Appendix A:
Signal Data Information for Modelling

Contents

A.1 Introduction

The input of accurate traffic signal data is important in the calibration and validation of a base model and also in the assessment of proposed models. *Signal Data Information for Modelling* document has been developed to provide detail of the options available for determining signal timings from SCATS[1] data for an existing site and also for the calculation of signal timings for a proposed site. It is important to note that this document is intended for modelling purposes only.

A.1.1 Data collection

For modelling an existing signalised intersection, the following information can be found on Main Roads TrafficMap:

Pavement and Signage Drawing (Light Maintenance drawings, LMB[2]) to identify:

- lane configuration;
- permitted movements.

Traffic Signal Arrangement Drawing (LMA[3]) to identify:

- signal group numbers;
- phasing arrangement;
- detector locations and numbers (for interpreting SCATS traffic volumes);
- signal lantern configurations per signal group; and
- filtered movements.

Signal Data spreadsheet which contains following tabs:

1. **Site tab** to identify:
   - TCS number(s)
   - SCATS region(s)
2. **Timings tab** to identify:
   - phase late start;
   - phase minimum green;
   - phase early cut-off green;
   - phase yellow;
   - phase all-red;
   - phase maximum green;

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[1] SCATS (Sydney Co-ordinated Adaptive Traffic System) is an adaptive urban traffic management system that synchronises traffic signals to optimise traffic flow across a whole city, region or corridor.

[2] LMB plans are signs and lines drawings showing the built geometry, carriageway widths and lane utilisation.

[3] LMA plans are traffic signal drawing plans that show the location of existing signal heads, SCATS detector loops and existing signal phases.

- pedestrian delay times;
- pedestrian walk time;
- pedestrian clearance 1 and clearance 2 times; and
- pedestrian protection time

3. **Link and Offset Plans** tab to identify:
    - Subsystem;
    - coordinated phases plans;
    - link plans; and
    - upper/lower cycle lengths.
4. **SCATS Phase History** tab to identify:
    - operated phase lengths;
    - operated cycle lengths;
    - operated phase sequences; and
    - traffic phase demand frequency.

Detector Volume Data spreadsheet also contains SCATS traffic volume data.

Phase Sequence Chart which generally contains late start, delays, pedestrian protection and special facilities (Refer to Attachment A.1).

Additional information such as **Strategic Monitor** (Refer to Attachment A.2) to identify selected link plans and **SCATS Event History** data to identify alternative phase and pedestrian demand frequency (Refer to A.2.4) can be provided by Main Roads.

A.1.2 Traffic Signal Modelling Components

In order to develop a high quality model of signalised intersections, modellers should ensures phases, inter-phases, signal groups, and coordination are modelled correctly. *Table A-1* provides the main traffic signal components which are required for modelling.

Table A-1 Traffic Signal Modelling Components

Component	Item	Note
Phases / inter-phases	Phasing sequence	LMA and Section A.4
	Minimum green time	Section A.1.1 and A.3.2
	Filtering movement	Refer to LMA
	Alternative and pedestrian phase frequency	Section A.2.2
	Average phase length	Section A.2.3
	Yellow time	Section A.1.1 and A.3.3.2
	All-red time	Section A.1.1 and A.3.3.2
	Signal group overlap	To determine if a signal group overlaps during intergreen time site visit may require.
Traffic Signal groups / phases	Late Start	Sections A.1.1and A.3.3.1
	Early Cut-off	Section A.1.1 and A.3.3.10
	Pedestrian protection time	Section A.3.5 and A.1
Pedestrian Signal groups	Delay	Sections A.3.4.1 and A.1
	Walk time	Section A.3.4.2 and A.1
	Clearance time	It may need to be recalculated for intersections with updated geometry. Section A.3.4.3 and A.1
	Walk for green	Section A.3.4.4
Coordination	Coordinate phase	A.5.2
	Reference site and phase	A.5.3
	Offset length	A.5.4

A.2 Average Signal Timing for Existing Sites

In the development of operational models the average timings are usually calculated for the relevant peak hour in the base model. This section provides information on how to calculate average signal timings based on SCATS data.

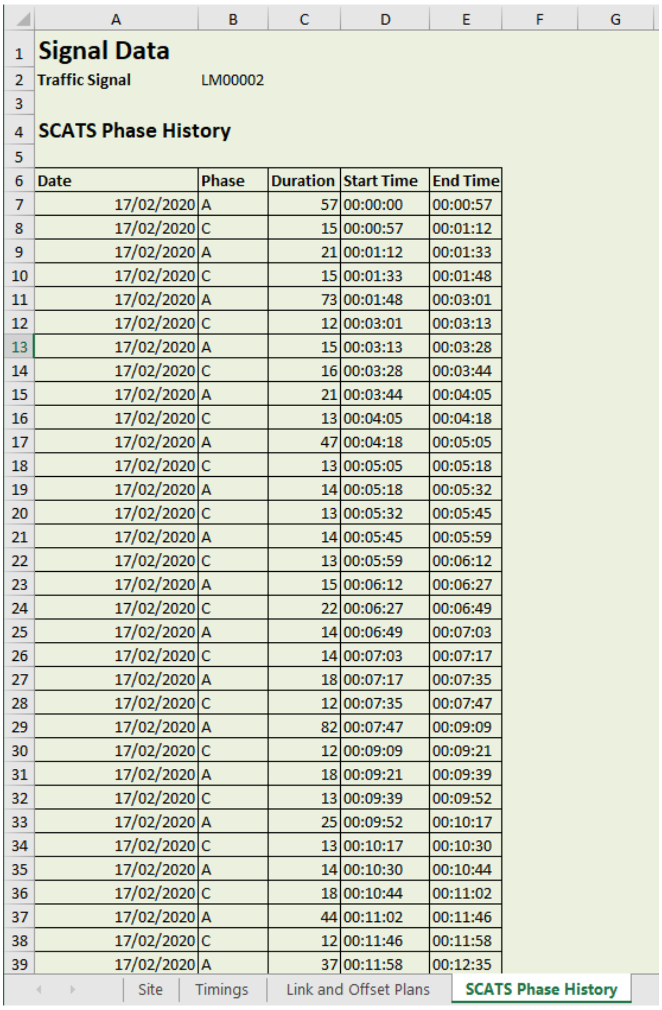
There are many ways to determine the average timings ranging from using very little data (five minute signal data collected on site) to detailed analysis of SCATS data. For operational modelling Main Roads requires the use of SCATS data, such as phase or event history, to determine the average signal timings.

A.2.1 SCATS Phase History File

A SCATS phase history file is a log file which contains phase sequences and phase times at signalised intersections. These files are generally available for the past 24 months and can be exported into a text or CSV file.

As *Figure A-1* shows, a phase history file (extracted from Main Roads *TrafficMap* Website) contains date, duration, start time and end time of the phases.

Figure A-1: Example of SCATS Phase History File (.xlsx)



Signal Data

Traffic Signal LM00002

SCATS Phase History

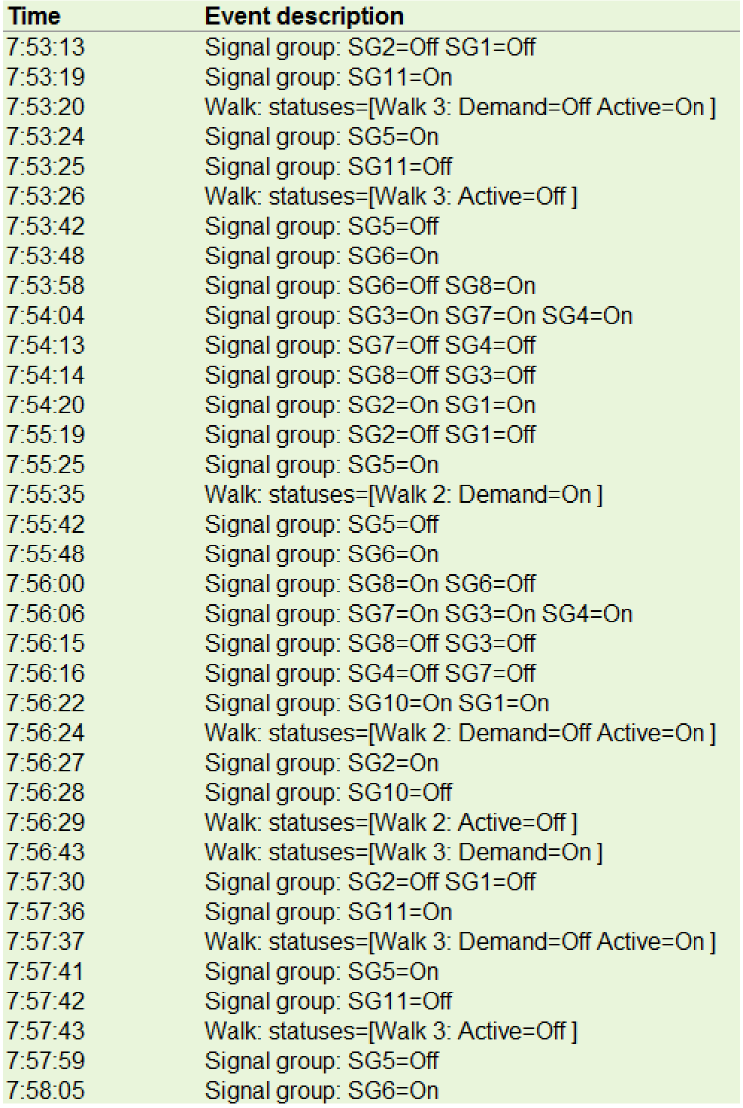
Date	Phase	Duration	Start Time	End Time
17/02/2020	A	57	00:00:00	00:00:57
17/02/2020	C	15	00:00:57	00:01:12
17/02/2020	A	21	00:01:12	00:01:33
17/02/2020	C	15	00:01:33	00:01:48
17/02/2020	A	73	00:01:48	00:03:01
17/02/2020	C	12	00:03:01	00:03:13
17/02/2020	A	15	00:03:13	00:03:28
17/02/2020	C	16	00:03:28	00:03:44
17/02/2020	A	21	00:03:44	00:04:05
17/02/2020	C	13	00:04:05	00:04:18
17/02/2020	A	47	00:04:18	00:05:05
17/02/2020	C	13	00:05:05	00:05:18
17/02/2020	A	14	00:05:18	00:05:32
17/02/2020	C	13	00:05:32	00:05:45
17/02/2020	A	14	00:05:45	00:05:59
17/02/2020	C	13	00:05:59	00:06:12
17/02/2020	A	15	00:06:12	00:06:27
17/02/2020	C	22	00:06:27	00:06:49
17/02/2020	A	14	00:06:49	00:07:03
17/02/2020	C	14	00:07:03	00:07:17
17/02/2020	A	18	00:07:17	00:07:35
17/02/2020	C	12	00:07:35	00:07:47
17/02/2020	A	82	00:07:47	00:09:09
17/02/2020	C	12	00:09:09	00:09:21
17/02/2020	A	18	00:09:21	00:09:39
17/02/2020	C	13	00:09:39	00:09:52
17/02/2020	A	25	00:09:52	00:10:17
17/02/2020	C	13	00:10:17	00:10:30
17/02/2020	A	14	00:10:30	00:10:44
17/02/2020	C	18	00:10:44	00:11:02
17/02/2020	A	44	00:11:02	00:11:46
17/02/2020	C	12	00:11:46	00:11:58
17/02/2020	A	37	00:11:58	00:12:35

A.2.2 SCATS Event History File

SCATS event history provides the recorded history of signal group activation for all signal groups (including pedestrian signal groups, labelled as Walk). This file can be used to calculate the pedestrian and alternative phase demands. Main Roads can provide SCATS event history file in .csv format.

Figure A- 2 shows an example of SCATS event history file for traffic and pedestrian signal groups.

Figure A- 2: Example of SCATS Event History file for pedestrian signal groups



Time	Event description
7:53:13	Signal group: SG2=Off SG1=Off
7:53:19	Signal group: SG11=On
7:53:20	Walk: statuses=[Walk 3: Demand=Off Active=On]
7:53:24	Signal group: SG5=On
7:53:25	Signal group: SG11=Off
7:53:26	Walk: statuses=[Walk 3: Active=Off]
7:53:42	Signal group: SG5=Off
7:53:48	Signal group: SG6=On
7:53:58	Signal group: SG6=Off SG8=On
7:54:04	Signal group: SG3=On SG7=On SG4=On
7:54:13	Signal group: SG7=Off SG4=Off
7:54:14	Signal group: SG8=Off SG3=Off
7:54:20	Signal group: SG2=On SG1=On
7:55:19	Signal group: SG2=Off SG1=Off
7:55:25	Signal group: SG5=On
7:55:35	Walk: statuses=[Walk 2: Demand=On]
7:55:42	Signal group: SG5=Off
7:55:48	Signal group: SG6=On
7:56:00	Signal group: SG8=On SG6=Off
7:56:06	Signal group: SG7=On SG3=On SG4=On
7:56:15	Signal group: SG8=Off SG3=Off
7:56:16	Signal group: SG4=Off SG7=Off
7:56:22	Signal group: SG10=On SG1=On
7:56:24	Walk: statuses=[Walk 2: Demand=Off Active=On]
7:56:27	Signal group: SG2=On
7:56:28	Signal group: SG10=Off
7:56:29	Walk: statuses=[Walk 2: Active=Off]
7:56:43	Walk: statuses=[Walk 3: Demand=On]
7:57:30	Signal group: SG2=Off SG1=Off
7:57:36	Signal group: SG11=On
7:57:37	Walk: statuses=[Walk 3: Demand=Off Active=On]
7:57:41	Signal group: SG5=On
7:57:42	Signal group: SG11=Off
7:57:43	Walk: statuses=[Walk 3: Active=Off]
7:57:59	Signal group: SG5=Off
7:58:05	Signal group: SG6=On

Definition of SCATS history outputs for traffic signal groups are listed below:

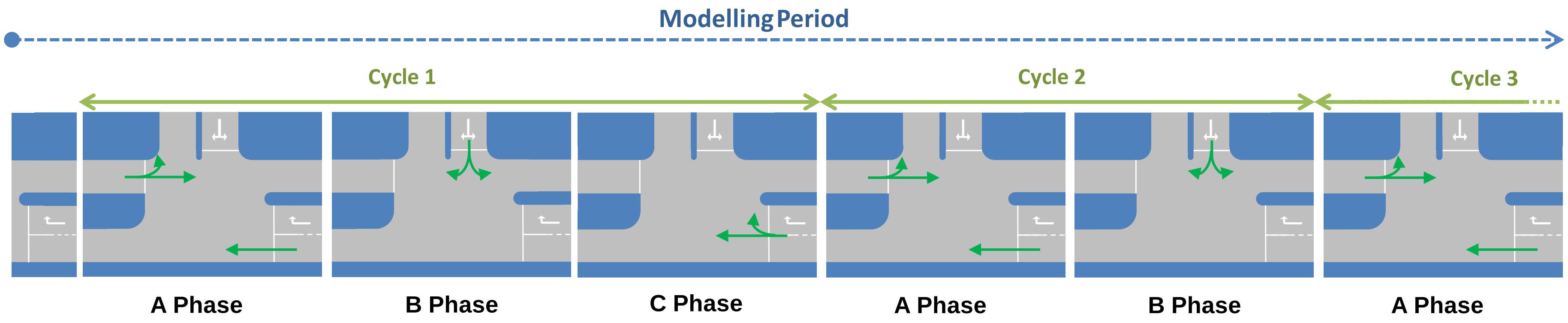
- SG*i* is signal group *I;*
- SG*i*=On is recorded when signal; group *i* is activated; and
- SG*i*=Off is recorded at the end of green time for signal group *i*.

A.2.3 Average Signal Timing Calculation

This section discusses the method that is recommended by Main Roads for calculating average signal timings for modelling. Calculations should be included in the modelling package for auditing purposes.

For modelling purposes, a complete cycle can be defined as from the start of the stretch phase[4] of a phase sequence to the start of the next stretch phase. *Figure A-3* shows an example of typical cycles of a signalised T-intersection with three phases. The stretch phase in this example is A phase. In cycle 2, C phase was skipped.

Figure A-3: Cycles of a T-intersection with three phases



The average cycle length and average phase lengths are calculated only for the completed cycles which start during the modelling period. The last complete cycle may finish after the end of the modelling period, however, that will be included in the calculations. Therefore, ‘calculation period’ is defined from the start of the first stretch phase within the modelling period until the start of the first stretch phase after the end of the modelling period.

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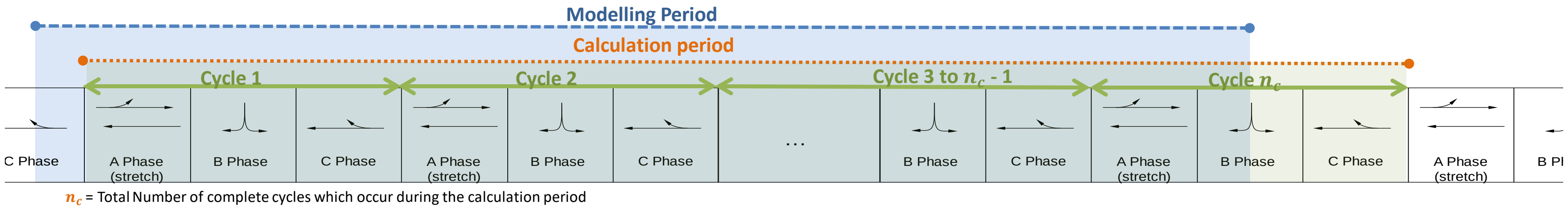
[4] Every phase sequence has one stretch phase which will run in every cycle. The stretch phase uses all the time not used by the other phases in the sequence. Most of the time the stretch phase is A phase.

Figure A-4 shows an example of how the calculation period of average timings can fall outside of the modelling period due to the stretch phase of the last cycle to be included has started during the modelling period.

Figure A-4: Calculation period



Average of the cycle length (ct_A) during the time period can be calculated as below:

$$ct_A = \frac{ct_T}{n_C}\text{(seconds)}$$

Where:

n_C is the number of complete cycles that occur during the calculation period. This is equal to the number of stretch phases that occur during the calculation period.

ct_T is total length of calculation period in seconds which is equal to the total length of complete cycles which starts during the time period. This is equal to the length of the time from when the first stretch phase occurred in the time period until the start of the first stretch phase which occurs immediately after the end of the time period (*Figure A-4*).

Average phase length (t_i) for every phase in the sequence during the time period (t_i, e.g. for A phase, i=A, for B phase, i=B etc.) can be calculated as below:

$$t_i = \frac{pt_i}{n_C} \quad \text{(seconds)}$$

Where:

pt_i is the total time in seconds when i phase (i= A, B, …) is active during the calculation period.

This activation time includes total green time and following intergreen time (early cut-off, yellow and all-red).

The sum of the average phase lengths during a time period should be equal to average cycle length for that time period.

It should be noted phase frequency is not considered in the average phase time calculated in SCATS History Viewer or SCATS History Reader.

The following Equation can be used to determine average phase lengths using calculated average phase lengths in SCATS:

$$t_i = ts_i \times f_i \qquad \text{(seconds)}$$

Where:

ts_i is calculated average phase time in SCATS for i phase; and

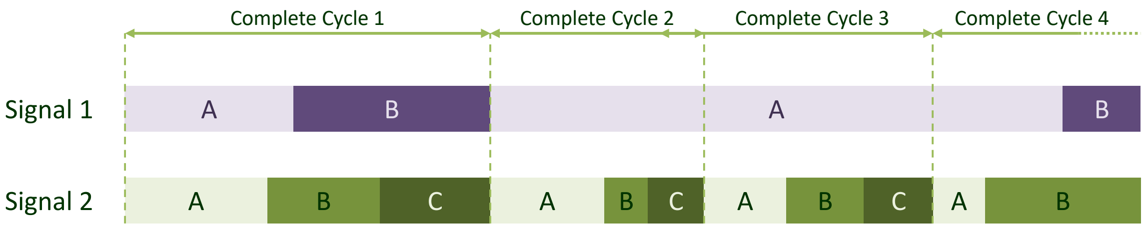
f_i is frequency of i phase ($0 \leq f_i \leq 1$).

Frequency of stretch phase is always one (100 percent).

For sites with low frequency phases, the stretch phase can be extended over more than one complete cycle of coordinated sites. This is important for calculation of a common cycle time for coordinated sites. In this situation average phase and cycle lengths may need to be calculated based on number of complete cycles that occur during the calculation period at other coordinated sites.

Start of A phases at Signal 1 and 2 are coordinated in the example which is shown in Figure A-5. To reflect the coordination between these signals in a model with fixed signal timings, the average phase and cycle times for Signal 1 should be calculated based on the number of complete cycles at Signal 2.

Figure A-5: Complete Cycles for Coordinated Sites



A.2.4 Pedestrian Demand Estimation

SCATS event history file (Figure A- 2) records if a pedestrian signal group operates during a phase. This can be used to estimate the pedestrian demand for modelling (i.e. when pedestrian signal groups are not run in every cycle).

Definition of SCATS history outputs for pedestrian signal groups are listed below:

- Walk *j* is pedestrian signal group *j.*
- Walk *j*: Demand=On is recorded when demand for pedestrian signal group *j* is detected (e.g. push button is pressed).

- Walk *j*: Demand=Off Active=On is recorded when demand for pedestrian signal group *j* is met as a result of its activation.
- Walk *j*: Active=Off is recorded at the start of clearance 1 for the pedestrian signal group *j*.

The number of pedestrian signal group activations during a time period may be estimated by counting the number of situations when signal group *j* was activated (e.g. Walk 1: Demand=Off Active=On) from the start of the first complete cycle until the end of the last complete cycle that started during the time period.

A.3 Signal Data Time Settings

For developing a well calibrated model of a signalised intersection, signal time settings in the model must be consistent with the current settings for an existing site or must be calculated carefully for a new site.

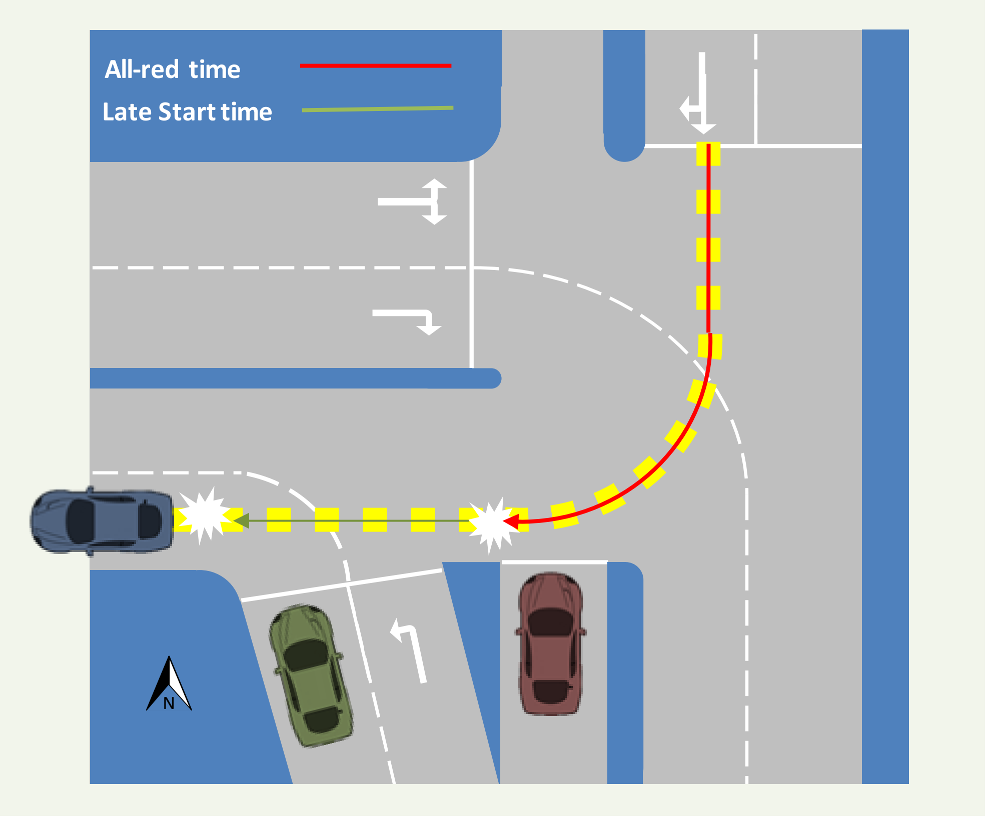
A.3.1 Late Start

The late start setting is typically used as a pre-defined time to delay the introduction of some signal groups at the start of a phase.

Two examples of late starts are:

- to delay the start of a left turn signal group because of the intersection geometry (Figure A-6);

Figure A-6: Example of left turn signal group late start (northbound)



- to delay the start of the filtering right turn. Examples of phasing sequence which includes late start applied on filtering right turn are shown in *Figure A-21* and *Figure A-25*.

Proposing late start for a new or an existing intersection requires Main Roads' agreement. For existing intersections, late start time can be found on Main Roads *TrafficMap* (Timings tab in Signal Data Spreadsheet and phase sequence chart).

Phase sequence chart (.doc) often contains late start information. This document may specify any signal groups on which late start time is applied. Site observation is required to confirm that these timings have been applied correctly.

A.3.2 Minimum Green

Minimum green is a minimum safe time when the green aspect of a signal must be displayed when it changes from red to green. Minimum green time is mainly dependant on the width of the intersection but can also be influenced by geometry, grades, usage by heavy vehicles and other local factors. In WA minimum green is greater or equal to six seconds.

For existing intersections, minimum green can be found on Main Roads *TrafficMap* (Timings tab in Signal Data Spreadsheet).

A.3.3 Vehicle Intergreen Times

Intergreen time is the period between the end of the green time of one phase and the beginning of the next phase's green time. This transition time includes early cut-off time, yellow time and all-red time.

For new signalised intersections or existing signal intersections with proposed modifications, intergreen times may be changed. Therefore, for the new scheme, in order to minimise the risk of accidents, intergreen times should be calculated carefully. The formulae in the proceeding sections were published in *Austroads' 2016 Guide to traffic Management Part 9: Traffic Operations, Appendix G: Signal Timing*. Modellers should follow the recommended methods to calculation intergreen times for signalised intersections in Western Australia.

For existing intersections, vehicle intergreen times can be found on Main Roads *TrafficMap* (Timings tab in Signal Data Spreadsheet and phase sequence chart).

A.3.3.1 Early Cut-off

Early cut-off time is used at two stage traffic signals, advanced warning flashing signals (AWFS) or extending clearance time for bicycle signal groups. It may also be used to manage traffic in a network (gating etc.).

Early cut-off time is calculated based on its application:

- For AWFS, early cut-off value (normally 7 seconds) depends on distance, approach speed and grade. For more information refer to Main Roads' Advance Warning Flashing Signals webpage.
- For staggered shut down, early cut-off time depends on the distance between the two stop lines.
- For sites coordinated with rail crossings, early cut-off time depends on the opening/closing speed of the boom gates and the distance from stop line to boom gates or time to get to the rail crossing at the end of the railway phase and time clear the rail crossing area (no man's land) at the end of the clearance phase.

A.3.3.2 Yellow Time

Yellow time provides sufficient warning of phase termination to drivers to decelerate and stop safely. A typical practical yellow time is defined from three to six seconds as recommended by Austroads.

The equation below from Austroads (AGTM09-16) shows how to determine the yellow time:

$$\boldsymbol{t_y = t_r + 0.5\,(V_D/3.6)/(a_d + 9.8G)} \text{ subject to } \boldsymbol{t_y \geq 3.0} \quad \text{(seconds)}$$

Equation: A-1

where:

t_y =yellow time (s)

t_r = reaction time (s), (1.0 s – 1.5 s)

V_D = design speed (km/h)

a_d = the deceleration acceptable to the majority of drivers (m/s²), commonly taken as 3.0 m/s², but in the case of heavy vehicles a lesser value may be appropriate

G = average approach grade over the stopping distance (per cent grade divided by 100)

$\begin{cases} G > 0 & for\ uphill\ grade \\ G < 0 & for\ downhill\ grade \end{cases}$ e.g. -0.05 for 5% downhill

It is recommended to round up the calculated yellow time from Equation: A-1 to the nearest 0.5 second for practical reasons. The same yellow time must be applied for the opposite traffic movements at an intersection on a grade.

For implementation yellow time in WA, *Table A-2* shows appropriate yellow times for different approach grades. Modellers should use this table to determine yellow times.

Table A-2: Yellow time $(\boldsymbol{Determined\ using\ t_r = 1.0\ s\ \ and\ \ a_d = 3.0\ m/s^2})$

Approach grade	$\boldsymbol{V_D = 40\ km/h}$	$\boldsymbol{V_D = 50\ km/h}$	$\boldsymbol{V_D = 60\ km/h}$	$\boldsymbol{V_D = 70\ km/h}$	$\boldsymbol{V_D = 80\ km/h}$
10.1% to 15% downhill	5.0	6.0	6.5	7.5	8.5
6% to 10% downhill	4.0	4.5	5.5	6.0	6.5
4.1% to 5.9% downhill	3.5	4.0	4.5	5.0	5.5
Level (0% to ± 4%)	3.0	3.5	4.0	4.5	5.0
4.1% to 5.9% uphill	3.0	3.0	3.5	4.0	4.5
6% to 10% uphill	3.0	3.0	3.5	4.0	4.5
10.1% to 15% uphill	3.0	3.0	3.5	3.5	4.0

Source: Main Roads Western Australia Website

The yellow time for signal groups with an early cut-off is equal to the yellow time of the phase in which the early cut-off operates.

A.3.3.3 All-red Time

The second part of the intergreen time is all-red time which provides sufficient time for vehicles crossing the stop line at the end of the yellow time of a phase or signal group to clear the conflict area with vehicle and pedestrian traffic of the next phase.

The recommended method by Austroads (AGTM09-16) to calculate all-red time is shown in the equation below:

$$\boldsymbol{t_{ar} = 3.6\ L_c/V_D} \text{ subject to } \boldsymbol{t_{ar} \geq 1.0} \qquad \text{(seconds)}$$

Equation A-2

where:

t_{ar} = all-red time (s)

L_c = clearance distance between the stop line and furthest point of potential conflict with vehicle and pedestrians of the next phase (m)

V_D = design speed (km/h)

In WA, posted speed is used in all-red time calculations.

For implementation purposes in WA, the following steps are taken to calculate all-red time:

Step 1: measure the clearance distance between the stop line and furthest point of potential conflict with vehicles and pedestrians of the next phase (in meter);

Step 2: divide the measured length by the posted speed limit in meter per second provided in *Table A-3*.

Table A-3: Posted speed limit in meter per second to calculate all-red time

Posted Speed – km/hr	Posted Speed – m/sec
40 km/hr	11 m/sec
50 km/hr	13 m/sec
60 km/hr	16 m/sec
70 km/hr	19 m/sec
80 km/hr	22 m/sec

Step 3: round the result up in increments of 0.5 seconds.

For unusual traffic conditions, longer all-red times can be justified (for example, heavily used intersections by slow vehicles).

To determine all-red times, modellers should refer to calculated values in *Table A-4* which provides all red time based on distance measured from stop line to last point of conflicts.

Table A-4: All-red Time

All-red (Distance measured from stop line to last point of conflict in meter)			
40 km/h – d/11		**50 km/h - d/13**	
DISTANCE* (Metres)	**TIME (Seconds)**	**DISTANCE* (Metres)**	**TIME (Seconds)**
up to 11	1.0	up to 13	1.0
12 to 17	1.5	14 to 19	1.5
18 to 22	2.0	20 to 26	2.0
23 to 28	2.5	27 to 32	2.5
29 to 33	3.0	33 to 39	3.0
34 to 38	3.5	40 to 45	3.5
39 to 44	4.0	46 to 52	4.0
60 km/h - d/16		**70 km/h - d/19**	
DISTANCE* (Metres)	**TIME (Seconds)**	**DISTANCE* (Metres)**	**TIME (Seconds)**
up to 16	1.0	up to 19	1.0
17 to 24	1.5	20 to 28	1.5
25 to 32	2.0	29 to 38	2.0
33 to 40	2.5	39 to 47	2.5
41 to 48	3.0	48 to 57	3.0
49 to 56	3.5	58 to 66	3.5
57 to 64	4.0	67 to 76	4.0
80 km/h - d/22			
DISTANCE* (Metres)	**TIME (Seconds)**		
up to 22	1.0		
23 to 33	1.5		
34 to 44	2.0		
45 to 55	2.5		
56 to 66	3.0		
67 to 77	3.5		
78 to 88	4.0		

Source: Downer Mouchel and Main Roads WA, as per Austroads Guide to Traffic Management Part 9: Traffic Operations (2016)

A.3.4 Pedestrian Timings

Pedestrian timings include:

- Delay
- Walk time (invitation to cross) when pedestrians begin their crossing (green figure on pedestrian lantern); and
- Clearance time (clearance 1 + clearance 2) is the time period which is provided for pedestrians to allow them to complete their crossing safely if they have stepped off the kerb at end of the walk time. During the clearance time there is a flashing red figure or countdown timer for mid-block signalised pedestrian crossing.

For existing intersections, pedestrian times can be found on Main Roads *TrafficMap* (Timings tab in Signal Data Spreadsheet).

For new signalised intersections or existing signal intersections with proposed modifications, pedestrian timings may be changed. Therefore, in order to minimise the risk of accident, those timings should be calculated carefully. Information on how to calculate the pedestrian timings are provided in sections A.3.4.1 to A.3.4.4.

Figure A-7, Figure A-8 and Figure A-9 show the relationship between vehicle traffic signal timing and pedestrian timings for different situations.

Figure A-7: Parallel walk with minimum green time i.e. phase is extended by pedestrians

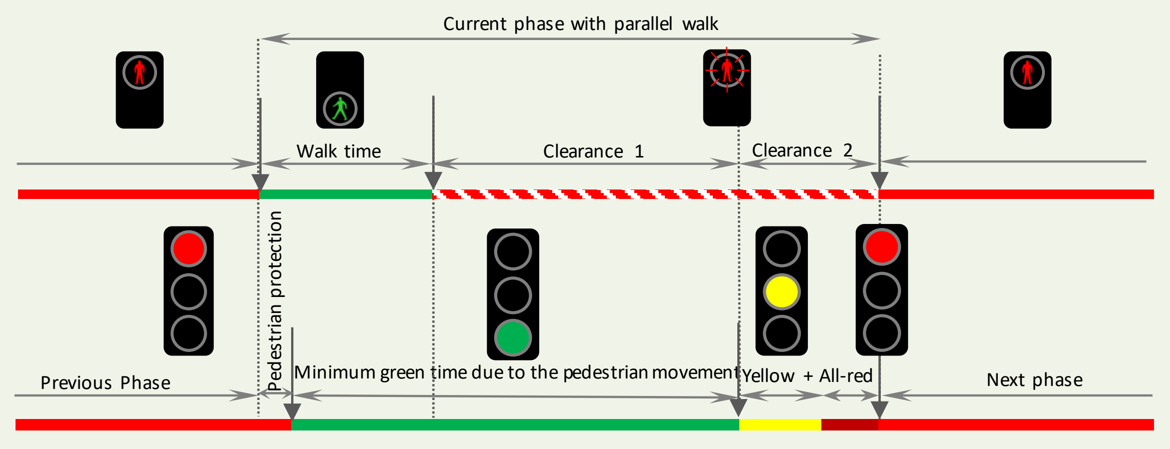


Figure A-8: Parallel walk with extended green time i.e. phase is extended by vehicles

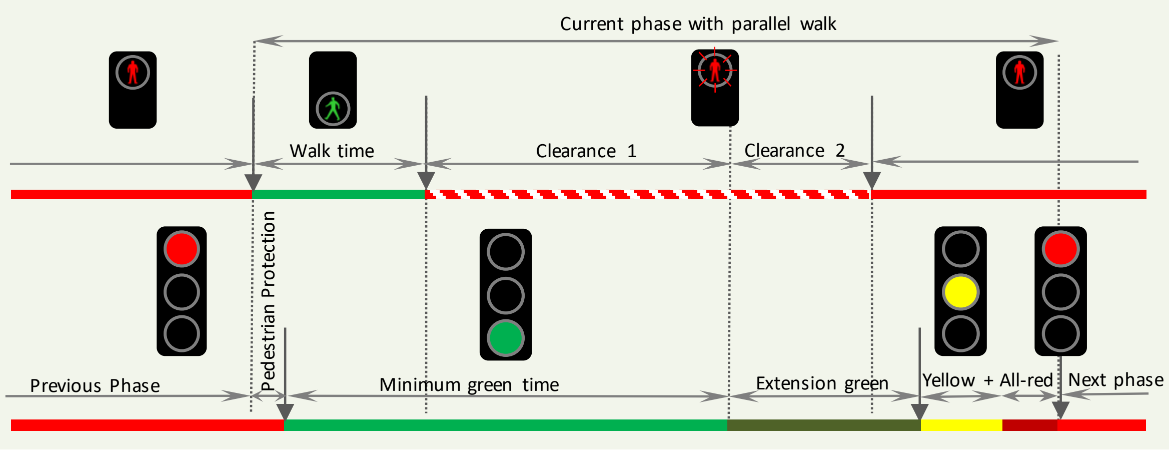
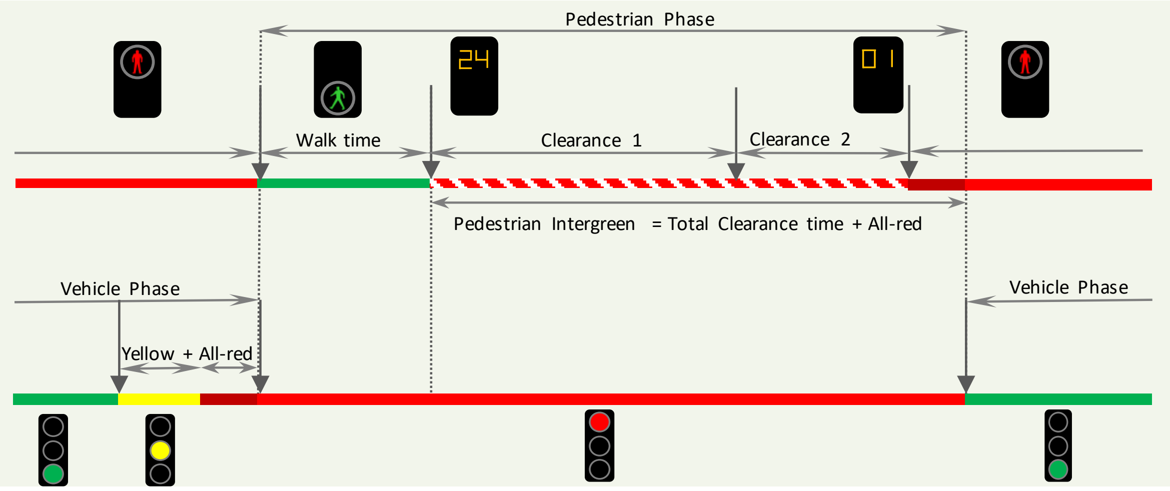


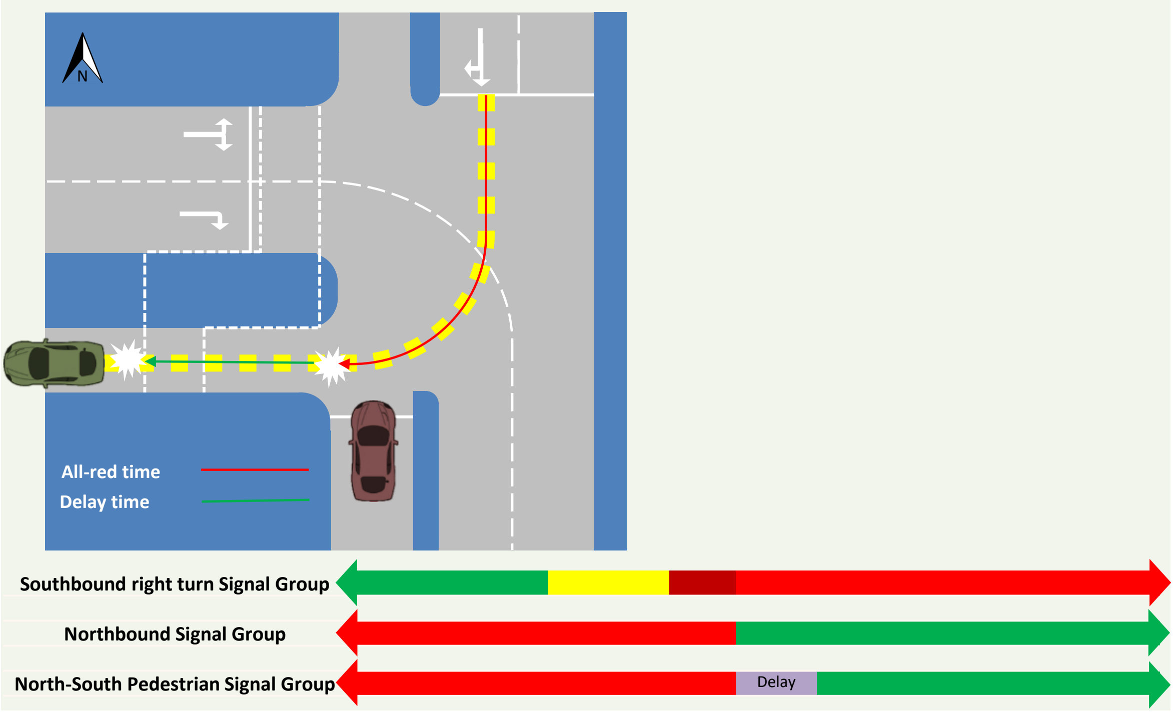
Figure A-9: Mid-block signalised crossing



A.3.4.1 Delay

Delay time will be applied before pedestrian walk time wherever all-red time of the previous phase is not sufficiently long to clear the conflict area with a parallel pedestrian crossing of the proceeding phase. For example, *Figure A-10* shows an example of delay time where the pedestrian conflict area is further away from the vehicles conflict area and how delay would be applied for the pedestrian signal group during the phase transition.

Figure A-10: An example of application of pedestrian delay time



A.3.4.2 Walk Time

Walk time (invitation to cross) is usually six seconds in WA, but may be increased in locations if deemed necessary, perhaps where vulnerable road users or mobility impaired users are prevalent. This is subject to Main Roads' policy and guidance.

A.3.4.3 Clearance Time

The pedestrian clearance time is based on the pedestrian crossing length measured from pushbutton pole to the ramp on the opposite kerb (Refer to *Figure A-11*: Full Crossing Length (A)).

Clearance time includes 'Clearance 1' and 'Clearance 2'. When a pedestrian signal group runs during a phase, the phase green time must be greater than or equal to Clearance 1. Clearance 2 may occur during intergreen. For safety purposes, in WA Clearance 2 must be one second shorter than intergreen time (refer to *Figure A-7*).

Pedestrian clearance times can be calculated as follows (decimal calculated total clearance time should be rounded up):

$$Clearance\ 1 + Clearance\ 2 = Total\ Pedestrian\ Clearance\ Time = \frac{Full\ Crossing\ Length\ (A)}{1.2}$$

Where:

$$Clearance\ 2 = Early\ Cut\ Off\ Green + Yellow + All\ Red - 1$$

Therefore:

$$Clearance\ 1 = Total\ Pedestrian\ Clearance\ Time - Clearance\ 2$$

Clearance time may need to be calculated using a walking speed of 1.0 meter per second. For more information refer to Main Roads' *Guidelines for Pedestrian Crossing Facilities at Traffic Signals*.

For implementation purposes in WA, Table A-5 provides pedestrian crossing time based on crossing distances.

Distance measured from pushbutton pole to ramp on opposite side. If the distance from pushbutton pole to the ramp on the opposite kerb does not match, the longest distance should be measured.

Table A-5: Clearance time settings

DISTANCE (Metres)	CLEARANCE TIME (Seconds)	DISTANCE (Metres)	CLEARANCE TIME (Seconds)
4.00	4	25.00	21
5.00	5	26.00	22
6.00	5	27.00	23
7.00	6	28.00	24
8.00	7	29.00	25
9.00	8	30.00	25
10.00	9	31.00	26
11.00	10	32.00	27
12.00	10	33.00	28
13.00	11	34.00	29
14.00	12	35.00	30
15.00	13	36.00	30
16.00	14	37.00	31
17.00	15	38.00	32
18.00	15	39.00	33
19.00	16	40.00	34
20.00	17	41.00	35
21.00	18	42.00	35
22.00	19	43.00	36
23.00	20	44.00	37
24.00	20	45.00	38

Source: Downer Mouchel and Main Roads WA

A.3.4.4 Walk for Green

Walk for green (also known as rest in walk/extended walk/stretch walk) is when walk interval for pedestrian movement with no parallel vehicle movement is extended as long as possible. The pedestrian movements with walk for green is automatically activated during the specified phases.

A.3.5 Pedestrian Protection Time

Pedestrian protection time which is delay of commencing the green time of the vehicle signal groups conflicted with a pedestrian signal group in a parallel walk phase.

WA has a number of different types of pedestrian protection at pedestrian crossing facilities at signalised intersections. Below are examples of the commonly configured pedestrian protection used at these crossing facilities:

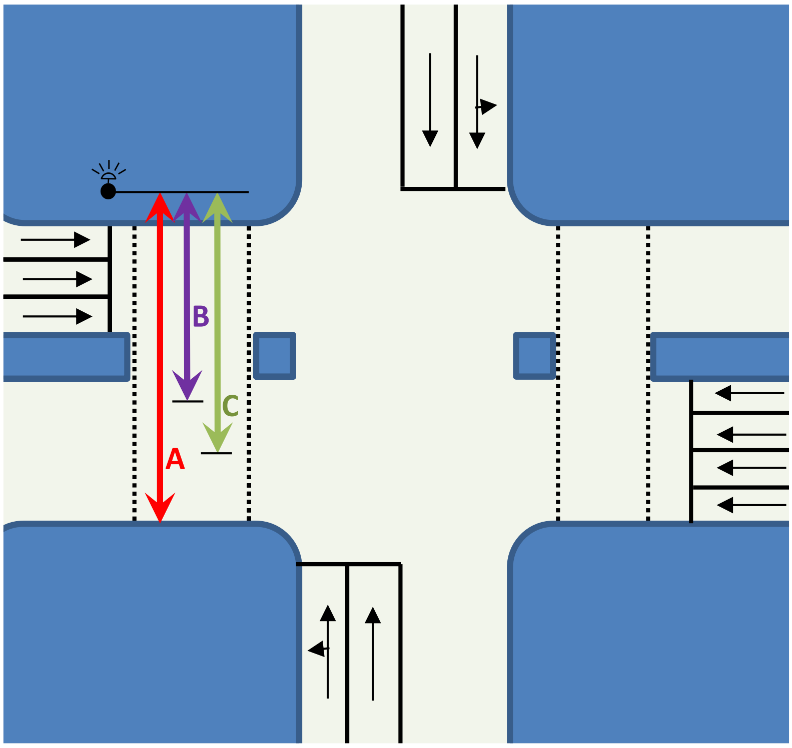
- Exclusive Pedestrian phase (where geometry / phasing arrangements allow);
- Parallel Walk with Time Control;
- Parallel Walk with Time Control and Flashing Yellow;
- Parallel Walk with Timed Red Arrow Control;
- Parallel Walk with Timed Red Arrow Control and Flashing Yellow; and
- Fully Controlled Crossing.

Pedestrian protection type should be agreed with Main Roads. Refer to Main Roads' *Guidelines for Pedestrian Crossing Facilities at Traffic Signals*.

Note: In WA, pedestrian protection time is different from late start. Late start is to ensure a vehicular movement (signal group) from previous phase is cleared before running its opposed vehicular movement in the current phase. Whereas, pedestrian protection is to stop parallel vehicular movement at the beginning of the current phase to make the pedestrian movement safer.

Similar to pedestrian clearance time, pedestrian protection times are determined by the length of the pedestrian crossing. *Figure A-11* describes the measurements required to determine these values.

Figure A-11: Determination of Pedestrian Protection Times



Note: *If the full crossing distance (A) from pushbutton pole to the ramp on the opposite kerb does not match, the longest distance should be measured.*

Measurements are:

- **A:** full crossing length (from push button to the kerb)
- **B:** length from push button before entry lane(s) to 1.0m past the median, or 55% of the full crossing length A (whichever is greatest)
- **C:** length from push button before entry lane(s) to the middle of the road on the exit lane(s)

To calculate the pedestrian protection time for measured A, B and C lengths, modellers should refer to *Table A-5*.

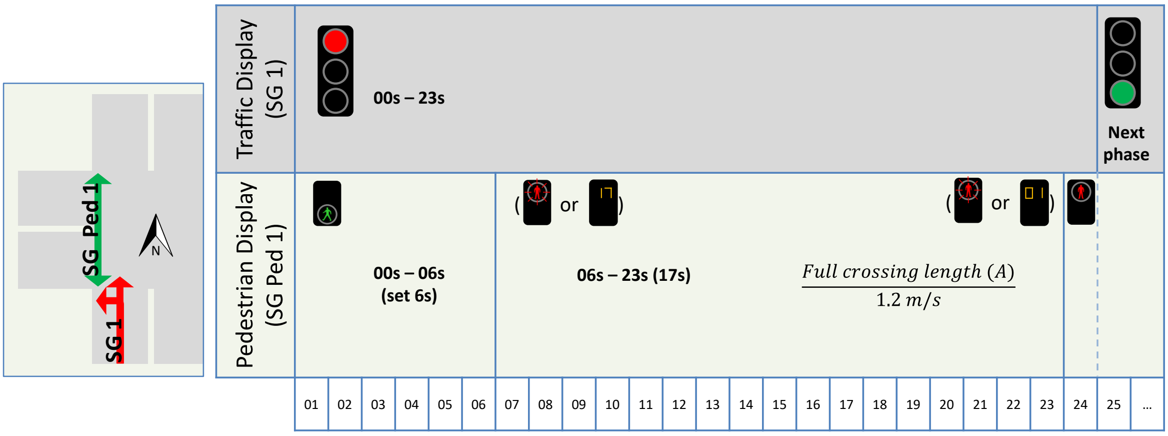
The following examples show how protection time is determined for each crossing type.

In these examples the western pedestrian crossing length (pedestrian signal group 1) is 20 metres. Therefore, as explained in the Section A.3.4.2 and A.3.4.3, walk time and clearance time are six seconds and 17 seconds, respectively.

A.3.5.1 Exclusive Pedestrian Phase

Figure A-12 shows exclusive pedestrian phase.

Figure A-12: Exclusive Pedestrian Phase

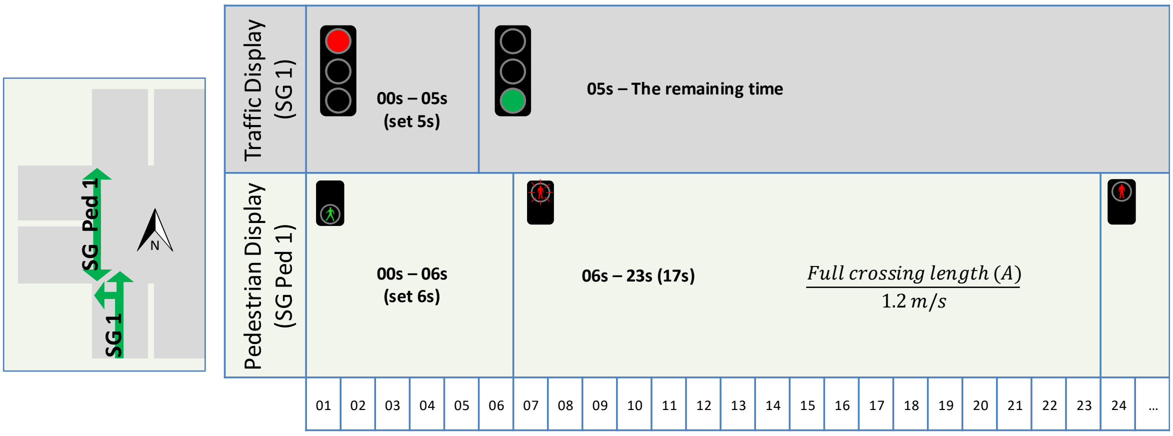


One second of all-red should be applied after mid-block crossing and exclusive pedestrian phase.

A.3.5.2 Parallel Walks with Time Control

Generally a time separation protection of five seconds is applied in WA (refer to *Figure A-13*).

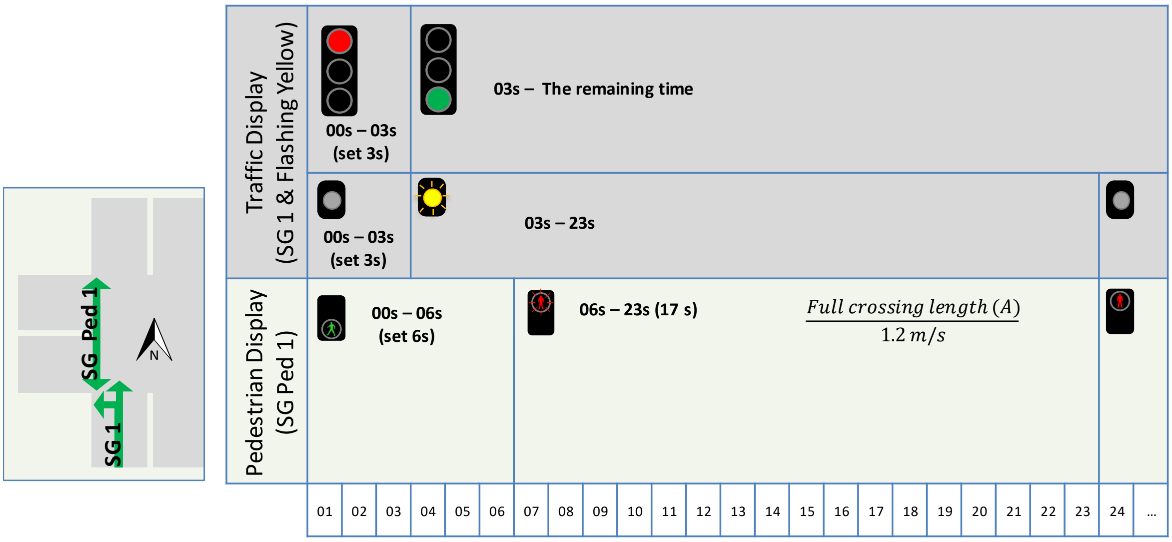
Figure A-13: Parallel Walks with Time Control



A.3.5.3 Parallel Walks with Time Control and Flashing Yellow

For a new site with flashing yellow, a time separation protection of three seconds should be applied in WA (refer to *Figure A-14*). After three seconds, the vehicular signal group which has conflict with the pedestrian crossing displays both a green light and a flashing yellow light. The flashing yellow light is displayed during the walk time and clearance time and warns drivers to proceed with care.

Figure A-14: Parallel Walk with Time Control and Flashing Yellow



A.3.5.4 Parallel Walk with Timed Red Arrow Control

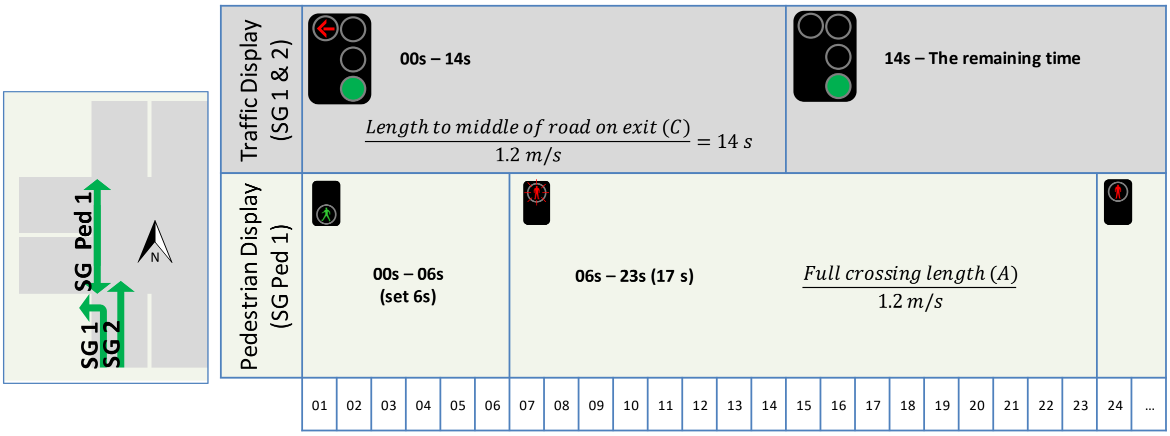
The red arrow should be displayed to provide enough time to the pedestrians who started their crossing from the far side of the road to pass the median and reach the middle of the road on the exit side (“C” movement in *Figure A-11*).

Red arrow time will be calculated as below:

$$Red\ Arrow\ Protection\ time = \frac{Length\ to\ middle\ of\ road\ on\ exit(C)}{1.2\ m/s}$$

In this example length of C is 17 metres; therefore, red arrow should be displayed for 14 seconds (refer to Figure A-15).

Figure A-15: Parallel Walk with Timed Red Arrow Control



A.3.5.5 Parallel Walk with Timed Red Arrow Control and Flashing Yellow

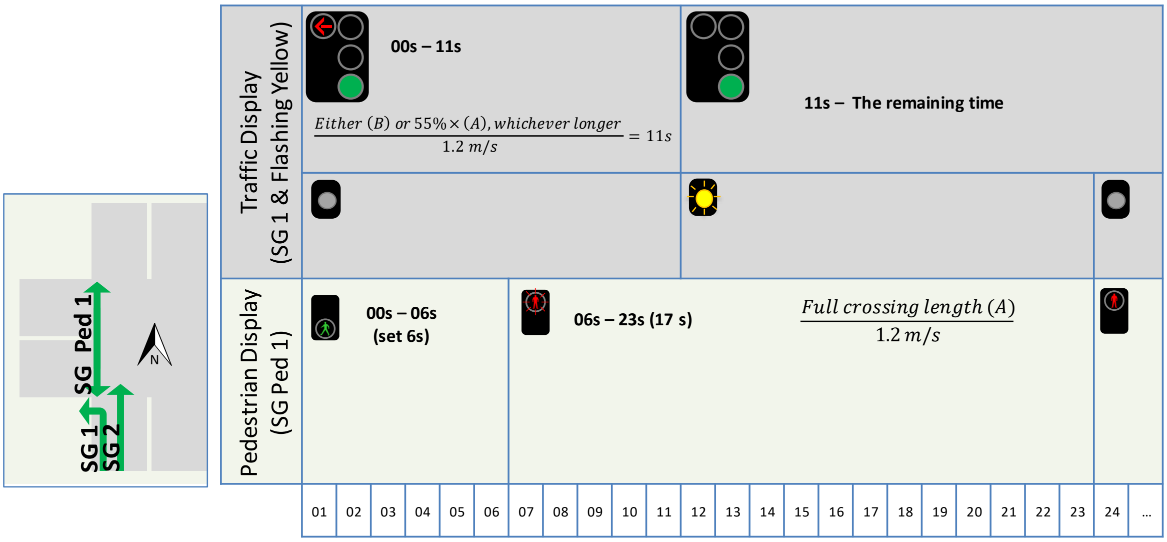
In this case the red arrow should be displayed to provide enough time to the pedestrians who started their crossing from the far side of the road to pass the median. Afterwards, the vehicular signal group which has conflict with the pedestrian crossing displays both green and flashing yellow signals. The flashing yellow signal is displayed during walk time and clearance time and warns drivers to proceed with caution.

Red arrow time with flashing yellow will be calculated as below:

$$Red\ Arrow\ \ time = \frac{Either\ (B) or\ 55\%\ \times (A), whichever\ is\ longer}{1.2\ m/s}$$

In this example length of B is 14 metres; therefore, red arrow should be displayed for 11 seconds (*Figure A-16*).

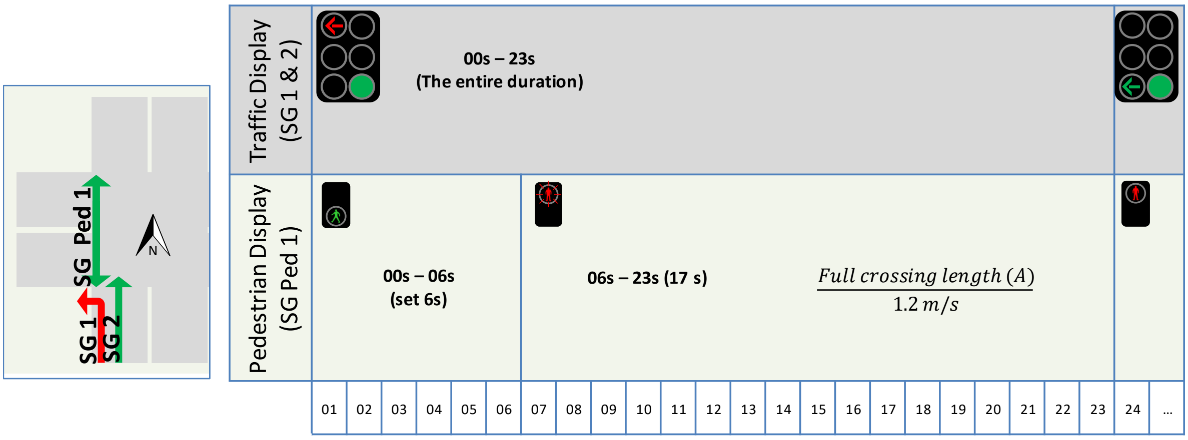
Figure A-16: Parallel Walk with Timed Red Arrow Control and Flashing Yellow



A.3.5.6 Fully Controlled Crossing

In this case, red arrow should be displayed during the entire time of walk time and clearance time (*Figure A-17*).

Figure A-17: Fully Controlled Crossing



A.3.5.7 Pedestrian Protection for Existing Sites

For existing intersections, pedestrian protection times can be found on Main Roads' *TrafficMap* (Timings tab in Signal Data Spreadsheet and phase sequence chart).

Generally, cell 11 of SCATS Special Times (Timings tab in Signal Data spreadsheet) is used for pedestrian protection time; however, others cells can also be used when more than one pedestrian protection time is defined for that intersection.

Phase Sequence Chart (.doc) often contains pedestrian protection information. It may specify any signal groups on which pedestrian protection time is applied (refer to Attachment A.1).

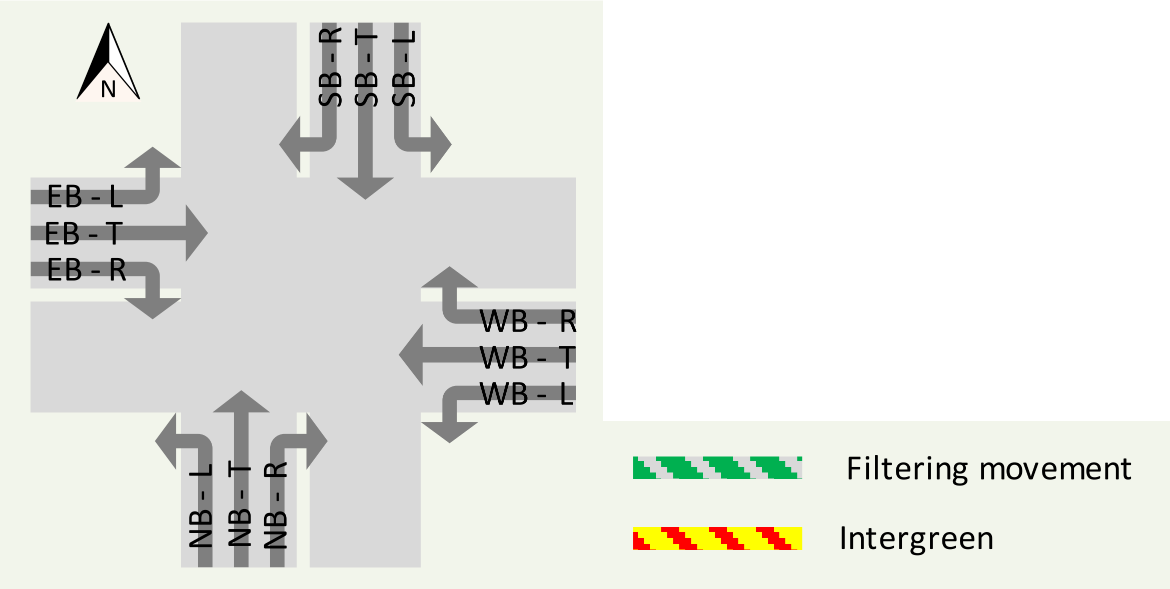
Site observation is required to confirm that pedestrian protection timings have been applied correctly.

A.4 Signal Phasing Sequences

For new signalised intersections and also for proposed modifications to existing signalised intersections, signal phase sequences must be approved by Main Roads. Examples of phase sequences that are compatible with SCATS are provided in this section. This will assist the modeller with determining the most appropriate phasing sequence. It should be noted that this section should be used for modelling purposes only.

Figure A-18 introduces all the possible movements and their signal groups used in *Figure A-19* to *Figure A-28*.

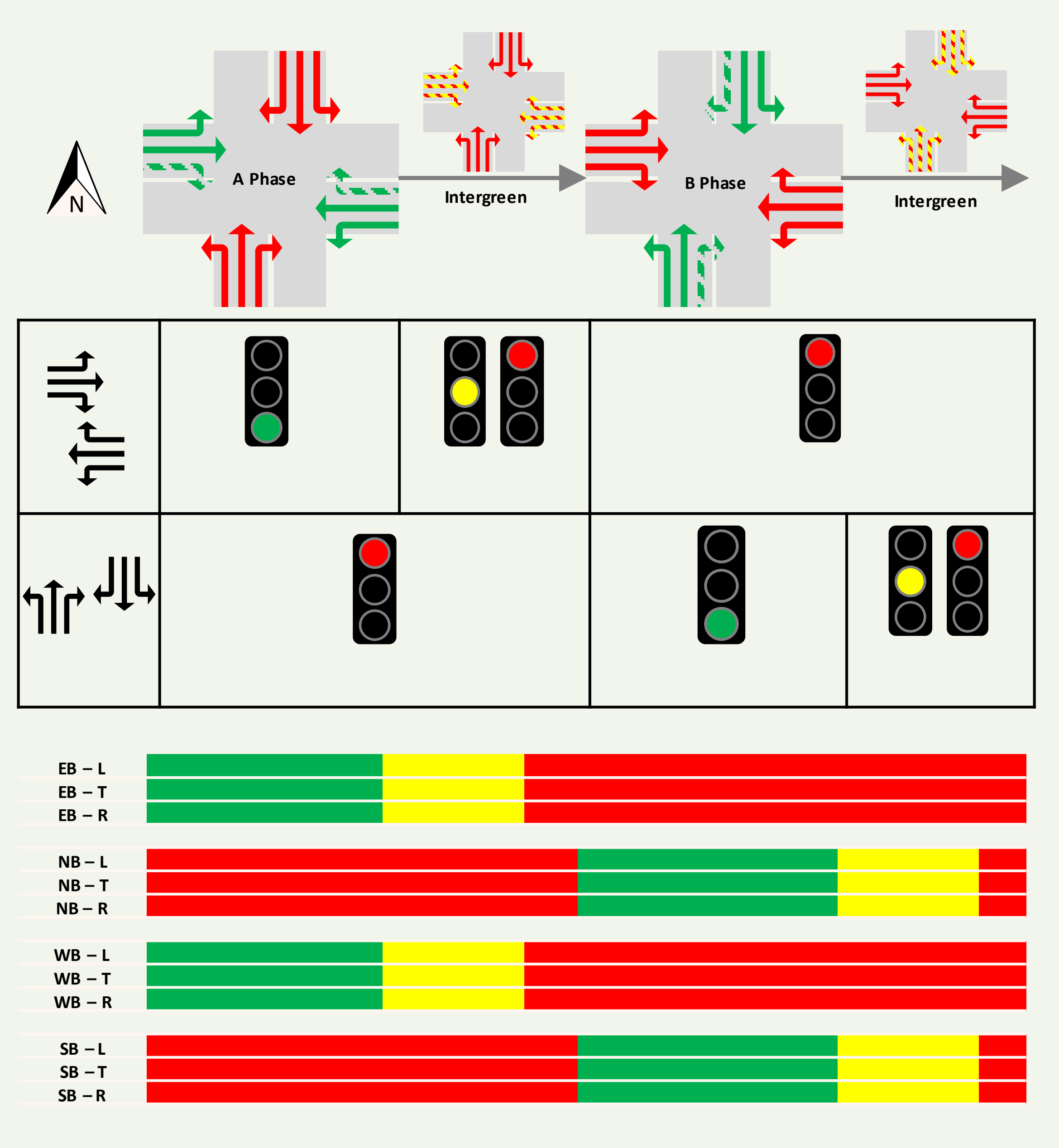
Figure A-18: Legend



A.4.1 Conventional

Figure A-19 shows a conventional phasing sequence with two phases (A and B). Right turn movements are filters.

Figure A-19: Conventional two phase

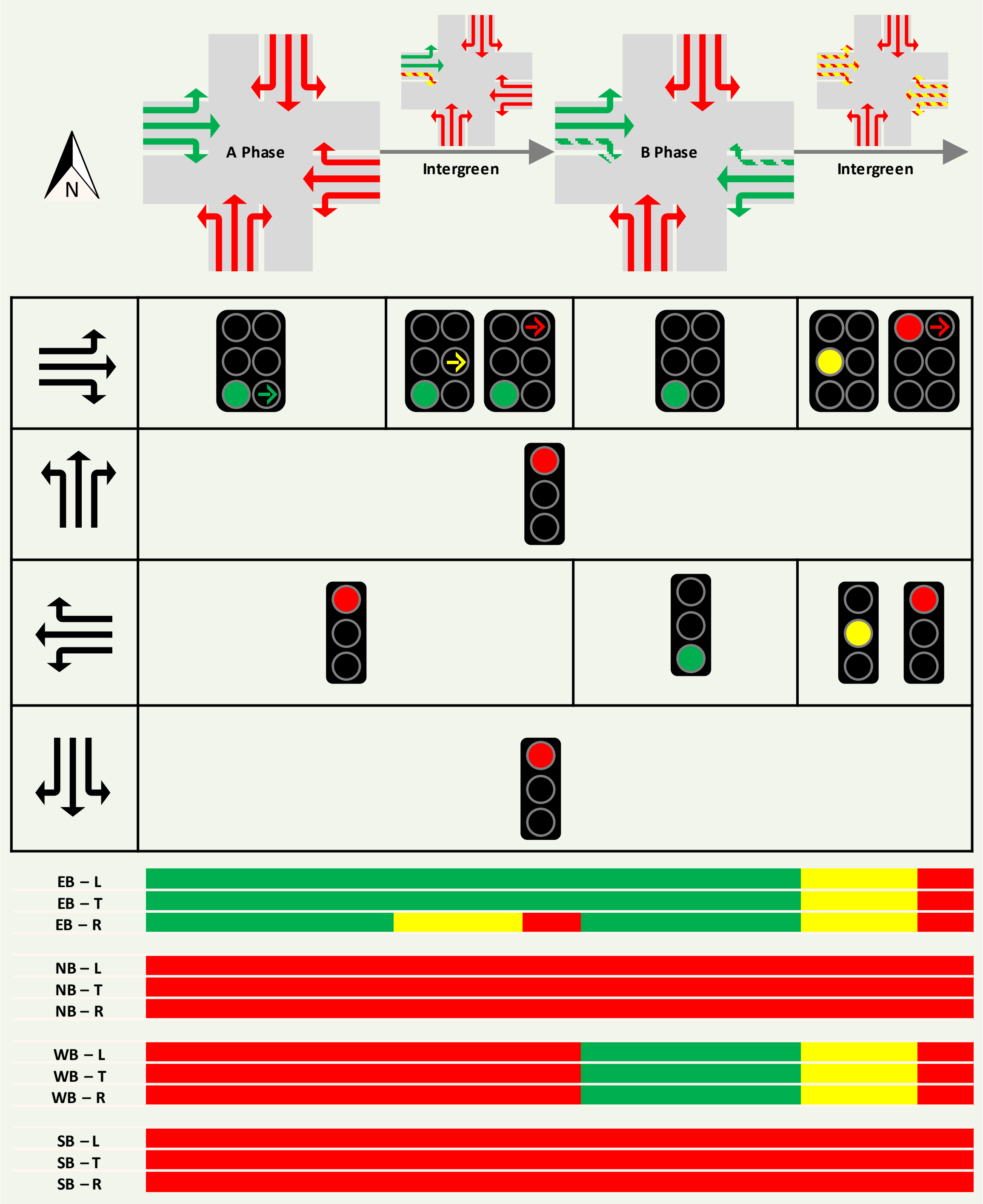


To have more complex phasing sequences for an intersection, based on its geometry and peak hour demand, one or both two phases in the conventional phasing sequence can be replaced with the following phasing sequences discussed in Section A.4.2 to Section A.4.7.

A.4.2 Leading Right Turn

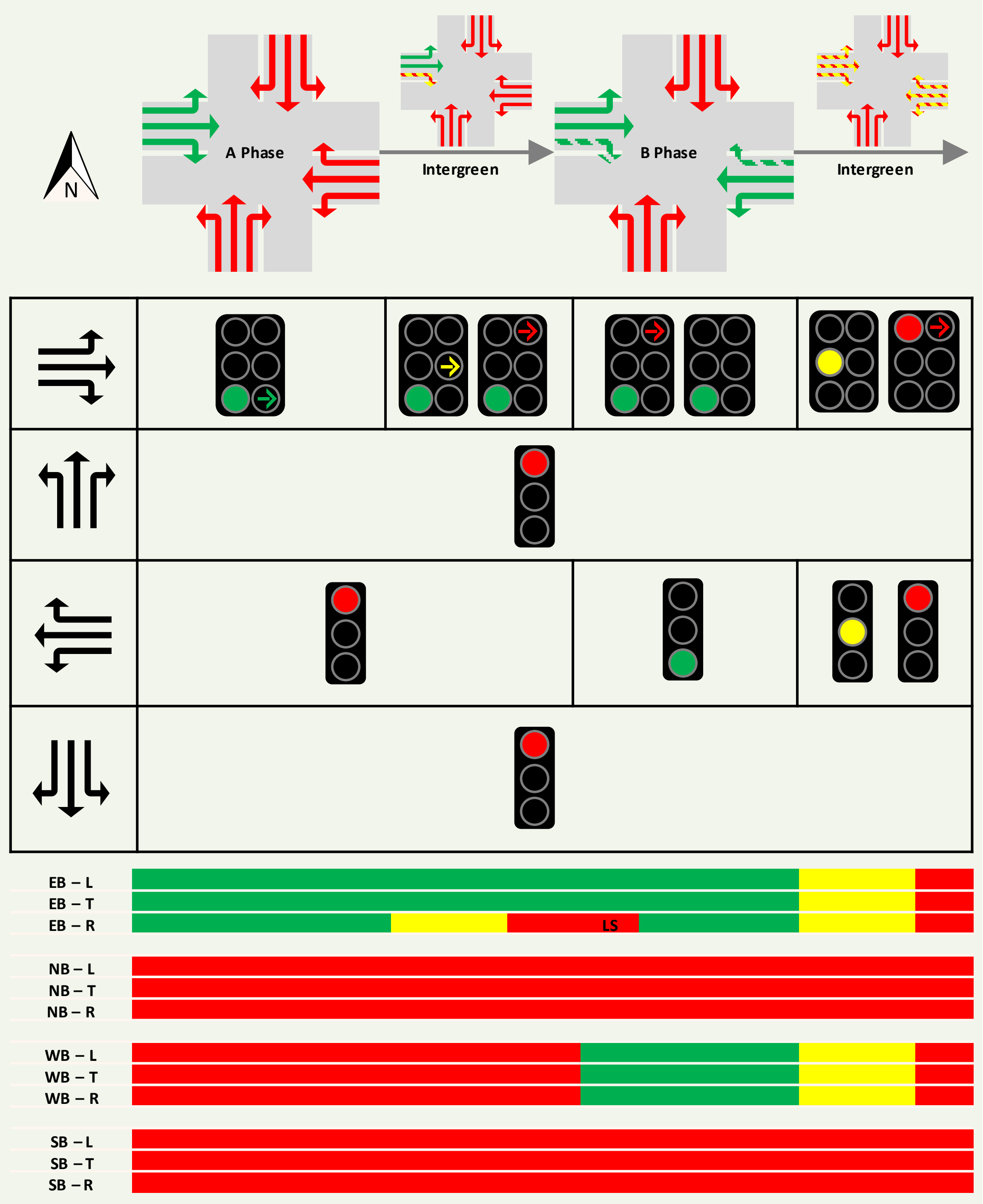
Figure A-20 shows the leading right turn with filter right turn phasing sequence for the eastbound approach. If it suits the intersection geometry and U-turn is not permitted, the northbound left turn signal group can run during A phase (e.g. aggro arrow, refer to Section A.4.8).

Figure A-20: Leading Right Turn with filter right turn (EB)



Leading right turn with late start (refer to Section A.1.1) is shown in *Figure A-21*. If it suits the intersection geometry and U-turn is not permitted, the northbound left turn signal group can run during A phase (e.g. aggro arrow, refer to Section A.4.8).

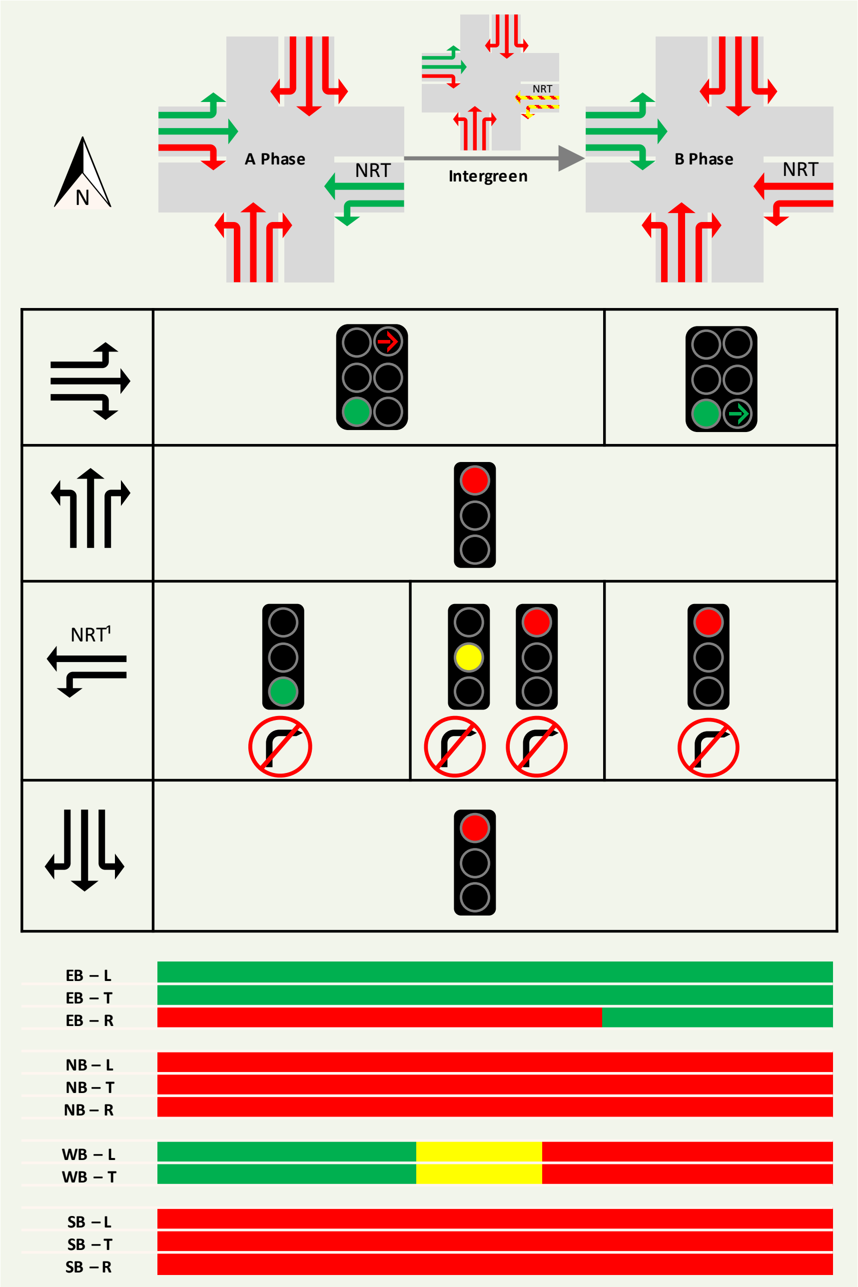
Figure A-21: Leading Right Turn with late start (EB)



A.4.3 Lagging Right Turn

Figure A-22 shows the lagging right turn phasing sequence for the eastbound approach. This sequence is recommended when there is no opposed right turn (Refer to Section A.1.1). If it suits the intersection geometry and U-turn is not permitted, northbound left turn signal group can run during B phase (e.g. aggro arrow, refer to Section A.4.8).

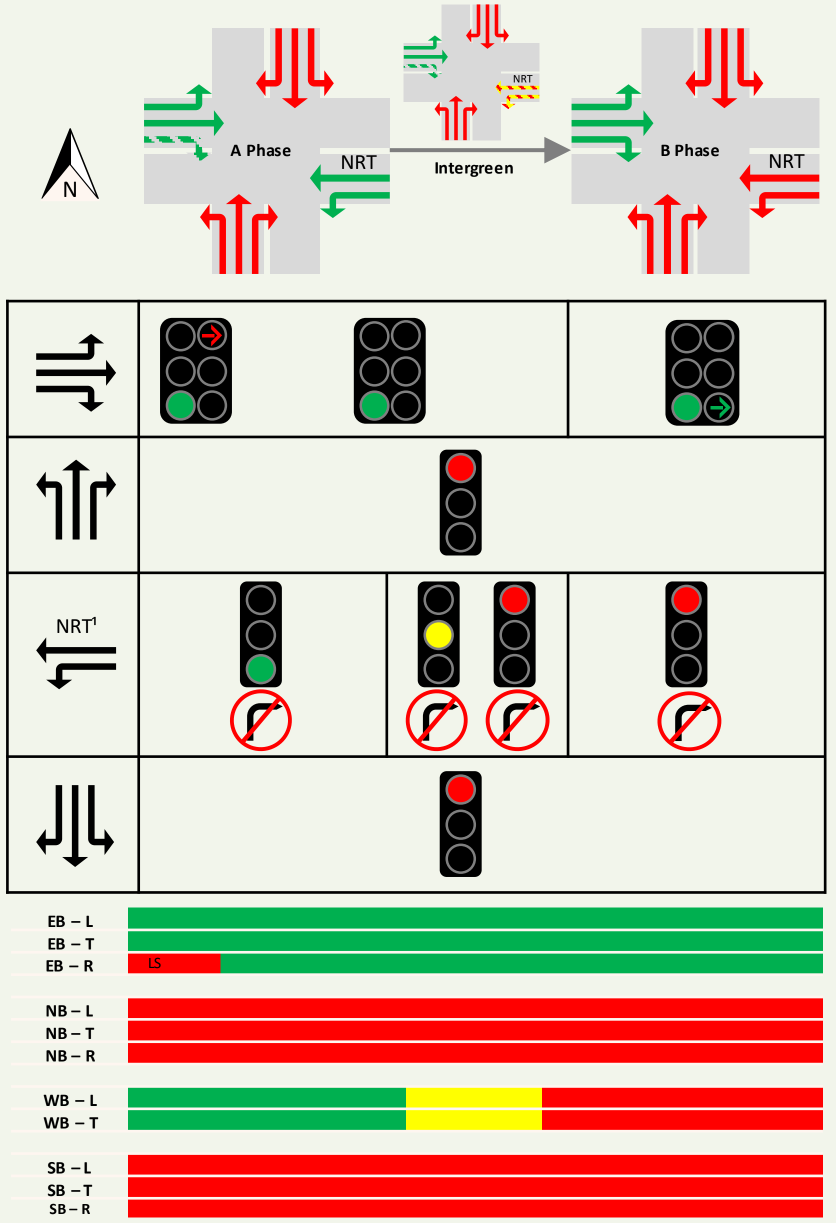
Figure A-22: Lagging Right Turn



[1] NRT = No Right Turn

Lagging right turn with filtering is shown in *Figure A-23* (refer to Section A.1.1). If it suits the intersection geometry and U-turn is not permitted, northbound left turn signal group can run during B phase (e.g. aggro arrow, refer to Section A.4.8).

Figure A-23: Lagging Right Turn with filtering

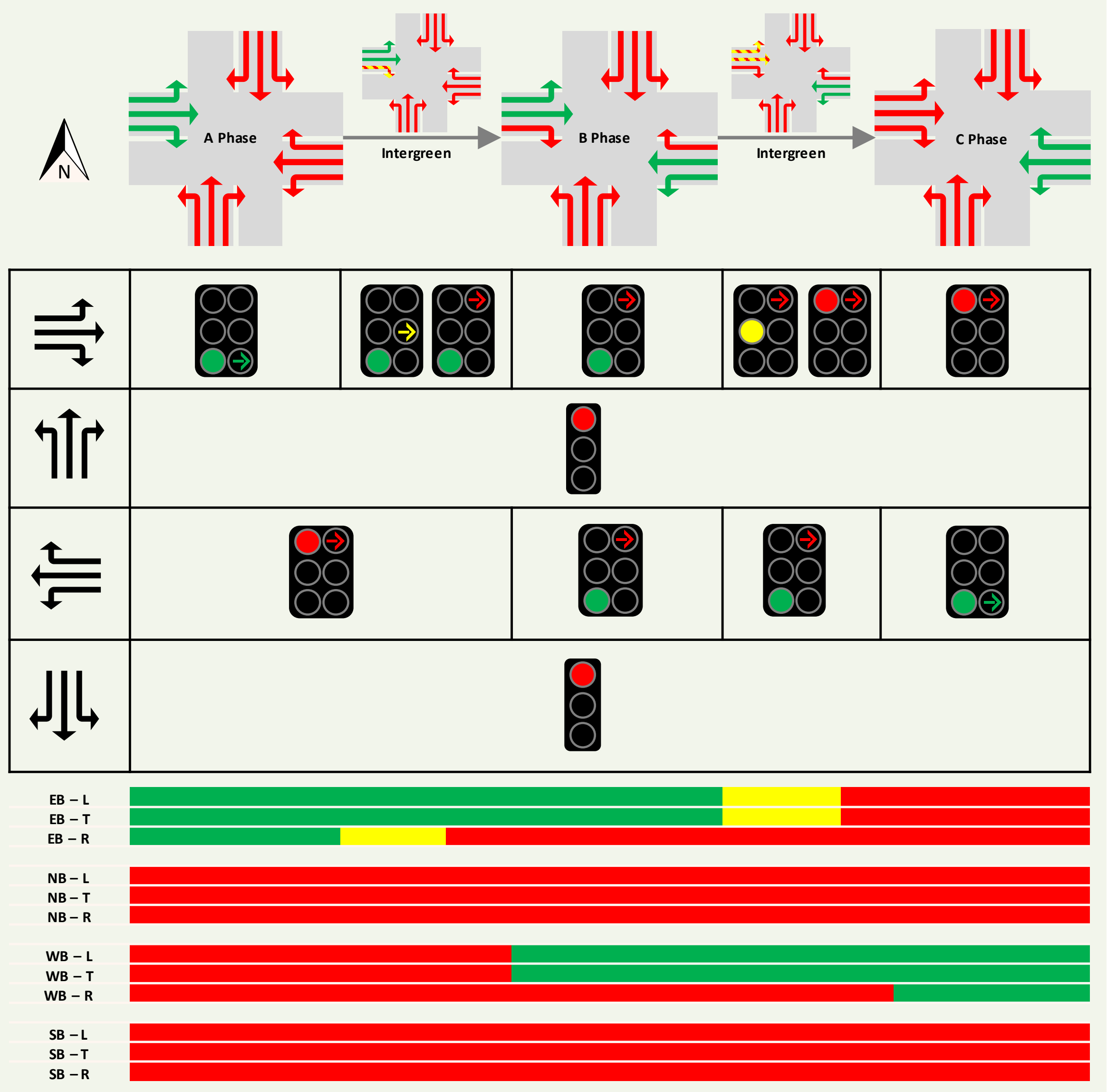


[1] NRT = No Right Turn

A.4.4 Lead – Lag Right Turn

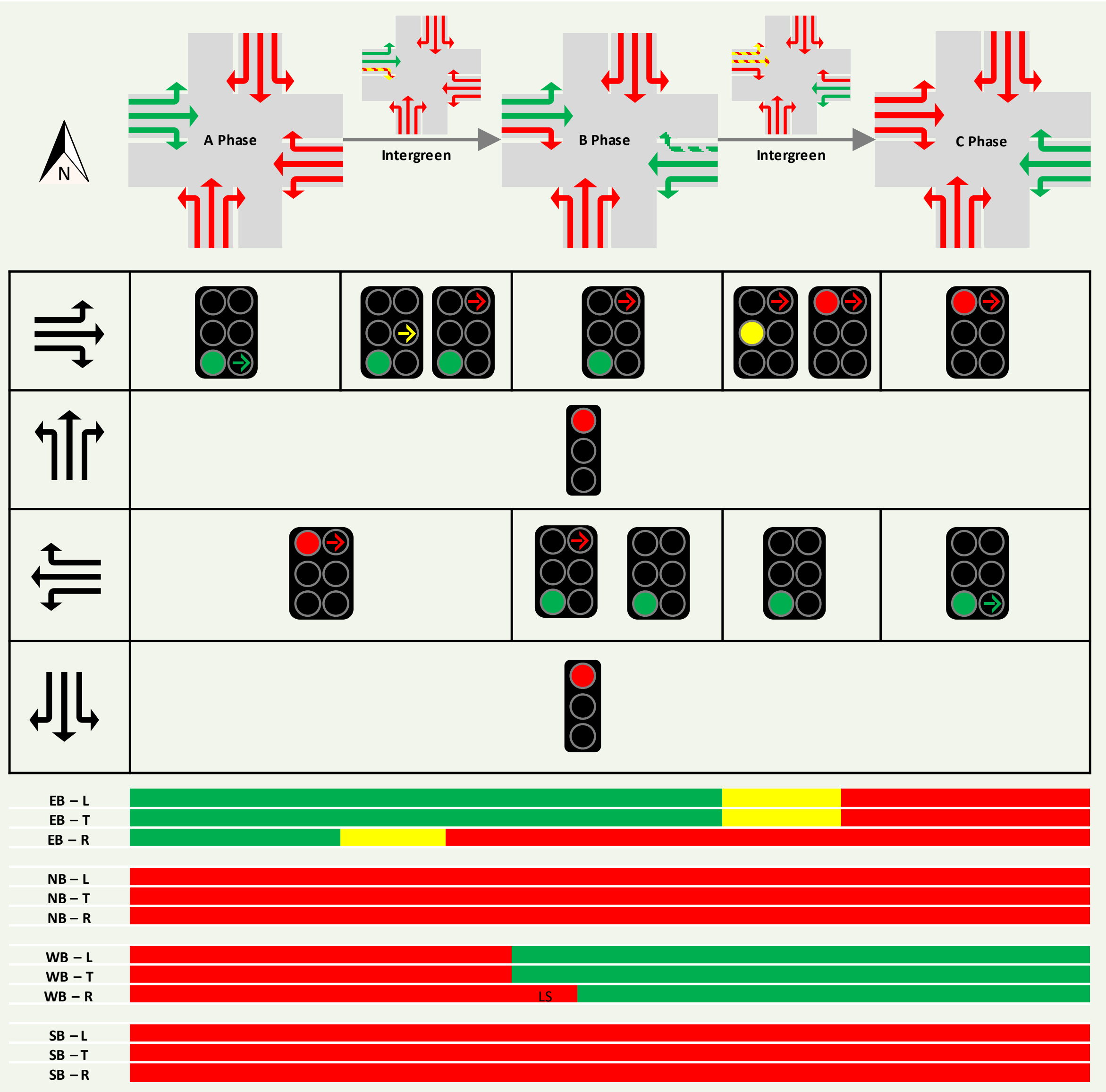
Figure A-24 shows the lead – lag right turn phasing sequence for the eastbound approach. If it suits the intersection geometry and U-turn is not permitted, northbound and southbound left turn signal groups can run during A and C phases, respectively (e.g. aggro arrow, refer to Section A.4.8).

Figure A-24: Lead - Lag Right Turn



Lead – lag right turn with filtering lagging right turn is shown in *Figure A-25*. Filtering leading right turn is not allowed (Refer to Section A.1.1). If it suits the intersection geometry and U-turn is not permitted, northbound and southbound left turn signal groups can run during A and C phases, respectively (e.g. aggro arrow, refer to Section A.4.8).

Figure A-25: Lead – Lag Right Turn - With filtering lagging turn

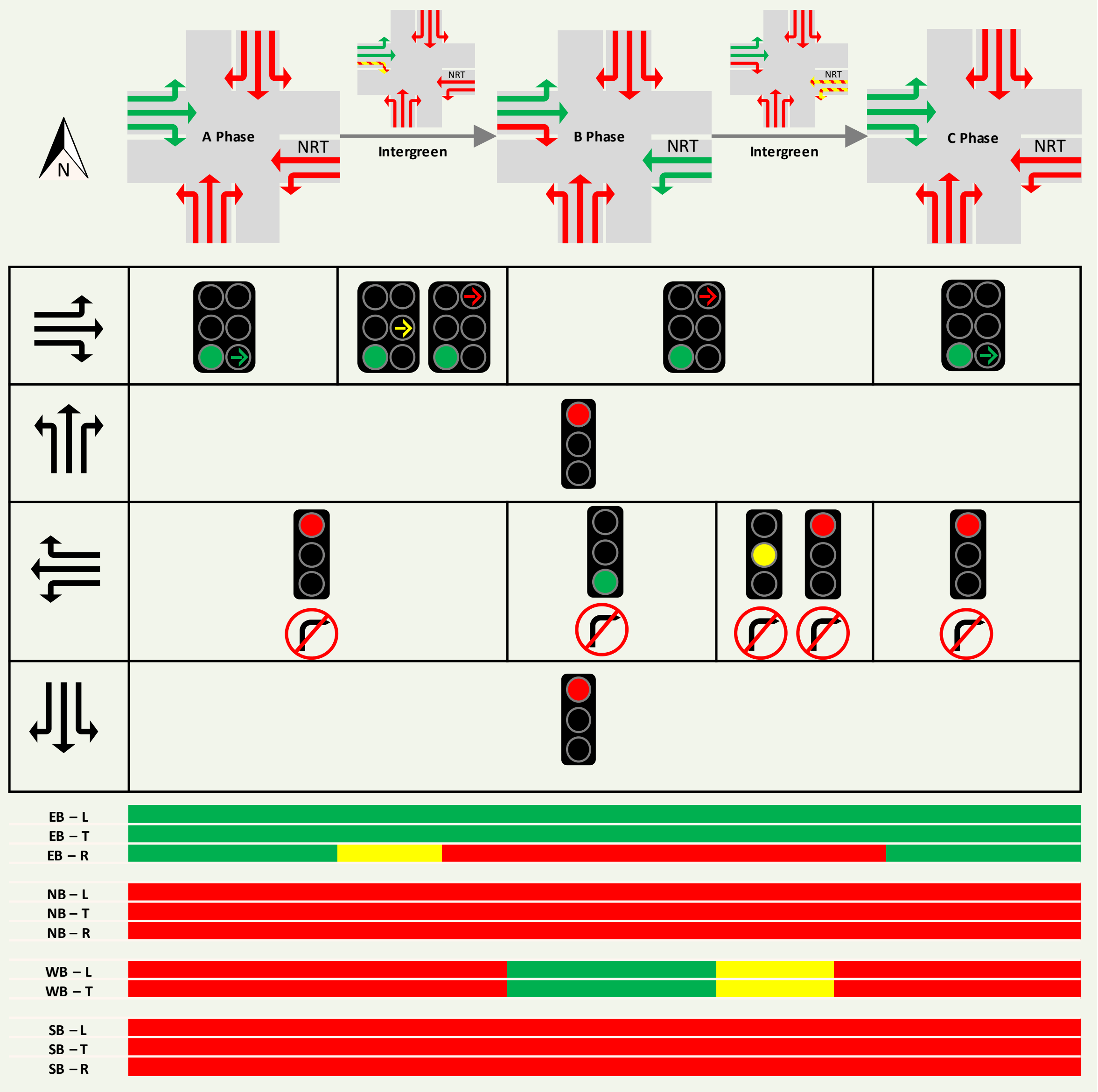


]

A.4.5 Repeat Right Turn

If right turn movement is heavy, the same signal groups can be repeated in a new phase. *Figure A-26* shows repeat right turn phasing sequence with no opposed right turn. If it suits the intersection geometry and U-turn is not permitted, northbound left turn signal groups can run during A and C phases (e.g. aggro arrow, refer to Section A.4.8).

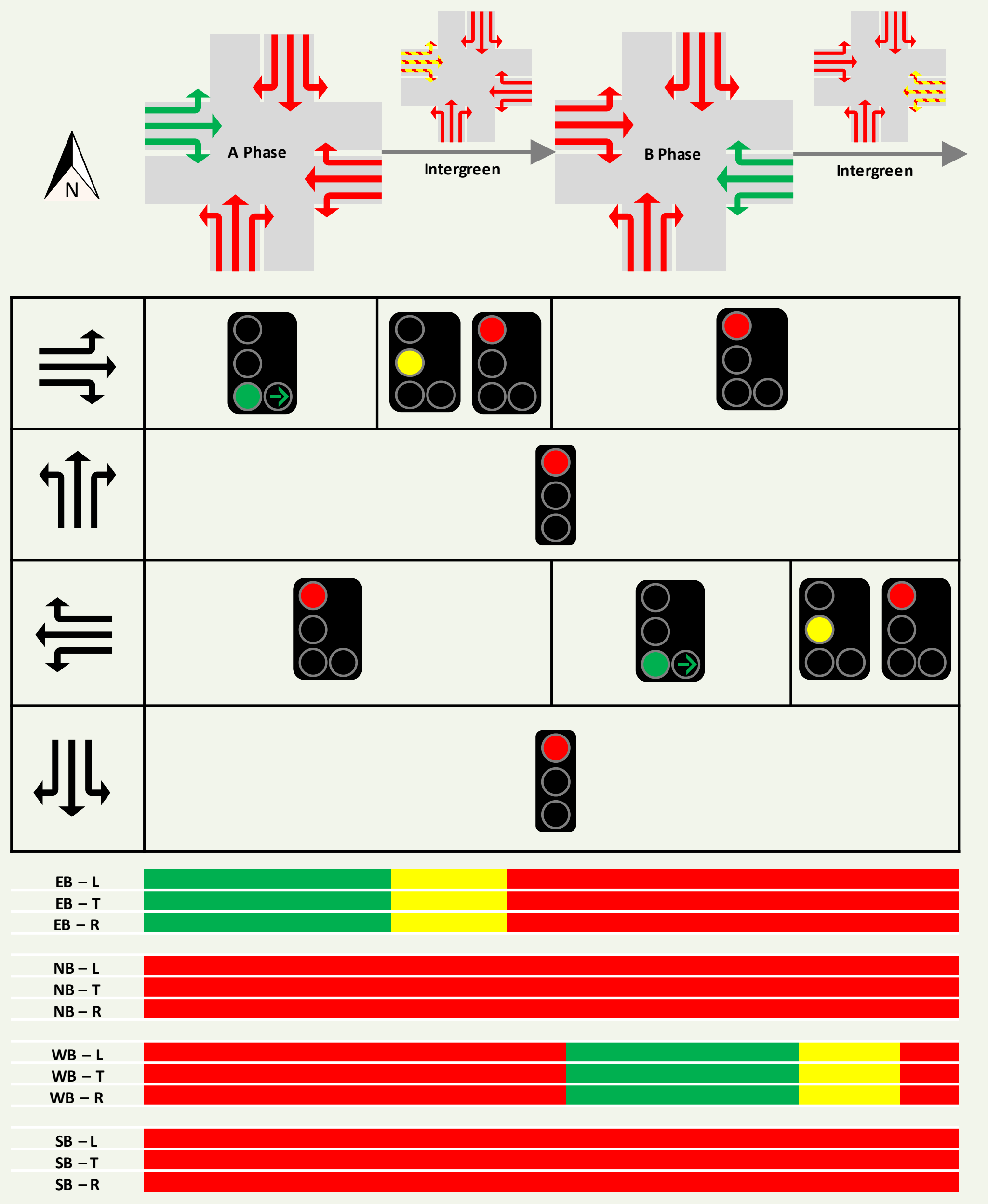
Figure A-26: Repeat Right Turn



A.4.6 Split Phasing

Figure A-27 shows the split phasing sequence. If it suits the intersection geometry and U-turn is not permitted, northbound and southbound left turn signal groups can run during A and B phases, respectively (e.g. aggro arrow, refer to Section A.4.8).

Figure A-27: Split Phasing



A.4.7 Diamond

Figure A-28 shows the diamond overlap phasing sequence. Depending on the demand three phasing sequences can occur:

A, A1, and B: when eastbound right turn traffic flows are heavier than westbound movement (purple path in *Figure A-28*);

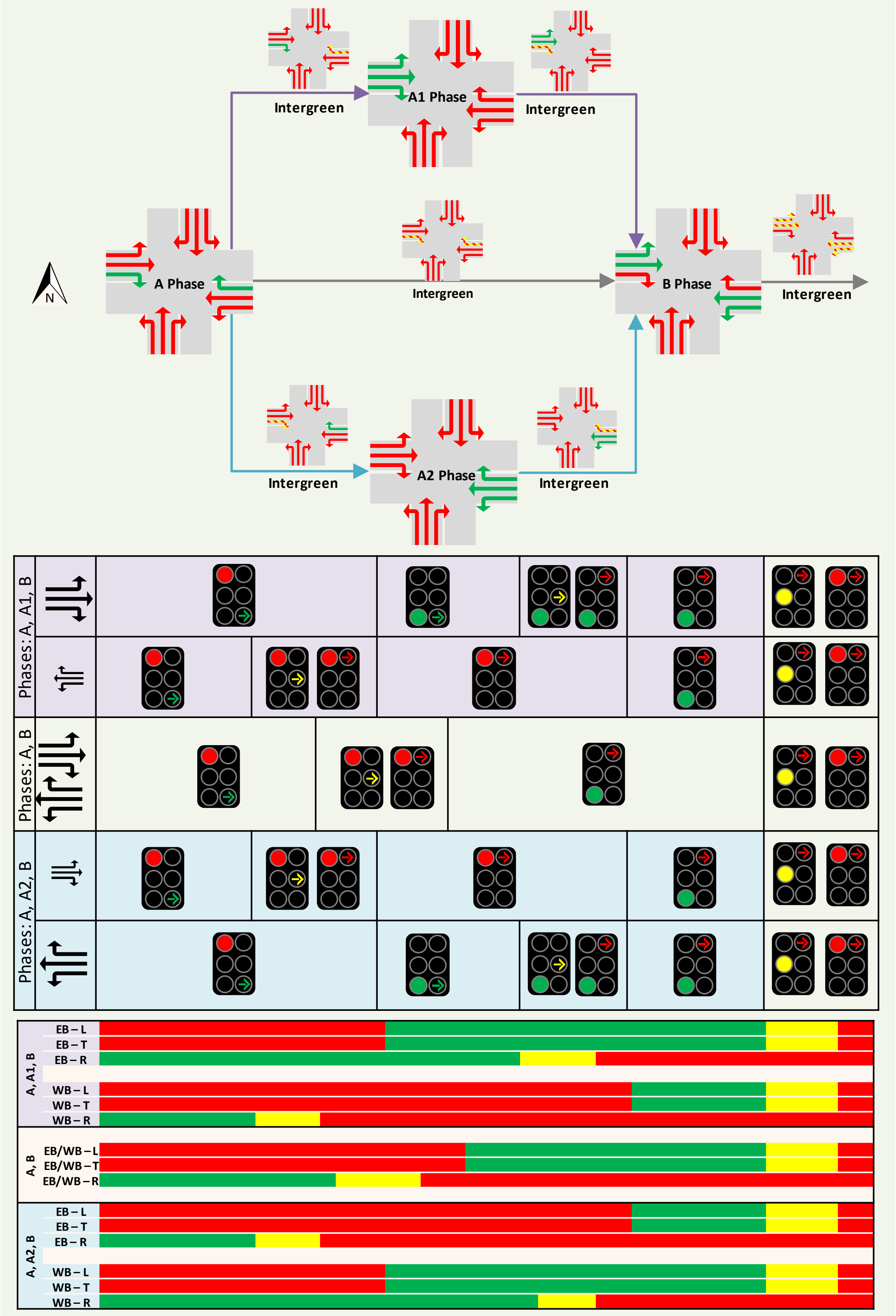
A and B: when eastbound and westbound right turn traffic flows are balanced;

A, A2, and B: when westbound right turn traffic flows are heavier than eastbound movement (blue path in *Figure A-28*).

If U-turn is not permitted, northbound and southbound left turn signal groups may also run during A/A1 and A/A2 phases, respectively (e.g. aggro arrow, refer to Section A.4.8).

Single diamond phasing sequence is when only one of the phases in the conventional phasing sequence (Refer to Section A.4.1) is replaced with diamond overlap and double diamond is when both of them are replaced with diamond overlap.

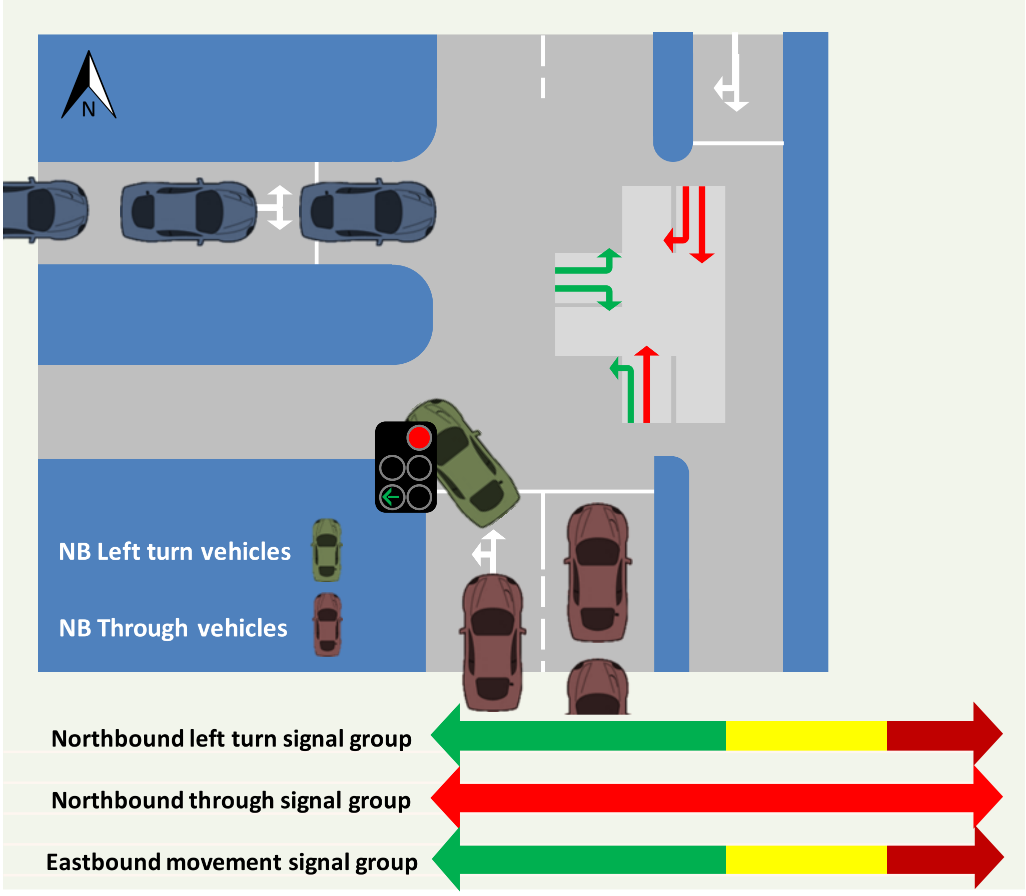
Figure A-28: Diamond Overlap



A.4.8 Aggro Arrow

A shared signalised left turn/through lane can be controlled by two individual signal groups (left turn and through movement signal groups). During a phase, only left turn signal group can operate, while, through movement signal group is not activated. This situation is called aggro arrow. *Figure A-29* shows an example of aggro arrow on a T-intersection.

Figure A-29: Aggro arrow



For example where the northbound left turn and through movements share a signalised lane, an aggro arrow can operate during phases when the eastbound right turn signal group is activated except when a U-turn is permitted.

Aggro arrow can operate on different phase sequences, such as:

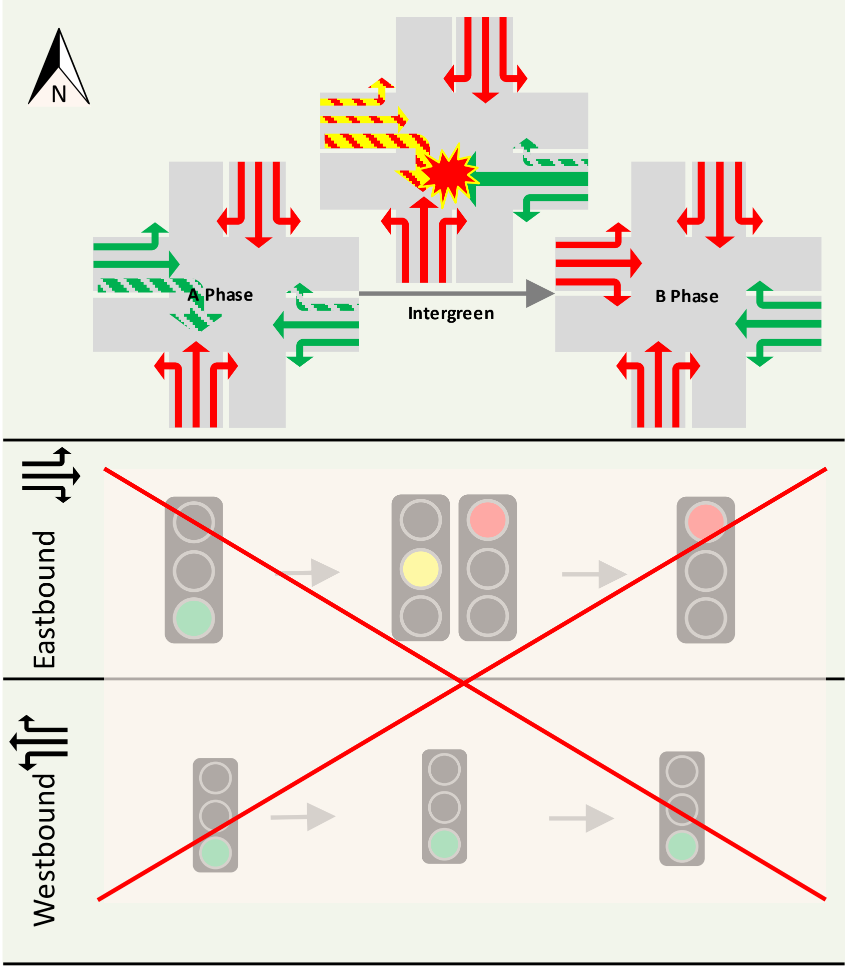
- leading right turn;
- lagging right turn;
- lead-lag right turn ;
- repeat right turn;
- split phasing; and
- single or double diamond.

A.4.9 Yellow Trap

Yellow trap happens when an opposed through movement of a right turn movement which is controlled by a circular light (filtering right turn e.g. eastbound right turn in *Figure A-30*) overlaps with the next phase. Yellow trap should be avoided in the models.

For example in *Figure A-30*, filtering eastbound right turn during A phase can be a potentially dangerous situation during the intergreen time (Yellow Trap). When a circular yellow signal (during intergreen) is displayed to drivers heading east, they may attempt to complete a right turn as they assume the opposite direction also faces yellow light, and that approaching traffic will stop. However the opposite approaching traffic will not stop and this leads to higher crash probability. To prevent this situation westbound signal group must not overlap during the intergreen.

Figure A-30: Yellow trap



A.5 SCATS Linking and Offsets

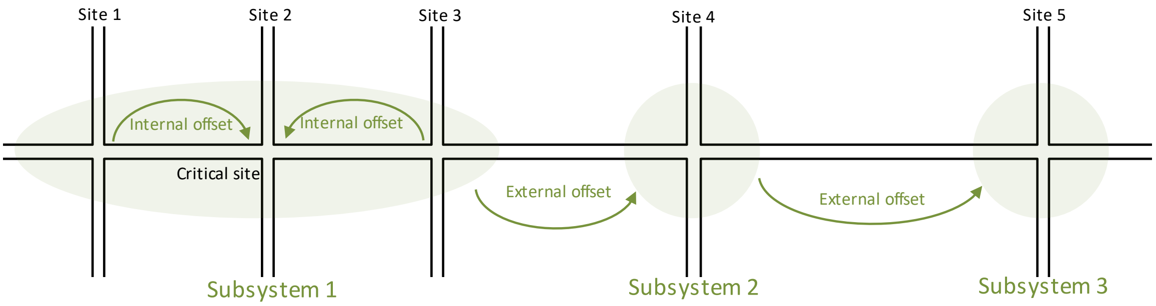
For modelling networks, in particular for existing intersections, it is important to understand how SCATS operates in order to replicate coordination between two or more adjacent intersections. Information regarding existing coordination can be extracted from Main Roads *TrafficMap*[5].

Coordination can be either relative to the start or the end of a phase. Site coordination can be described in two different categories:

1. Coordination of sites within a subsystem[6] (using coordinated phase plans or slaved[7] offsets), and,
2. Coordination of sites which belong to different subsystems (either within a region or external to the region).

Figure A-31 illustrates an example of SCATS coordination system.

Figure A-31: Example of SCATS Coordination System via offsets



Currently in WA, most subsystems contain only one site for operational purposes. Therefore, the first type of coordination is not common in WA and it is not discussed in this document. Sections A.5.1 to A.5.4 describe how to determine offset settings for modelling purposes.

A.5.1 Link Plans

Link plans are used to achieve subsystem coordination. Subsystems have four link plans. The convention is as follows:

- **Link Plan 1:** designed for light / night time traffic flow (low cycle length);
- **Link Plan 2:** designed for afternoon peak.
- **Link Plan 3:** designed for balanced flow between both directions
- **Link Plan 4:** designed for morning peak

---

[5] TrafficMap data gets updated every three months. If Link and Offset Plans are not up-to-date, contact Main Roads.

[6] The subsystem in SCATS is the basic unit of strategic control. A subsystem comprises of one or more intersections which are always coordinated together and thus share a common cycle length.

[7] A site may be slaved to the demand of a phase at another (master) site. All data for slave operation is entered in the slave site only.

It must be considered that the link plans describe above do not necessarily operates during the specified periods. This is because the traffic volume measured by SCATS loops do not meet the prescribed threshold to operate those plans. Therefore, to calculate offsets for the base model, the link plan(s) which was used by SCATS during the modelling period, can be determined using the strategic monitor graph (refer to Attachment A.2).

Link plans can be found for individual intersections on Main Roads *TrafficMap* (Link and Offset Plans tab in Signal Data spreadsheet).

A.5.2 Coordinated Phase

Coordinated phase plans can be used to determine the coordinated phase and its coordination reference point (i.e. at the start or at the end of the phase). Each site has four coordinated phase plans.

Coordinated phase plans can be found for individual intersections on Main Roads TrafficMap (Link and Offset Plans tab in Signal Data spreadsheet). The active coordinated phase plan at any time is the one which has the same number as the active link plan (as determined in Section A.5.1) at the same time.

Coordinated phase is defined (as a letter, e.g. A, B, C, etc.) in the coordinated phase plan for a site (i.e. *c* in *a,b^c)*. If the coordinated phase is preceded by ^, the start of phase is coordinated; otherwise, the coordination point is at the end of the phase.

For example, 0**,**0^A means that the coordination point is the start of the A phase.

A.5.3 Reference Site and Phase

A link plan, (*a***,***bcd*), includes:

- first offset (*a*, which is a number);
- second offset (*b,* which is a number);
- reference phase:
    - (*c,* which is a letter) – when the link refers to the end of the phase
    - (^*c*) – when the link refers to the start of the phase.
- reference site (*d,* which is site's TCS number).

If the link plan data is zero, the subsystem is not linked.

A letter *X* after the reference site (*d*) means the link is external to a site from a subsystem in another region.

A.5.4 Determination of Operating Offset

Offset length is a dynamic value which is determined based on cycle length for each link plan.

Cycle length plan (x,y) is used to specify the offset length, where:

- *x* is the cycle length below which first offset value in the coordinated phase plan (*a*) is used;

- *y* is the cycle length above which second offset value in the coordinated phase plan (*b*) is used.

y is always greater than or equal to *x*.

Cycle length plans can be found for individual intersections on Main Roads *TrafficMap* (Link and Offset Plans tab in Signal Data spreadsheet).

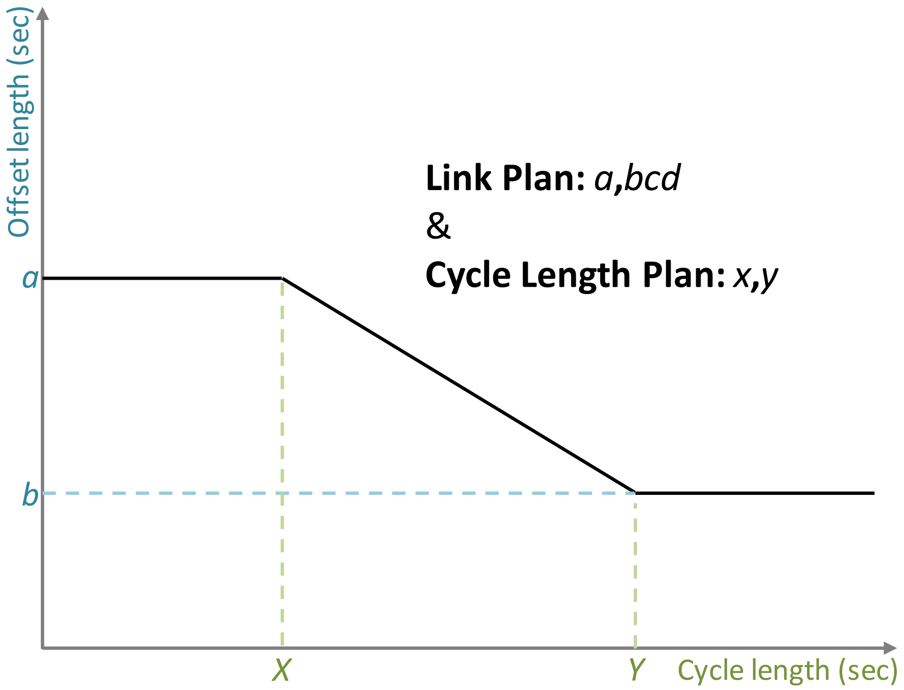
Each subsystem has four cycle length plans. The cycle length plan (which has the same number as the corresponding link plan as determined in Section A.5.1) should be used to specify the offset length.

For modelling purposes, if fixed signal timing is being modelled, the offset length should be calculated based on the average cycle length for the modelling period.

There are two offset length calculation methods used in SCATS:

- **Method one**, which is the default method and is linear interpolation between the first offset (*a*) and second offset (*b*) for cycle lengths between *x* and *y*.

Figure A-32: Offset length and cycle length relationship (where a>b)



- **Method two** only works when an up-arrow (^) symbol follows x (i.e. *x*^,*y*) in the cycle length plan. Here offset *a* will operate at cycle lengths below *x* seconds. Offset *b* will operate only when the cycle length rises to *y* seconds and will be maintained until the cycle length falls below *x* seconds, when offset *a* will operate.

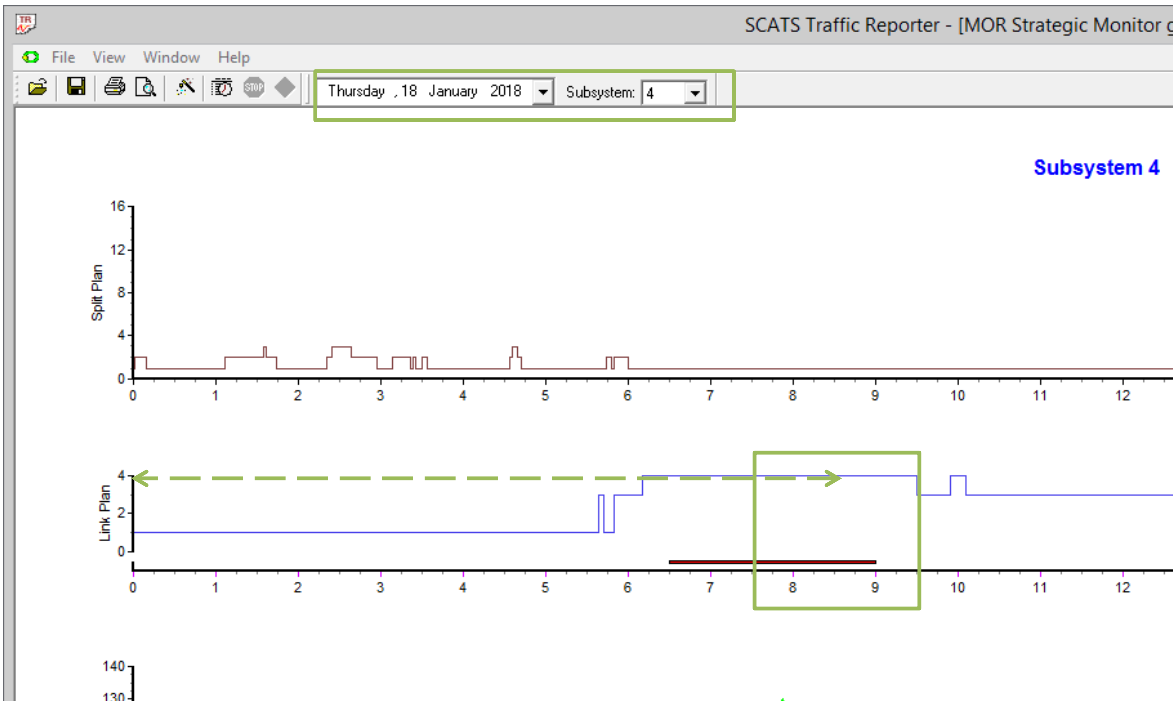
Cycle length plan of 0,0 means either first or second offset can be selected for operations. In this situation, SCATS phase history can be used to calculate the average offset length.

A.5.4.1 Example of finding coordination data

Example of finding coordination data for site 359 for 8-9 am, on 18 January 2018:

Step 1: Strategic monitor (Figure A-33) shows link plan 4 and therefore coordinated phase plan and cycle length plan 4 were active during the modelling period.

Figure A-33: TCS 359 Strategic Monitor



SCATS Traffic Reporter - [MOR Strategic Monitor

Thursday , 18 January 2018

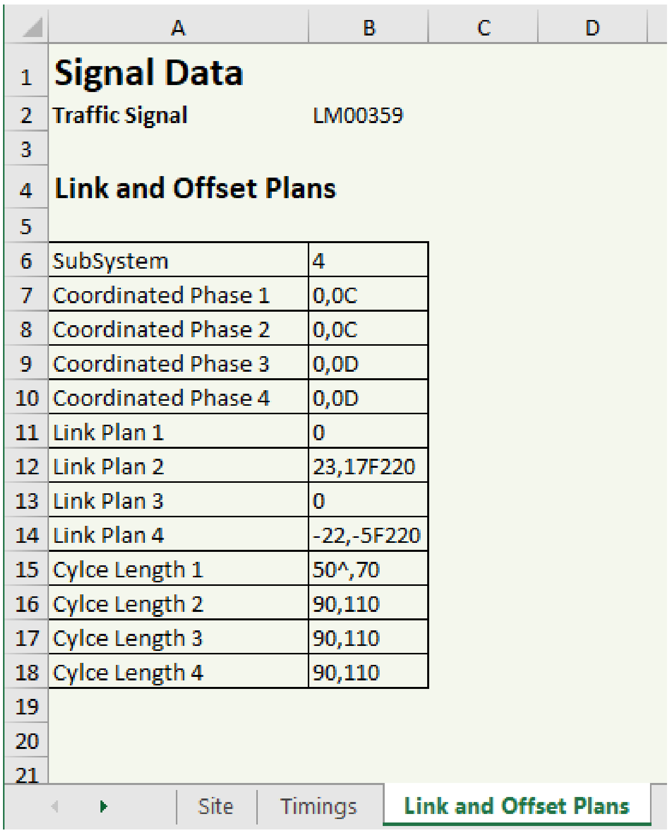
Subsystem: 4

Step 2: Average cycle length of 115 seconds was calculated for TCS 359 using SCATS history file (Refer to Section A.2).

If the link plan is not consistent over the modelling period, the link plan which was mostly active around the peak period can be used.

Steps 3: Link, coordinated phase and cycle length plans for TCS 359 extracted from TrafficMap is shown in Figure A-34.

Figure A-34: Link and Offset Plans example



Signal Data

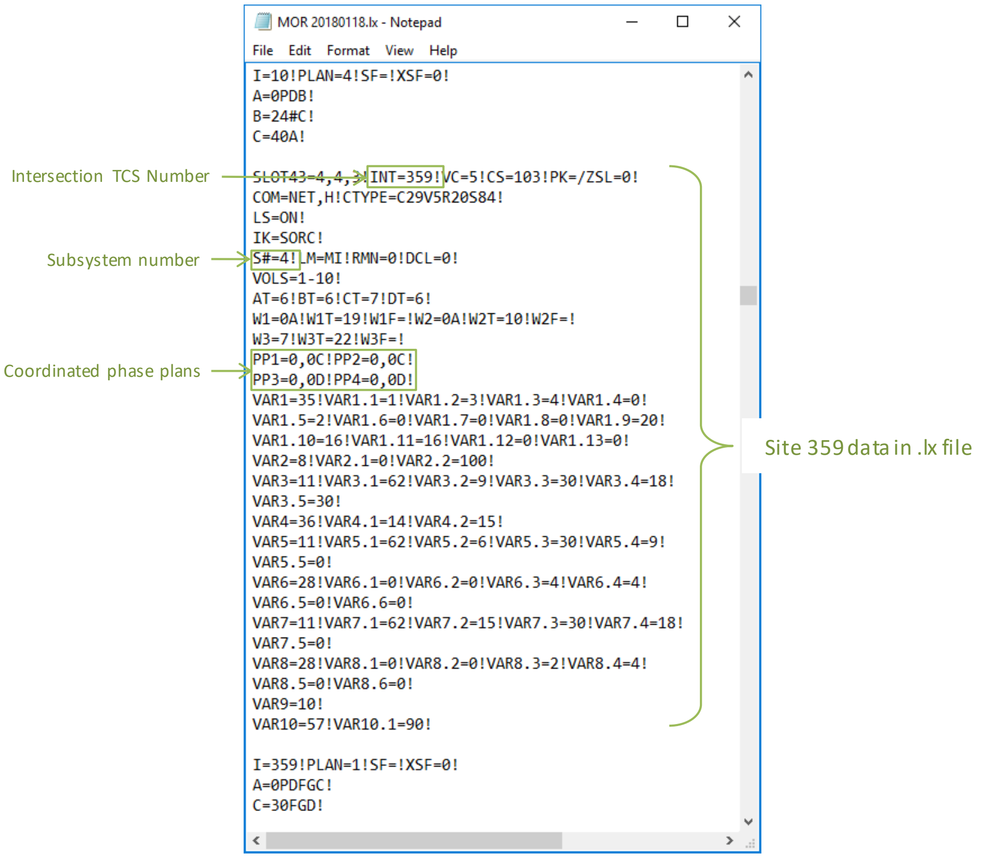
Traffic Signal LM00359

Link and Offset Plans

SubSystem	4
Coordinated Phase 1	0,0C
Coordinated Phase 2	0,0C
Coordinated Phase 3	0,0D
Coordinated Phase 4	0,0D
Link Plan 1	0
Link Plan 2	23,17F220
Link Plan 3	0
Link Plan 4	-22,-5F220
Cylce Length 1	50^,70
Cylce Length 2	90,110
Cylce Length 3	90,110
Cylce Length 4	90,110

If LX file is available, link, coordinated phase and cycle length plans for TCS 359 can be found under site and subsystem sections of the file (Figure A-35).

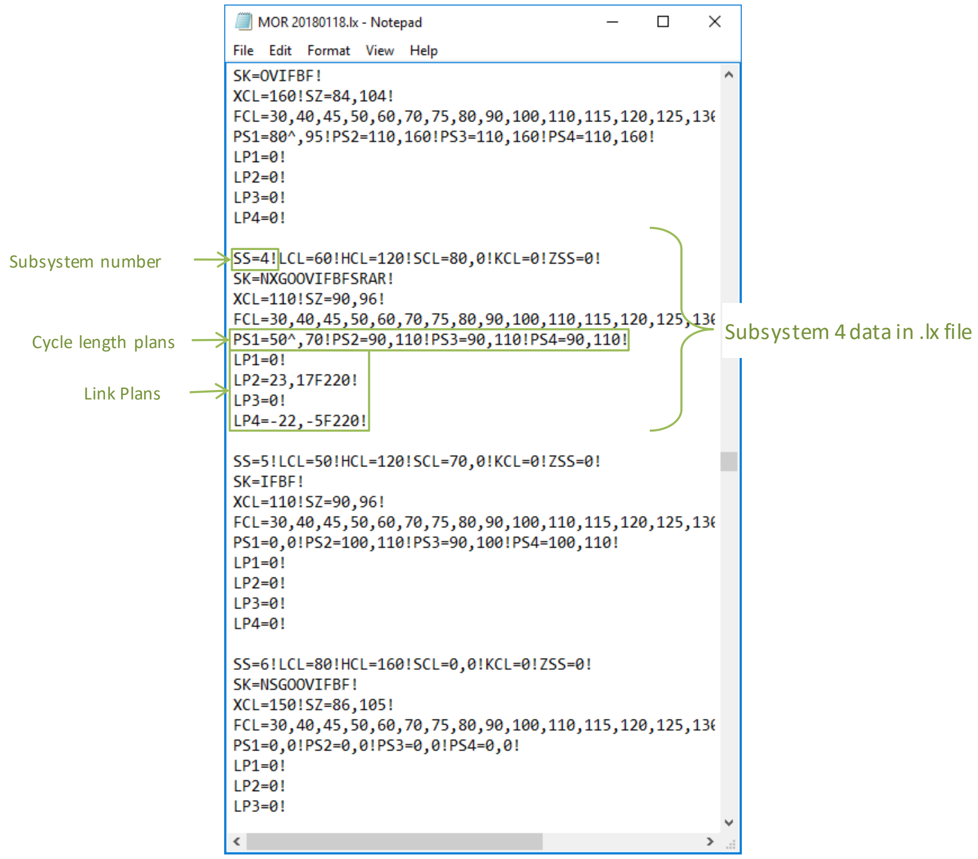
Figure A-35 Site and subsystem sections in LX file



```
I=10!PLAN=4!SF=!XSF=0!
A=0PDB!
B=24#C!
C=40A!

SLOT43=4,4,3!INT=359!VC=5!CS=103!PK=/ZSL=0!
COM=NET,H!CTYPE=C29V5R20S84!
LS=ON!
IK=SORC!
S#=4!LM=MI!RMN=0!DCL=0!
VOLS=1-10!
AT=6!BT=6!CT=7!DT=6!
W1=0A!W1T=19!W1F=!W2=0A!W2T=10!W2F=!
W3=7!W3T=22!W3F=!
PP1=0,0C!PP2=0,0C!
PP3=0,0D!PP4=0,0D!
VAR1=35!VAR1.1=1!VAR1.2=3!VAR1.3=4!VAR1.4=0!
VAR1.5=2!VAR1.6=0!VAR1.7=0!VAR1.8=0!VAR1.9=20!
VAR1.10=16!VAR1.11=16!VAR1.12=0!VAR1.13=0!
VAR2=8!VAR2.1=0!VAR2.2=100!
VAR3=11!VAR3.1=62!VAR3.2=9!VAR3.3=30!VAR3.4=18!
VAR3.5=30!
VAR4=36!VAR4.1=14!VAR4.2=15!
VAR5=11!VAR5.1=62!VAR5.2=6!VAR5.3=30!VAR5.4=9!
VAR5.5=0!
VAR6=28!VAR6.1=0!VAR6.2=0!VAR6.3=4!VAR6.4=4!
VAR6.5=0!VAR6.6=0!
VAR7=11!VAR7.1=62!VAR7.2=15!VAR7.3=30!VAR7.4=18!
VAR7.5=0!
VAR8=28!VAR8.1=0!VAR8.2=0!VAR8.3=2!VAR8.4=4!
VAR8.5=0!VAR8.6=0!
VAR9=10!
VAR10=57!VAR10.1=90!

I=359!PLAN=1!SF=!XSF=0!
A=0PDFGC!
C=30FGD!
```



```
SK=OVIFBF!
XCL=160!SZ=84,104!
FCL=30,40,45,50,60,70,75,80,90,100,110,115,120,125,13
PS1=80^,95!PS2=110,160!PS3=110,160!PS4=110,160!
LP1=0!
LP2=0!
LP3=0!
LP4=0!

SS=4!LCL=60!HCL=120!SCL=80,0!KCL=0!ZSS=0!
SK=NXGOOVIFBFSRAR!
XCL=110!SZ=90,96!
FCL=30,40,45,50,60,70,75,80,90,100,110,115,120,125,13
PS1=50^,70!PS2=90,110!PS3=90,110!PS4=90,110!
LP1=0!
LP2=23,17F220!
LP3=0!
LP4=-22,-5F220!

SS=5!LCL=50!HCL=120!SCL=70,0!KCL=0!ZSS=0!
SK=IFBF!
XCL=110!SZ=90,96!
FCL=30,40,45,50,60,70,75,80,90,100,110,115,120,125,13
PS1=0,0!PS2=100,110!PS3=90,100!PS4=100,110!
LP1=0!
LP2=0!
LP3=0!
LP4=0!

SS=6!LCL=80!HCL=160!SCL=0,0!KCL=0!ZSS=0!
SK=NSGOOVIFBF!
XCL=150!SZ=86,105!
FCL=30,40,45,50,60,70,75,80,90,100,110,115,120,125,13
PS1=0,0!PS2=0,0!PS3=0,0!PS4=0,0!
LP1=0!
LP2=0!
LP3=0!
```

If coordinated phase plan 4 is active, end of D phase is coordinated for site 359 between 8-9 am.

If Link plan and cycle length plan 4 are active:

- end of D phase at site 359 is coordinated to end of F phase at site 220 (TCS); and
- offset length is:
    - equal to 22 seconds if the cycle length is less than or equal to 90 seconds, and
    - equal to 5 seconds if the cycle length is greater than or equal to 110 seconds.

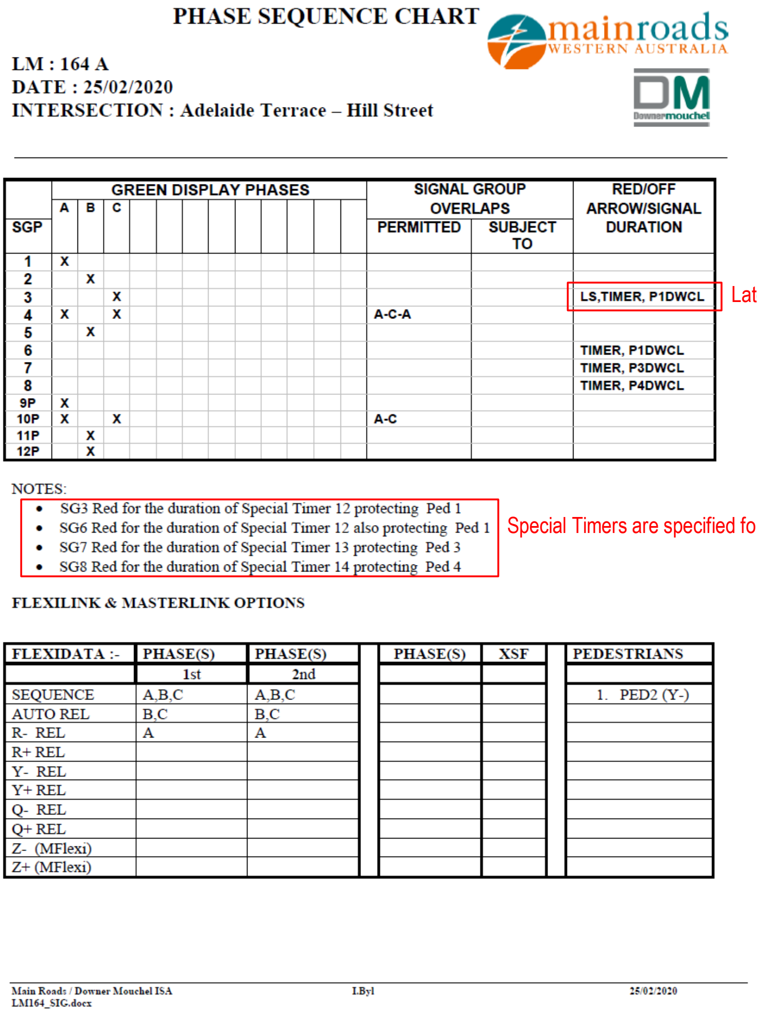
Therefore, for an average of 115 seconds cycle length from 8-9 am, the offset length is 5 seconds. This means, D phase at site 359 ends 5 seconds before the end of F phase at site 220. Figure A-36 shows the time coordination between the intersections.

Figure A-36: Coordination Example

References

Title	Author	Year
Austroads Guide to Traffic Management Part 9, Traffic Operations	Austroads Ltd, Sydney. NSW. Australia.	2016
SCATS Operation Instructions: A guide to SCATS commands and alarms, Issue B	Roads and Maritime Services, Sydney. NSW. Australia.	2014
SCATS Website	http://www.scats.com.au/how-scats-works.html	accessed April, 2018

Attachment A.1. An Example of Phase Sequence Chart



PHASE SEQUENCE CHART

LM : 164 A
DATE : 25/02/2020
INTERSECTION : Adelaide Terrace – Hill Street

	GREEN DISPLAY PHASES												SIGNAL GROUP OVERLAPS		RED/OFF ARROW/SIGNAL DURATION
SGP	A	B	C										PERMITTED	SUBJECT TO	
1	X														
2		X													
3			X												LS,TIMER, P1DWCL
4	X		X										A-C-A		
5		X													
6															TIMER, P1DWCL
7															TIMER, P3DWCL
8															TIMER, P4DWCL
9P	X														
10P	X		X										A-C		
11P		X													
12P		X													

Late start time is applied on Signal group 3

NOTES:
- SG3 Red for the duration of Special Timer 12 protecting Ped 1
- SG6 Red for the duration of Special Timer 12 also protecting Ped 1
- SG7 Red for the duration of Special Timer 13 protecting Ped 3
- SG8 Red for the duration of Special Timer 14 protecting Ped 4

Special Timers are specified for Pedestrian protection

FLEXILINK & MASTERLINK OPTIONS

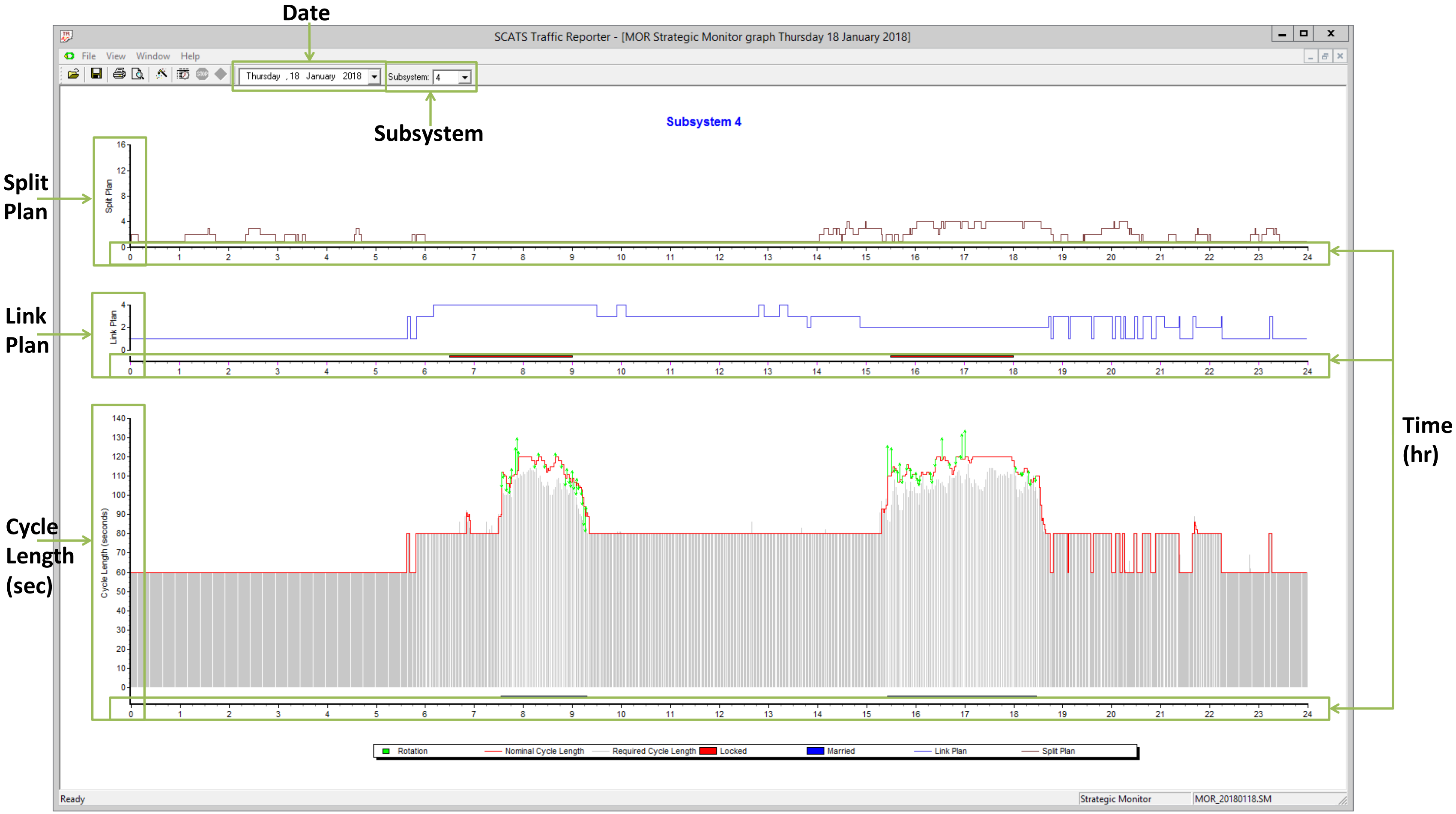
FLEXIDATA :-	PHASE(S)	PHASE(S)	PHASE(S)	XSF	PEDESTRIANS
	1st	2nd			
SEQUENCE	A,B,C	A,B,C			1. PED2 (Y-)
AUTO REL	B,C	B,C			
R- REL	A	A			
R+ REL					
Y- REL					
Y+ REL					
Q- REL					
Q+ REL					
Z- (MFlexi)					
Z+ (MFlexi)					

Main Roads / Downer Mouchel ISA I.Byl 25/02/2020
LM164_SIG.docx

Attachment A.2. Strategic Monitor

The strategic monitor graph shows recorded split plans, link plans and cycle length[8] voted by SCATS over 24 hours for a subsystem. It can be requested through Main Roads website for a specific day(s).

Figure A-37: An example of Strategic Monitor Graph



SCATS Traffic Reporter - [MOR Strategic Monitor graph Thursday 18 January 2018]

Thursday , 18 January 2018

Subsystem: 4

Ready

Strategic Monitor

MOR_20180118.SM

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[8] SCATS voted cycle length may be different from operated cycle length on site, therefore, strategic monitor graph should not be used to calculate average cycle length for modelling.