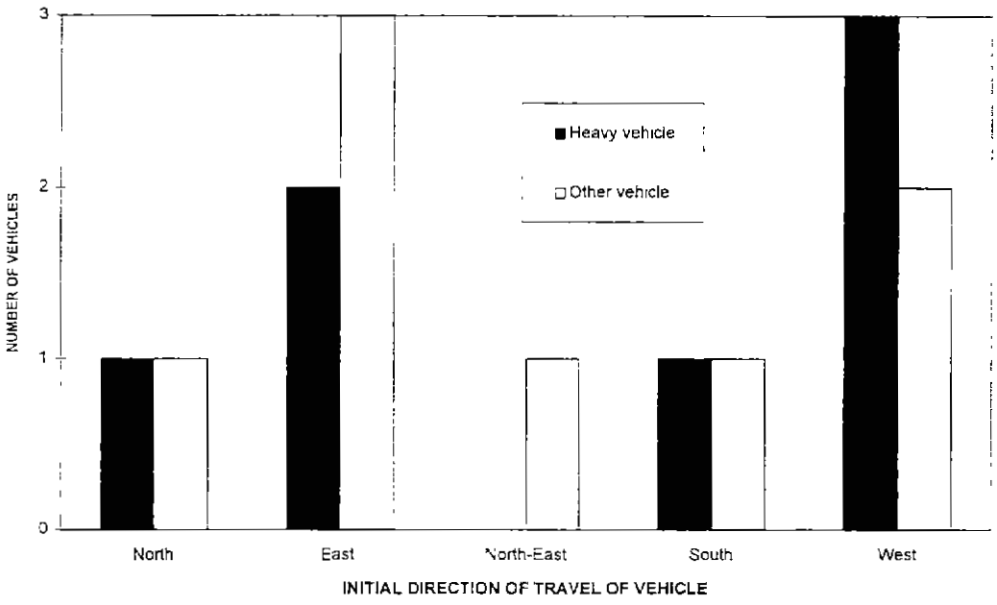
Predominant Heavy Vehicle Movements by DCA:

Right-Through - 63%

Time of Day Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns:



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
The ratio of heavy vehicle to all casualty crashes of 6 1% is relatively low compared to the 8.3% average for Metropolitan Melbourne arterial/arterial intersections. Apart from the clustering of heavy vehicle crashes around the intersection of Police Road and the south-east bound lanes of the Princes Highway, no strongly recurring crash characteristics for heavy vehicles are evident.

3. Road Environment Factors Contributing to Crash Occurrence

Speed:
Unlikely.

Alignment/Topography:
Unlikely.

Intersection Geometry (if applicable):
The geometric arrangement of the right turn movement from east to south-east may be a factor in right-through crashes, though there is no evidence to suggest that heavy vehicles are more involved in crashes as the right-turner than as the through-vehicle.

Intersection Control (if applicable): Yes. The signal phasing for the right turn from east to south-east provides inadequately in terms of safety for right-turn and through-vehicles. This conclusion is supported by an extraordinarily high frequency of crashes of this type, not necessarily involving heavy vehicles. Between 1985 and 1990 there were at least 60 crashes involving these movements reported to Police. In almost half of these crashes vehicle occupants were injured. There is also some evidence that clearance times for pedestrians and vehicles generally may be inadequate for reasonable levels of safety. Partial right turn-phases, such as exist in this instance, do little to reduce crashes of the right-through type - this is particularly true when the turn phase operates as a lagging movement.
Road Surface (friction and roughness): Skidding on wet pavement was noted by Police as a factor in one crash in which the driver of a heavy vehicle failed to brake adequately when faced with a red signal.
Roadside Features/Hazards: No.
Land Use: No.
Traffic Operation: Yes (refer to Intersection Control, above).
Delineation: Unlikely.
Street lighting: No.
Sight Distance: No.
Road Divided/Undivided: No.
Lane Configuration (e.g. lane drop/merge, etc.): No.
Lane Provision for Turning: No.
Road works: No.
Shoulder Condition: No.
Other: No.

4. Conclusions

This intersection has a low ratio of heavy vehicle to all casualty crashes of 6.1% compared to 8.3% average for Metropolitan Melbourne arterial/arterial intersections and has clustering of crashes in only one area of a complex intersection layout. Even then, there is no clear pattern of crashes *for heavy vehicles*. The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

Right-through Crashes

- This crash type is characteristic of intersection signal crash patterns. Right-turners are experiencing **difficulty in selecting safe gaps in on-coming traffic**, without the aid of a fully controlled right turn phase for this movement. The right turn movement is especially difficult given the **intersection geometry and associated complexity of the driving task**. The existing partially controlled right-turn phase for this movement is of a type found to have no appreciable effect on crash right-through crash frequencies. The operation of this phase as a lagging movement (i.e. following the through movement) further reduces its potential to improve safety.

Other Crashes

- Other crashes are diverse in type and cause. Vehicles starting up on an opening green signal striking either pedestrians or other vehicles which entered the intersection on green but have **failed to clear in time** are common to two cases. **Traffic congestion** within the intersection and the **driver's view being obscured** by other large vehicles were also mentioned by Police as possible causes.

5. Countermeasure Options

The following countermeasure is proposed for this intersection:

Right-through Crashes

- install a fully controlled right-turn phase for the movement from east to south-east. This will address the extraordinarily high frequency of crashes of this type, not necessarily involving heavy vehicles. Between 1985 and 1990 there were at least 60 crashes involving these movements reported to Police. In almost half of these crashes vehicle occupants were injured.

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Centre Road/ Springvale Road, City of Springvale (LGA = 51)

Location Details

ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
P87002489	27-Jan-87	1300	Tuesday	Ped. Far Side	Other Injury	S / /	7/ ./	60	DAY	Clear	Dry
P88019005	18-Apr-88	735	Monday	Left Near	Other Injury	N /W /	1/ 7/ .	60	DAY	Clear	Dry
P88045664	8-Nov-88	630	Tuesday	Right Through	Serious Injury	N /S /	7/ 1/ .	60	DAY	Clear	Dry
P89013014	29-Mar-89	1530	Wednesday	Right Through	Other Injury	NE/W /	5/ 7/ .	60	DAY	Clear	Dry
P89021200	22-May-89	1030	Monday	Right Through	Serious Injury	E /W /	1/ 8/ .	60	DAY	Clear	Wet
D90010498	15-Mar-90	1700	Thursday	Right Through	Serious Injury	W /E /	1/ 7/ .	60	DAY	Clear	Dry
G90038517	15-Oct-90	1245	Monday	Right Through	Serious Injury	E /W /unknown	1/01/07	60	DAY	Clear	Dry
D91030270	1-Aug-91	650	Thursday	Lane Side Swipe	Other Injury	E /E /E	7/01/01	60	DARK	Raining	Wet

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

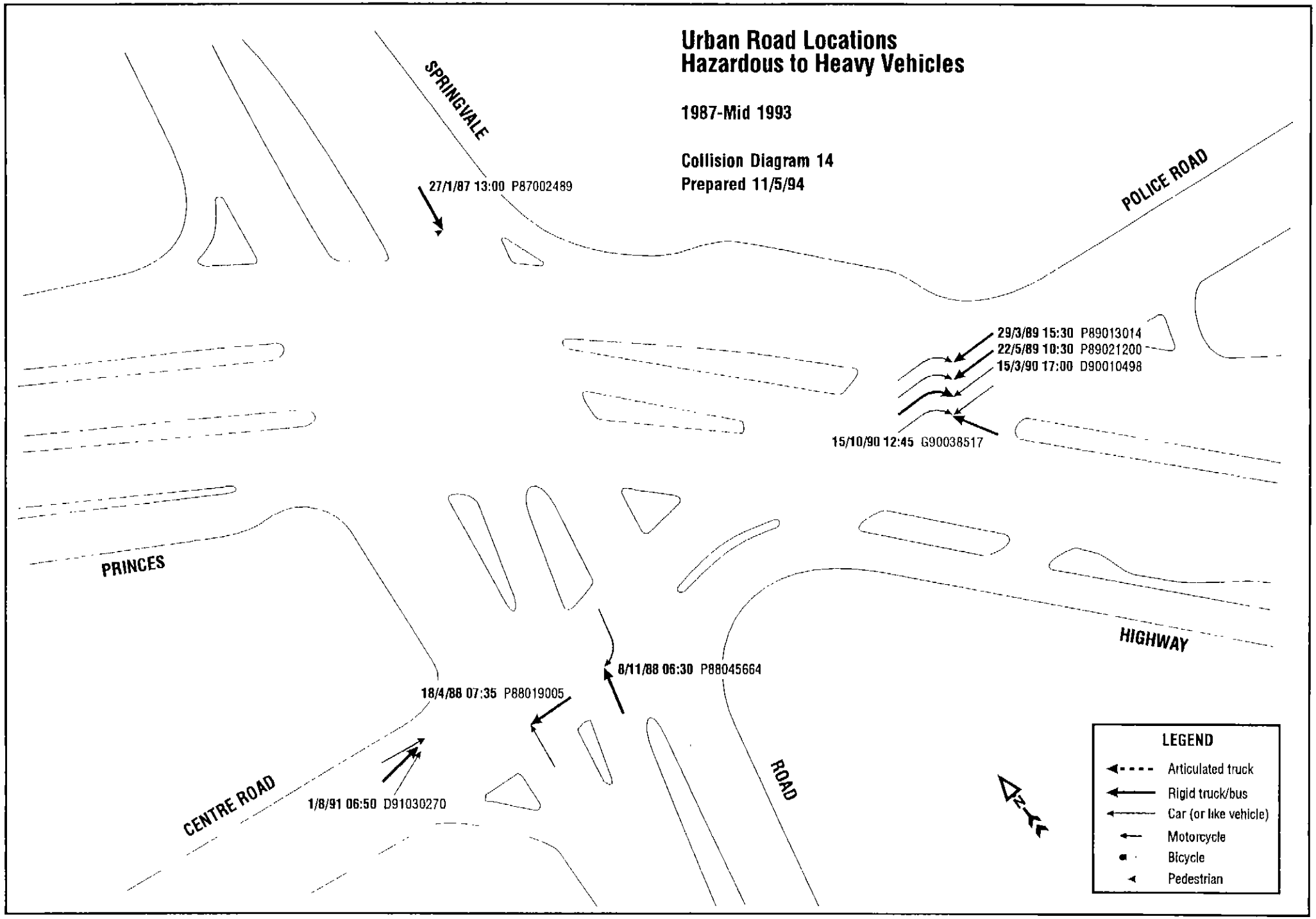

Urban Road Locations
Hazardous to Heavy Vehicles
1987-Mid 1993
Collision Diagram 14
Prepared 11/5/94
SPRINGVALE
POLICE ROAD
PRINCES
HIGHWAY
CENTRE ROAD
ROAD
27/1/87 13:00 P87002489
29/3/89 15:30 P89013014
22/5/89 10:30 P89021200
15/3/90 17:00 D90010498
15/10/90 12:45 G90038517
8/11/88 06:30 P88045664
18/4/88 07:35 P88019005
1/8/91 06:50 D91030270
LEGEND
Articulated truck
Rigid truck/bus
Car (or like vehicle)
Motorcycle
Bicycle
Pedestrian

PHOTO 1 OF 4 - FACING WEST

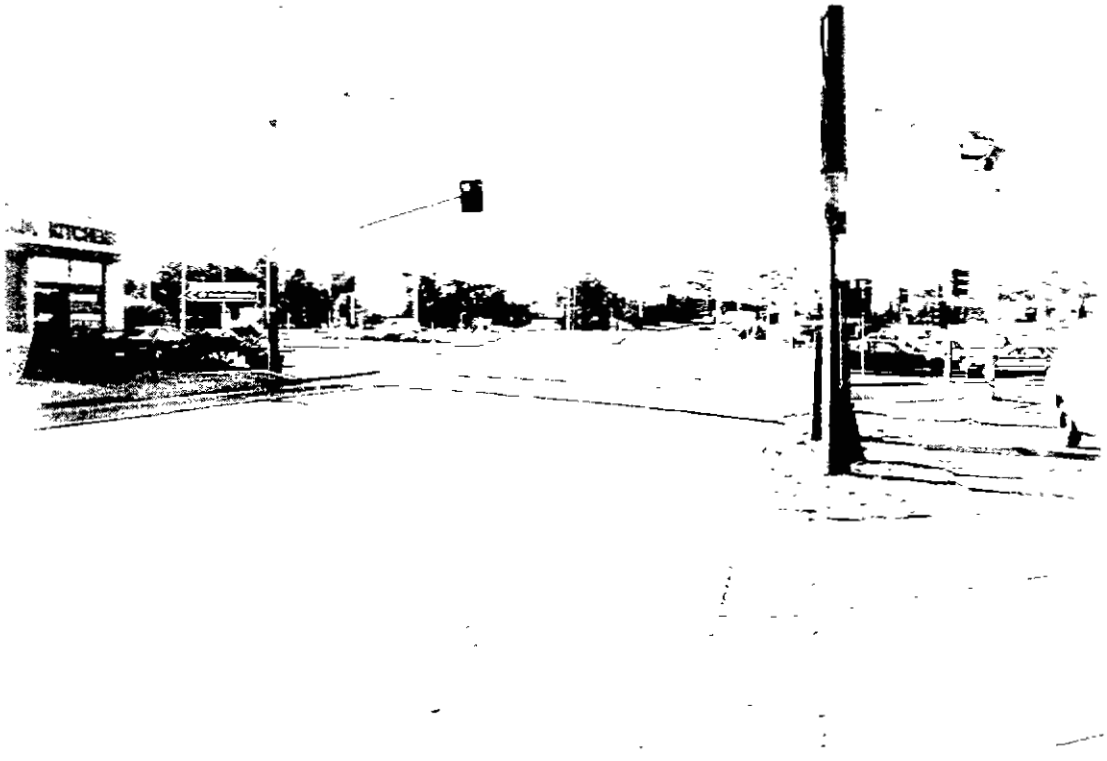


PHOTO 2 OF 4 - FACING EAST

PHOTO 3 OF 4 - FACING NORTH

PHOTO 4 OF 4 - FACING EAST FROM PEDESTRIAN CROSS WALK

CONTROLLER OPERATIONS SHEETS

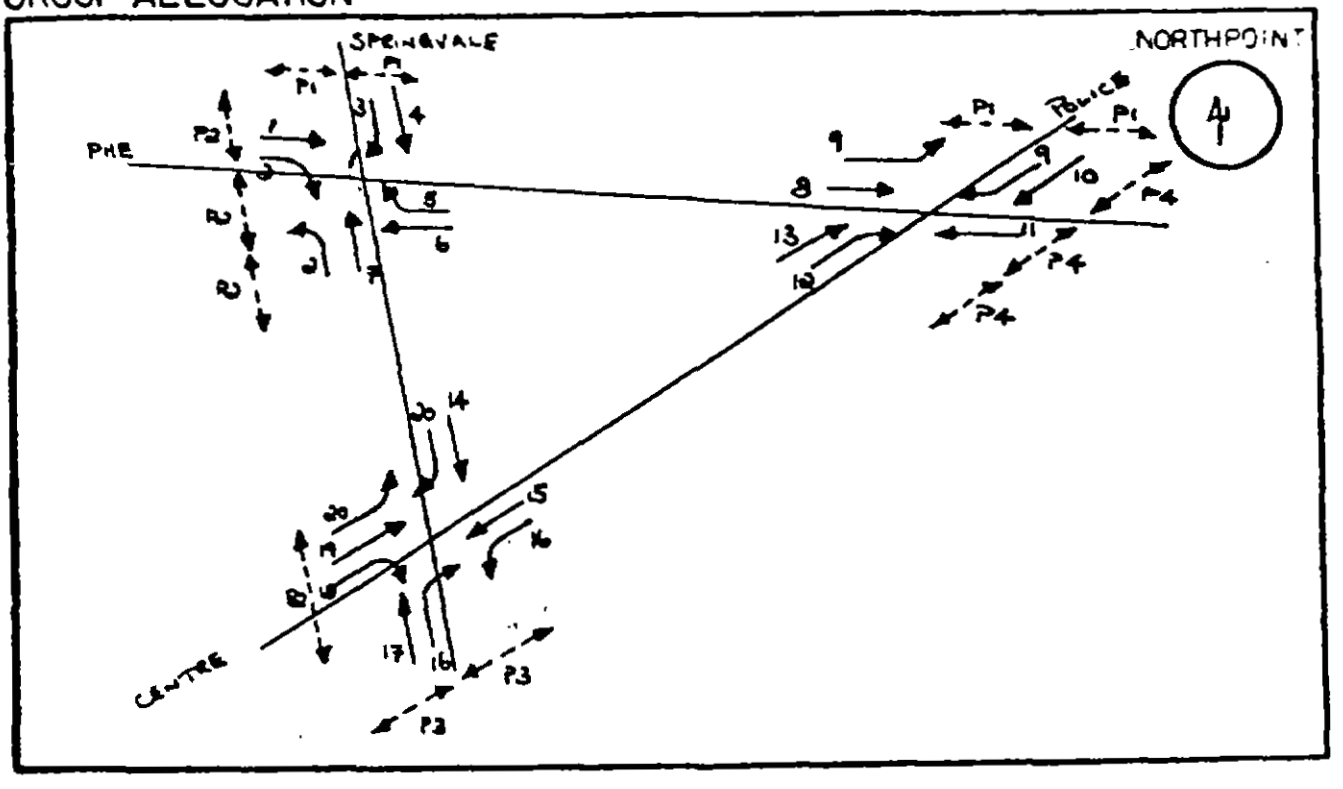
INTERSECTION: P.H.E. / SPRINGVALE Rd / Centre Rd / Police Rd No 185

MUNICIPALITY: SPRINGVALE DESIGNER F. RACO DATE 24-4-85

CONTROLLER: PTF VT4 SECTION LEADER R. Connell DATE 24/4/85

PLAN No. 840 051 PROGRAM CHECKED [signature] DATE 17-5-85

GROUP ALLOCATION



DETECTOR MAP

NORTHPOINT

REFER TO ATTACHED SHEET FOR DETECTOR MAP

3 ASPECT RIGHT TURN GROUPS

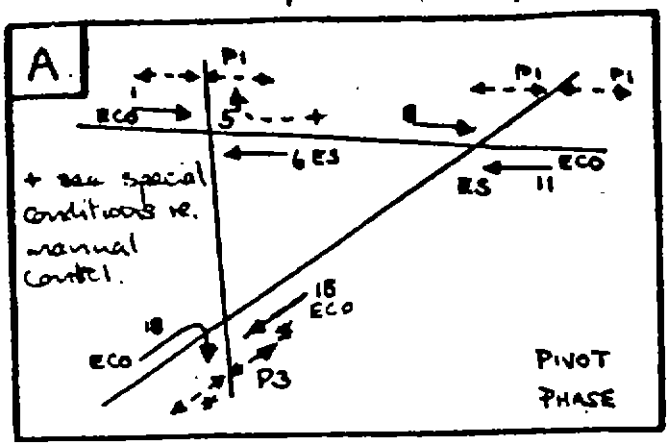
SG: 2, 3, 5, 9, 16, 20

2 ASPECT RIGHT TURN GROUPS

SG: 12, 18

PHASING DIAGRAM

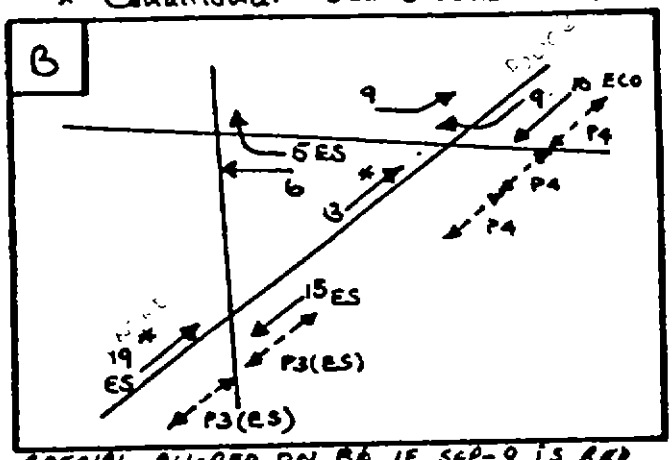
INTERSECTION PHE / SPRINGVALE / CENTRE / POLICE NO 185



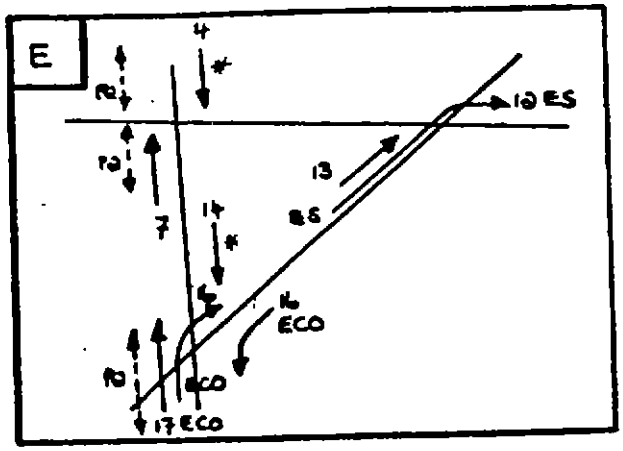
PHASE	PROHIBITED PHASE CHANGES TO	REVERSION ON MAXIMUM	MAXIMUM VIS ON REVERSION
A			
B			
C	B		
D			
E			
F			
G			

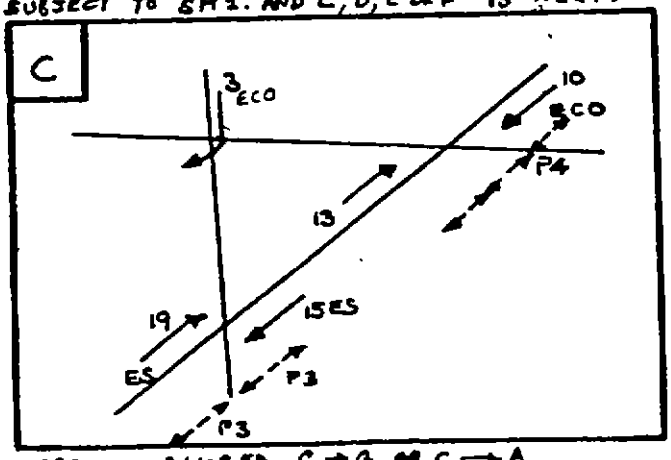
* Conditional – SEE SPECIAL SGP-NOTES

NORTHPORT 4

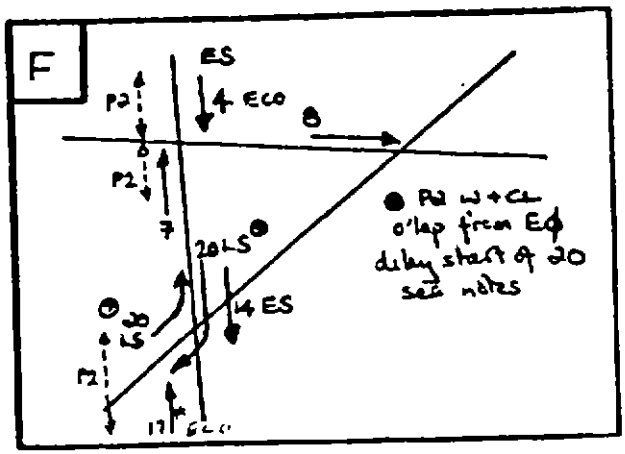


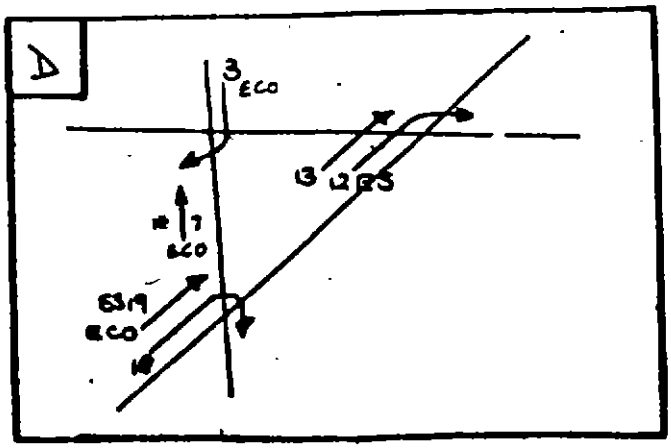
SPECIAL ALL-RED ON B→ IF SGP-9 IS RED SUBJECT TO SM1. AND C, D, E OR F IS NEXT.

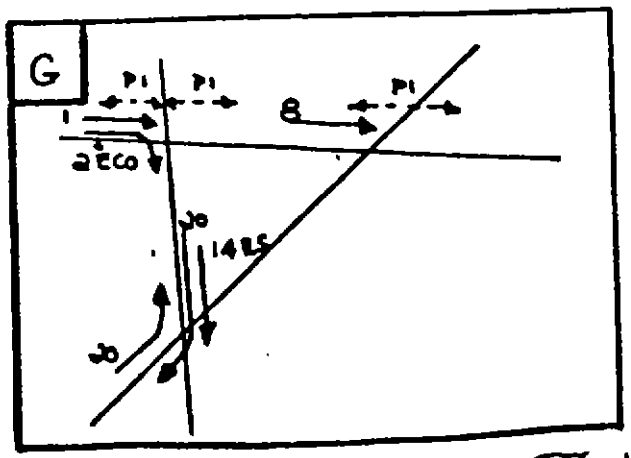




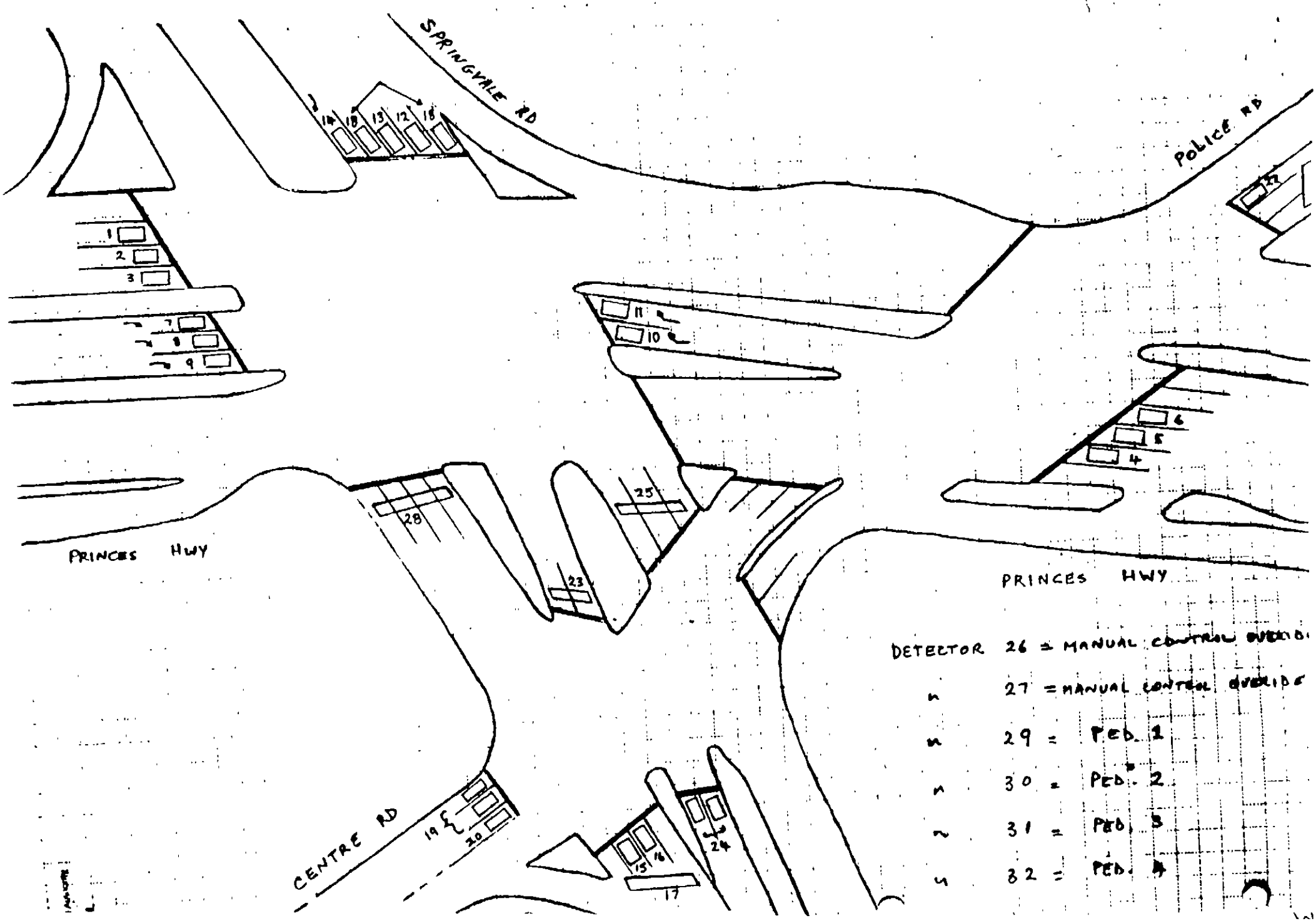
SPECIAL ALL-RED C→B OR C→A







Designed TEK 3/1

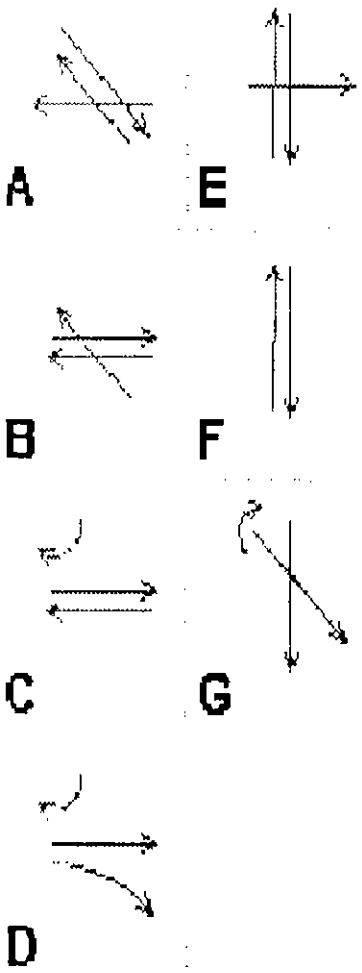

SPRINGVALE RD
POLICE RD
PRINCES HWY
PRINCES HWY
CENTRE RD
DETECTOR 26 = MANUAL CONTROL OVERRIDE
" 27 = MANUAL CONTROL OVERRIDE
" 29 = PED. 1
" 30 = PED. 2
" 31 = PED. 3
" 32 = PED. 4

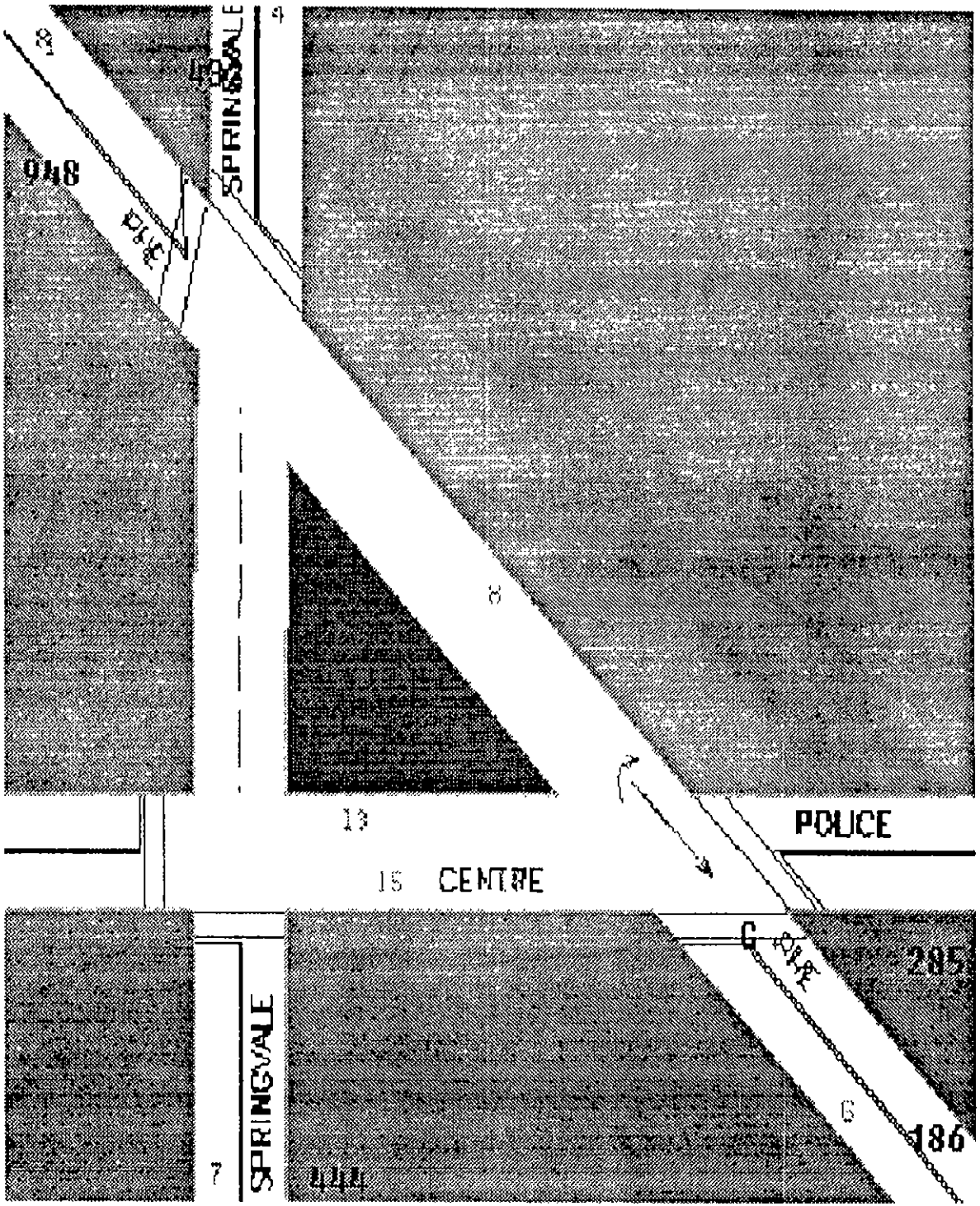
TCS 185

SPR

SPR SS=45

PHASES





STUDY OF HEAVY VEHICLE CRASHES IN URBAN AREAS

OPTION 3: REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS

Location: Dandenong-Frankston Road/Healey Road, Dandenong South

Case No: M15

Prepared by Bruce Corben and Kathy Diamantopoulou
Monash University Accident Research Centre

for Road User Research Pty Ltd,
as part of Federal Office of Road Safety Research Project 2420

1995

REPORT ON INVESTIGATION OF HEAVY VEHICLE BLACK SPOT INTERSECTIONS IN URBAN AREAS

Date of Inspection: 4 July, 1994 **Case No:** M15

1. Location Details

Street Names: Healy Road/Dandenong-Frankston Road.
Suburb and Local Government Area: Dandenong South, City of Dandenong.
Melway Map Reference: 95 D7
Road Functional Classification: Dandenong-Frankston Road: primary arterial road; Healey Road: local road (but a major role within the industrial subdivision)
Alignment/Topography: Straight, flat approaches.
Intersection Geometry (if applicable): T intersection.
Traffic Control Type: Give way sign facing Healey Road traffic.
Surrounding Land Use: Industrial.
Designated Heavy Vehicle Route: Healey Road serves a large industrial area; Dandenong-Frankston Road is an important freight link between Dandenong, Frankston and beyond.
Speed Zone: Dandenong-Frankston Road: 80 km/h; Healey Road: 60 km/h.
Number of Traffic Lanes: Healey Road - one approach and one departure lane; Dandenong-Frankston Road: two through in both directions, one exclusive left turn lane for the south bound carriageway and one exclusive right for the north bound carriageway.
Pedestrian (or other vulnerable road user) Activity: Minimal.
Characteristics of Traffic (Control) Operation: Gaps in south bound traffic are created for right-turners from Healey Road by new intersection signals at nearby Elliott Road/Monterey Road (about 600m to north)

Treatment History:
In early 1994 an additional south bound lane was constructed in Dandenong-Frankston Road, as was an exclusive left turn deceleration lane for movements into Healey Road. The timing of these works falls outside the period for which crash data are available and therefore does not impact on inferences about crash occurrence.

Location Plan Attached:
No.

Photographs Attached:
Yes.

Other Observations/Comments:
None

2. Crash Details

Period of Crash Analysis:
1987 to mid-1993

Total Number of Crashes:
Fatal - 1
Serious Injury - 5
Other Injury - 12
Total - 18

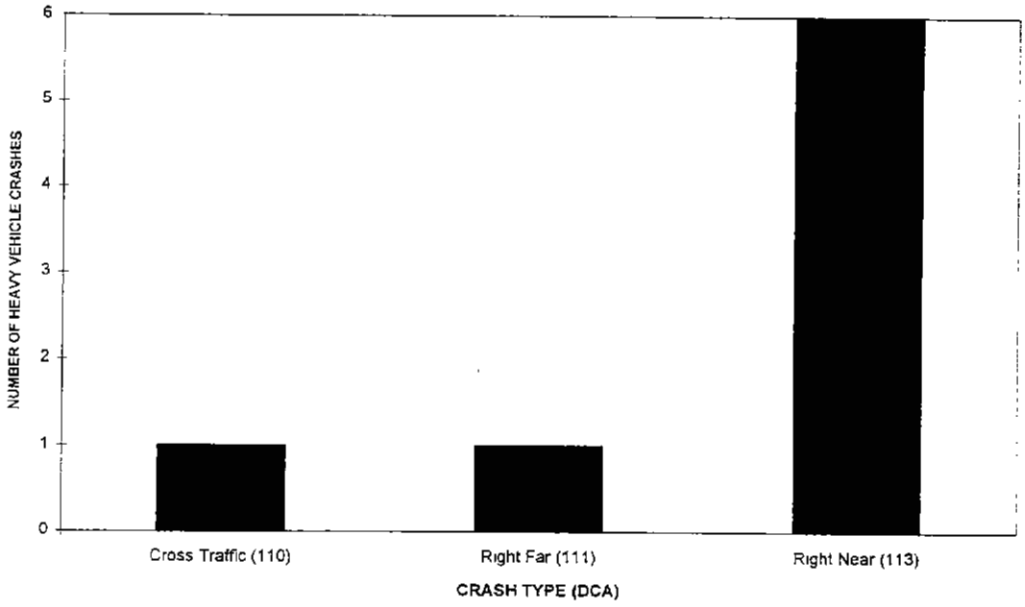
Total Number of Heavy Vehicle Crashes:
Fatal - 1
Serious Injury - 2
Other Injury - 5
Total - 8

Percentage of Heavy Vehicle to All Casualty Crashes: 44.4%

Average Percentage of Heavy Vehicle to All Casualty Crashes for Metro Melbourne Arterial/Arterial Intersections: 8.3%

Number of Crashes by Heavy Vehicle Type:
Articulated - 2
Rigid - 6
Bus - 0

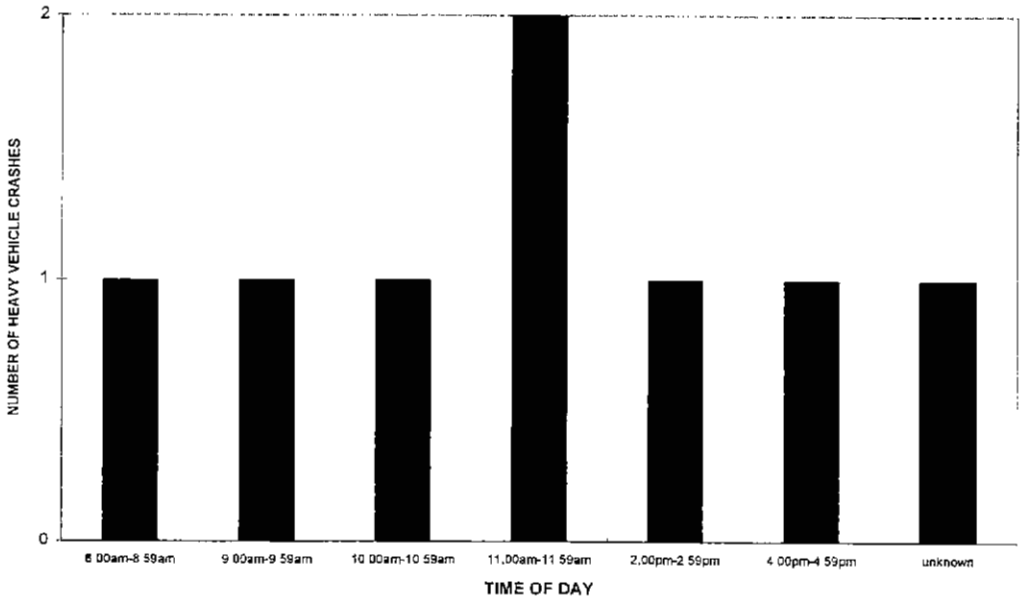
Predominant Heavy Vehicle Crash Patterns (DCA):



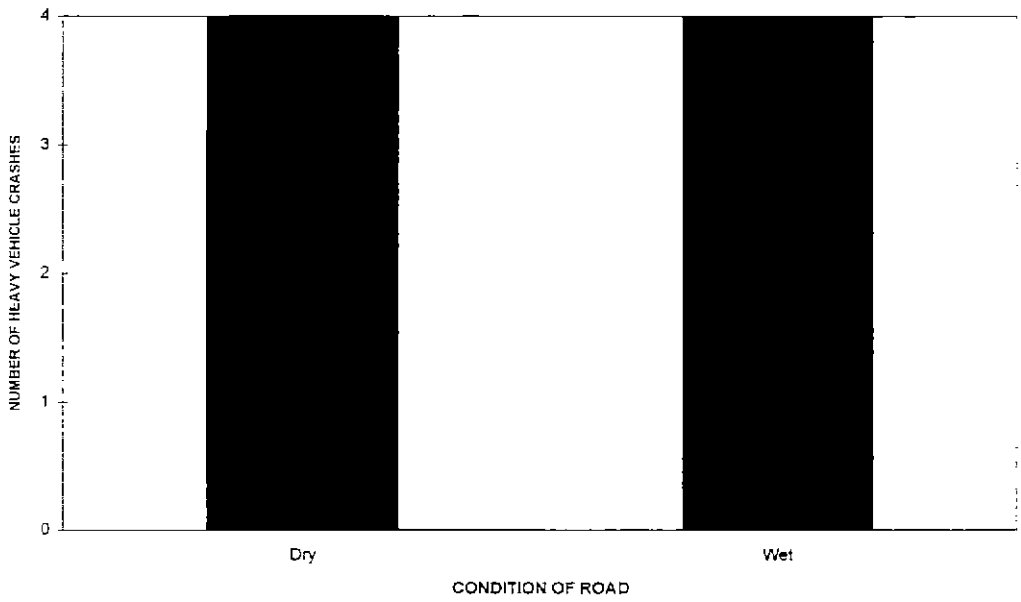
Predominant Heavy Vehicle Movements by DCA:

Right-near or right-far Type - 100%

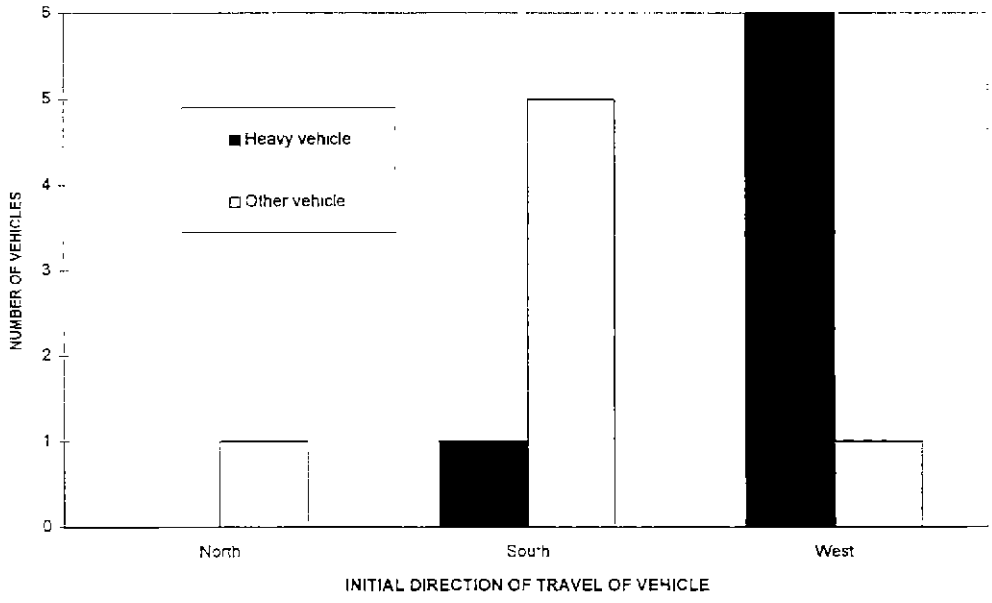
Time of Day Crash Patterns:



Condition of Road Crash Patterns:



Initial Direction of Travel of Vehicle Crash Patterns



Collision Diagram Attached:
Yes.

Other Patterns/Comments:
All crashes involved vehicles turning right from Healey Road. In seven out of eight cases, the right-turner from Healey Road was a heavy vehicle. No heavy vehicle casualty crashes have been reported since late 1990.

3. Road Environment Factors Contributing to Crash Occurrence

Speed: Unlikely to be a major contributing factor.
Alignment/Topography: No.
Intersection Geometry (if applicable): No.
Intersection Control (if applicable): Yes, to the extent that drivers are required to select safe gaps in two directions of traffic in order to make a right turn from Healey Rd.
Road Surface (friction and roughness): No.
Roadside Features/Hazards: No.
Land Use: Indirectly - being a large industrial estate heavy vehicles are major users of the intersection.
Traffic Operation: Yes - heavy vehicles turning left into Healey Road obscure the view for right-turners from Healey Road of south bound through-traffic.
Delineation: Unlikely.
Street lighting: No.
Sight Distance: No - other than the obstruction caused by heavy/large vehicles themselves.
Road Divided/Undivided: No - all approaches are divided.
Lane Configuration (e.g. lane drop/merge, etc.): Indirectly - refer to Traffic Operation above.
Lane Provision for Turning: Refer lane configuration above.
Road works: No.
Shoulder Condition: No.
Other: No.

4. Conclusions

The following factors may have, in combination, contributed to the occurrence of heavy vehicle crashes at this location:

- **approaching heavy vehicles, being positioned to turn left into Healey Road, obscure the view for right-turners from Healey Road** of approaching south bound traffic,
- the drivers of heavy vehicles turning right from Healey Road **failing to choose safe gaps** in Dandenong-Frankston Road traffic (principally south bound).

5. Countermeasure Options

Given that no heavy vehicle crashes have occurred since 1990 and with the improvements made to the intersection geometry in 1994, namely the construction of an exclusive left turn lane to reduce the problem of large, left-turning vehicles obscuring the view for right-turners of through vehicles (refer to section 1 of this report), no further countermeasures appear warranted at this time

ATTACHMENTS

HEAVY VEHICLE BLACKSPOT INTERSECTIONS IN URBAN AREAS

LOCATION: Dandenong-Frankston Road/ Healy Road, City of Cranbourne (LGA = 13)

Location Details

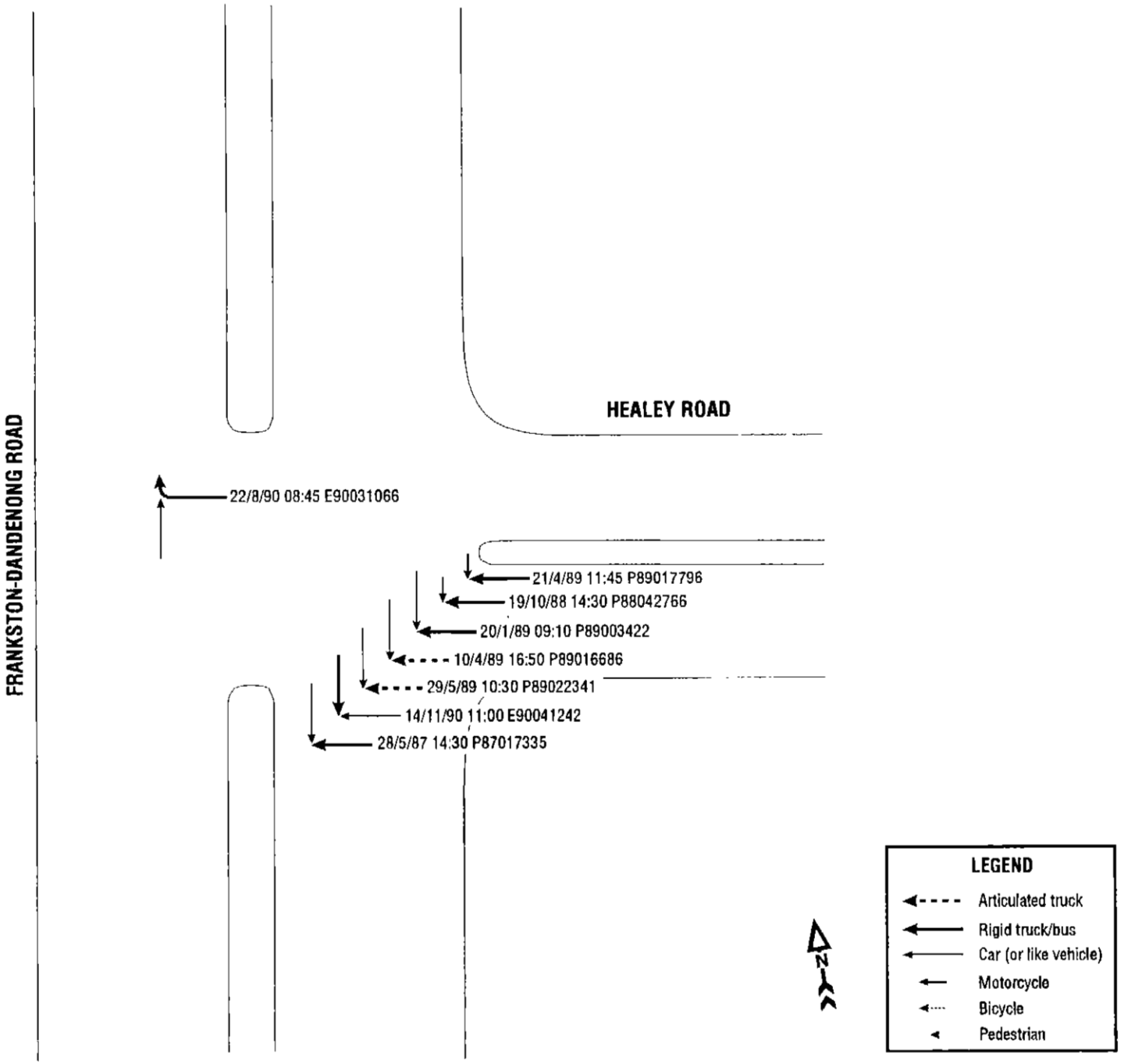
ACCIDENT NUMBER	DATE	TIME OF DAY	DAY OF WEEK	DCA CRASH TYPE	SEVERITY LEVEL	VEHICLE DIRECTION	VEHICLE TYPE	SPEED LIMIT	LIGHT CONDITION	WEATHER CONDITION	ROAD CONDITION
P88042766	19-Oct-88	1430	Wednesday	Right Near	Fatality	W /S /	7/10/ .	80	DAY	Clear	Dry
P89003422	20-Jan-89	910	Friday	Right Near	Other Injury	W /S /	7/ 1/ .	80	DAY	Clear	Dry
P89016686	10-Apr-89	1650	Monday	Right Near	Other Injury	W /S /	6/ 1/ .	80	DAY	Raining	Wet
P89017796	21-Apr-89	1145	Friday	Right Near	Serious Injury	W /S /	7/10/ .	75	DAY	Clear	Dry
P89022341	29-May-89	1030	Monday	Right Near	Other Injury	W /S /	6/ 2/ .	75	DAY	Raining	Wet
E90031066	22-Aug-90	845	Wednesday	Right Far	Other Injury	W /N /	7/ 4/ .	75	DAY	Raining	Wet
E90041242	14-Nov-90	1100	Wednesday	Right Near	Serious Injury	S /W /	7/ 1/	75	DAY	Clear	Dry
P87017335	28-May-87	unknown	Thursday	Cross Traffic	Other Injury	unknown	5/ 7/ .	75	DARK	Raining	Wet

Note: Vehicle Type Codes: 1,2,3,4,5 - Car or similar: 6 - Articulated Truck: 7 - Rigid Truck: 8 - Bus/Coach: 10 - Motorcycle: 13 - Bicycle

Urban Road Locations
Hazardous to Heavy Vehicles

1987-Mid 1993

Collision Diagram 15
Prepared 11/5/94



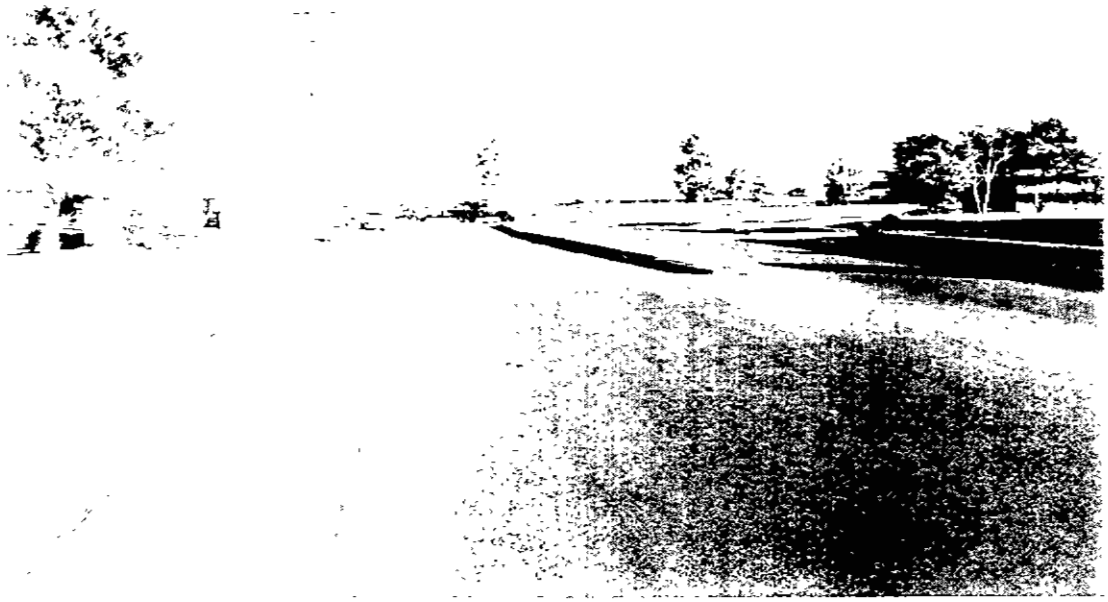


PHOTO 1 OF 4 - FACING WEST

PHOTO 2 OF 4 - FACING NORTH FROM STOP LINE

PHOTO 3 OF 4 - FACING NORTH

PHOTO 4 OF 4 - FACING SOUTH