

## Reference material

# Advanced train control Migration System (AMS) Specifications – Resolving Maximum Speed in Areas Where Speed Signs are Deficient

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Authorised by: Chief Engineer, Asset Standards Authority  
Published: December 2017

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# AMS Project Specifications: Resolving Maximum Speed In Areas Where Speed Signs Are Deficient

**DeskSite Reference: 5103779**

Guideline – Applicable to Transport Projects AMS Program

## Quality Management System

Status:	Approved
Version:	2.0
Branch:	Infrastructure and Services
Business unit:	ATP / AMS Program
Date of issue:	12 May 2017
Review date:	12 May 2017
Audience:	<b>ATP / AMS Project Specific Document</b>
Asset classes:	<input checked="" type="checkbox"/> Heavy Rail; <input type="checkbox"/> Light Rail; <input type="checkbox"/> Multi Sites; <input checked="" type="checkbox"/> Systems; <input checked="" type="checkbox"/> Fleets
Project type:	Major
Project lifecycle:	<input checked="" type="checkbox"/> Feasibility; <input checked="" type="checkbox"/> Scoping; <input checked="" type="checkbox"/> Definition; <input checked="" type="checkbox"/> Construction readiness; <input checked="" type="checkbox"/> Implementation; <input checked="" type="checkbox"/> Finalisation; <input type="checkbox"/> Not applicable
Process owner:	Project Director

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<b>Approved for Release by:</b> Craig Southward		<b>Date:</b>

**Document History**

Version	Date of Issue	Author	Summary of change
0.1	16/03/2016	P.Hartley	Initial Draft
0.2	13/04/2016	P.Hartley	Incorporated initial draft comments from ST, ASA and ATP project.
0.3	03/05/2016	P.Hartley	Incorporated final comments from ST, ASA and ATP project.
1.0	06/05/2016	P.Hartley	Issued for approval
1.1	10/02/2017	P.Hartley	Additional section for clarification re: TOC vs Site speed sign discrepancies
1.2	12/05/2017	P.Hartley	Removal of Balise ID reference to TOC Manual
2.0	12/05/2017	P.Hartley	Finalised for issue

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## Foreword

This guideline forms a part of the TfNSW suite of railway signalling guidelines which detail the requirements for the implementation of ATP / AMS on the TfNSW heavy rail network. This guideline specifically covers the identification and resolution of maximum allowable speed deficiencies on the TfNSW network.

To gain a complete overview of ATP / AMS signalling design requirements, this document should be read in conjunction with the AMS project documentation.

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## 1. Introduction

A Speed Sign provides the maximum allowable speed on a portion or duration of a line. The sign may contain multiple maximum allowable speeds to cater for the different types of trains that operate on the TfNSW network.

Projects like the Automatic Train Protection (ATP) program, require a continuous maximum allowable speed so a train can always be supervised to an upper speed limit.

On the existing TfNSW network today, there may be speed sign deficiencies in the form of:

- Speed sign coverage
  - No speed signs apparent for portions of lines
    - Where a train enters a line and the maximum allowable speed is only defined some distance ahead, in the direction of travel e.g. entering a Main line
  - No speed signs apparent for the duration of a line
    - Where a train enters a line and there is no maximum allowable speed defined ahead, in the direction of travel until exiting the line e.g. entering a Refuge line
- Speed sign discrepancies
  - TOC Manual vs actual site arrangements

The lack of speed sign coverage over a portion of line may be due to site constraints where a speed sign would need to be located in a cutting or within close proximity to infrastructure such as points or platforms. The lack of coverage for the duration of a line may be because the train is entering a crossing loop or refuge.

Speed sign discrepancies may be due to limited correlation activities between actual site arrangements and kilometrage/speeds published in the TOC Manual over a period of time.

## 2. Purpose

This guideline forms a part of the AMS project documentation guidelines which detail the requirements for the implementation of ATP / AMS on the TfNSW heavy rail network.

The intent of this guideline is to:

- Establish a baseline of maximum allowable speed information to be used for design purposes,
- Identify existing layouts where there is a deficiency in normal, general, medium and/or high speed sign coverage,
- Define design rules to address such coverage deficiencies so design can progress in the interim
- Define a design rule to address TOC Manual vs Site discrepancies so design can progress in the interim
- Define a design process when dealing with deficiencies/discrepancies.

### 2.1. Scope

This document addresses:

- Speed sign deficiencies associated with main signal moves on electrified running lines within the TfNSW network, bound by Hamilton, Lithgow, Macarthur and Kiama.
- Speed sign discrepancies between the TOC and site arrangements.

### 2.2. Application

This document applies to AEO's engaged to carry out signal design for new works.

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### 3. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

**AMS Project Specification:**

AMS Signal Design Principles

**Transport for NSW standards:**

TS TOC 2 Train Operating Conditions (TOC) Manual

ESC 210 Track Geometry and Stability

**RailSafe Notices:**

NSG 604 Indicators and signs

Weekly Notices

### 4. Terms and definitions

The following terms and definitions apply in this document:

**AEO** Authorised Engineering Organisation; means a legal entity (which may include a Transport Agency as applicable) to whom the ASA has issued an ASA Authorisation

**ASA** Asset Standards Authority

**ATP** Automatic Train Protection; a system which supervises train speed and target speed, alerts the driver of the braking requirement, and enforces braking when necessary. The system may be intermittent, semi-continuous or continuous according to its track-to-train transmission updating characteristics.

**Emergency Braking Distance:** The braking distance for a train when it has been subjected to an “emergency” brake application.

**Main Movement:** Train moves associated with main aspects (inc. low speed/close up aspects).

**RFI:** Request For Information

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**Service Braking Distance:** The braking distance for a train when it has been subjected to a “full” service brake application.

**SPAD:** Signal Passed At Danger

**TfNSW** Transport for New South Wales

**TOC Manual** Train Operating Conditions Manual

**ST** Sydney Trains

## 5. Speed sign coverage deficiencies

### 5.1. Speed sign documentation baseline

An AEO is expected to apply the actual site speed sign profile when ascertaining the current maximum allowable speeds on the TfNSW network.

### 5.2. Examples of speed sign coverage deficiencies

An example of a train movement where full speed sign coverage is provided is described in section 5.2.2 for clarity.

Where an AEO encounters train movements where durations or portions of lines have no maximum allowable speeds defined, refer to section 5.3 to ascertain an appropriate maximum allowable speed.

Section 5.2.3 onwards contains layouts taken from around the TfNSW network, where speed sign coverage deficiencies exist for portions/durations of lines. The layouts are not an exhaustive list, more a sample of deficiencies that exist today.

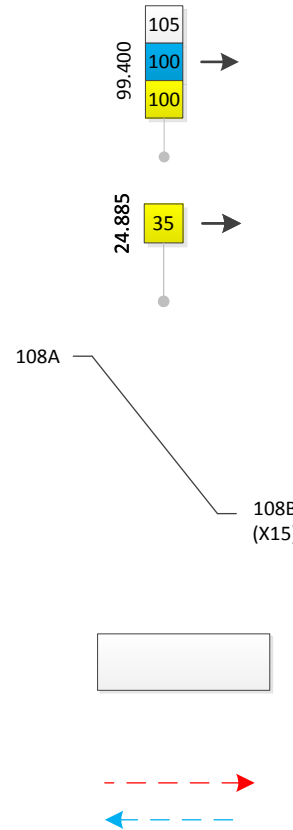
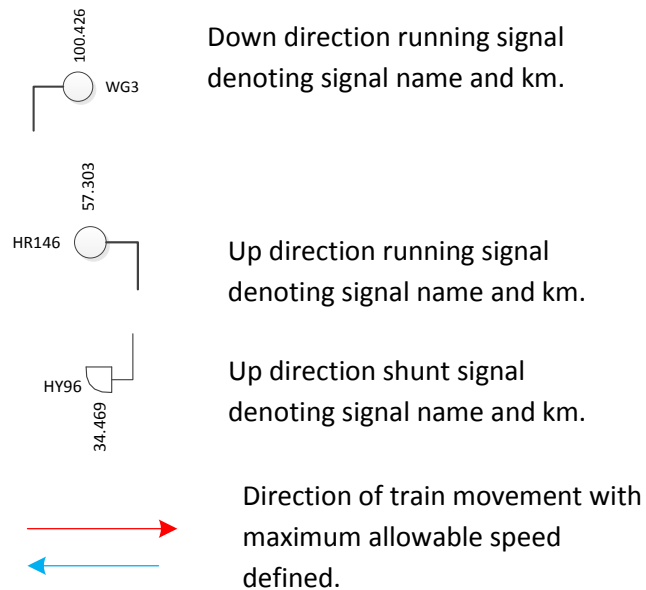
Please note the following:

- Each layout has been sourced from a signalling plan
- For clarity, some layouts may have been simplified (may not contain all lines/assets depicted on a signalling plan)
- Speed sign location, maximum allowable speeds and applicable direction have been sourced from the TOC Manual.

Reference material only

### 5.2.1. Signalling layout symbols

The symbols in the following layouts are explained in **Figure 1**.



**Figure 1:** Signalling layout symbols



Reference material only

### 5.2.3. Layout 1

Figure 3 shows a train commencing a main movement from signal 160 in the up direction on the Up Main, traverses 207 points and enters the Down Main. The first applicable speed sign for the train's straight direction of travel is approximately 1235m from the toe of 207A points.

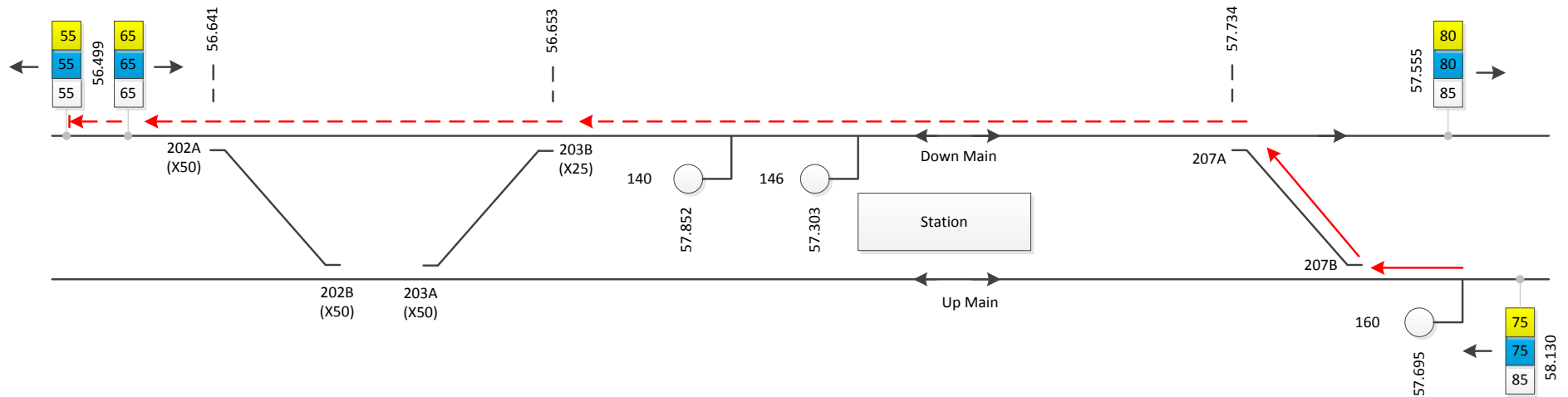


Figure 3: Speed deficiency for a portion of a line

### 5.2.4. Layout 2

Figure 4 shows a train commencing a main movement from signal 3 in the down direction on the Down Main, traverses 100 points and enters the Up Main. The first applicable speed sign for the train's direction of travel is approximately 721m from the toe of 100B points.

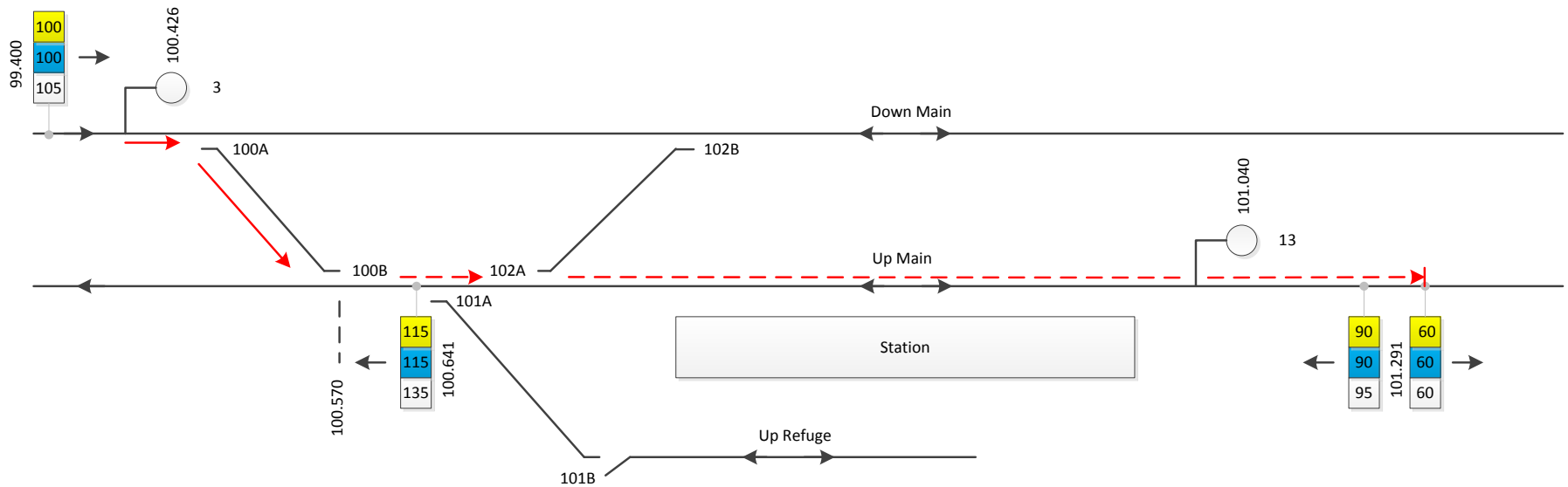


Figure 4: Speed deficiency for a portion of a line

Note: The driver should maintain the turnout speed for a minimum of a train's length beyond the exit toe of 100B, meaning the 115-115-135 speed sign does not need to be considered during the speed sign deficiency assessment.

Reference material only

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### 5.2.5. Layout 3

Figure 5 shows a train commencing a main movement from signal 41 in the down direction on the Up Main, approaching signal 49. The first applicable speed sign for the train's direction of travel is approximately 620m from signal 41. Note signal 41 is only accessible via a shunt movement in rear.

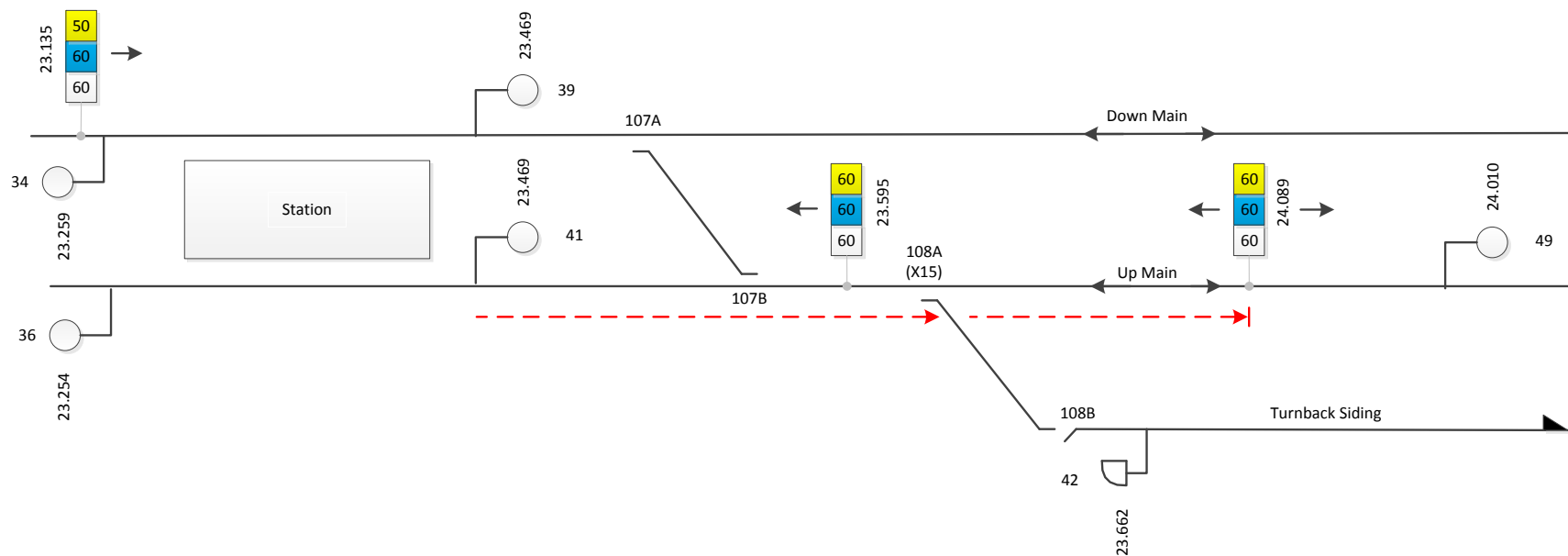


Figure 5: Speed deficiency for a portion of a line

### 5.2.6. Layout 4

Figure 6 shows a train commencing a main movement from signal 60 in the up direction on the Down Refuge, traverses 165 points and enters the Down Main. The first applicable speed sign for the train's direction of travel is approximately 500m from the toe of 165A points.

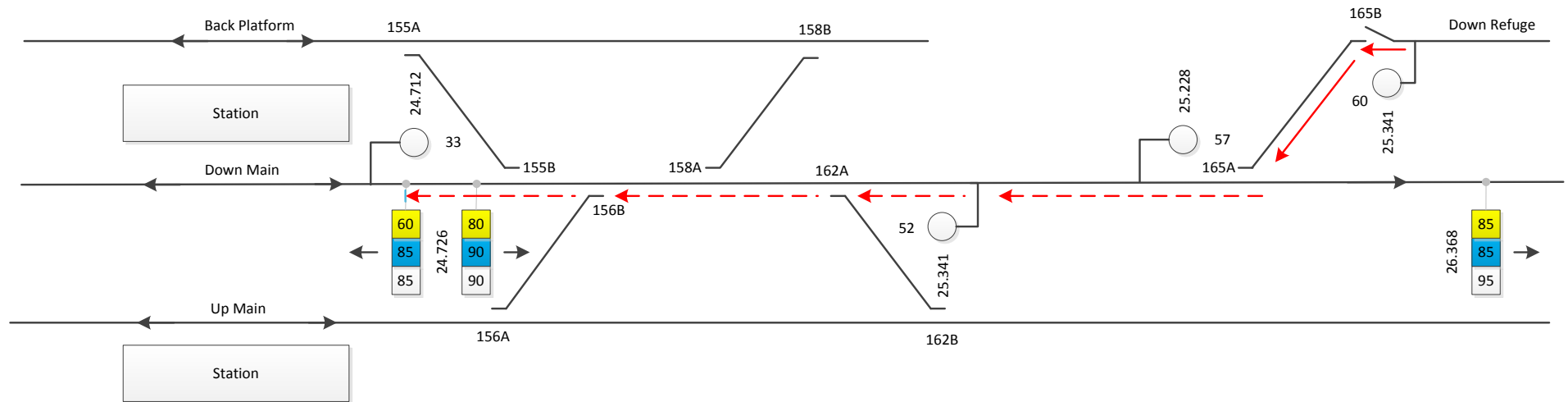


Figure 6: Speed deficiency for a portion of a line

Reference material only

Reference material only

### 5.2.7. Layout 5

Figure 7 shows a train commencing a main movement from signal 17 in the down direction on the Down Main, traverses 151 points and enters the Back Platform. The first applicable speed sign for the train's direction of travel is approximately 430m from the toe of 151B points.

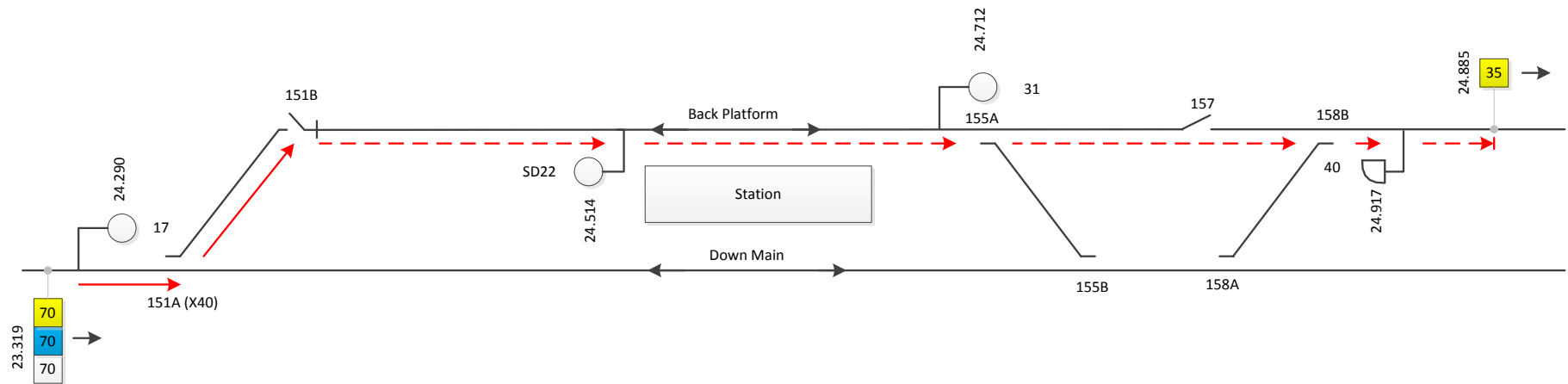


Figure 7: Speed deficiency for a portion of a line



Reference material only

### 5.2.8. Layout 6

Figure 8 shows a train that has travelled in the down direction on the Main Line and terminated at the Station. The train then restarts in the up direction on the Main Line. The first applicable speed sign for the train's direction of travel is approximately 105m from the Sydney side edge of the platform.

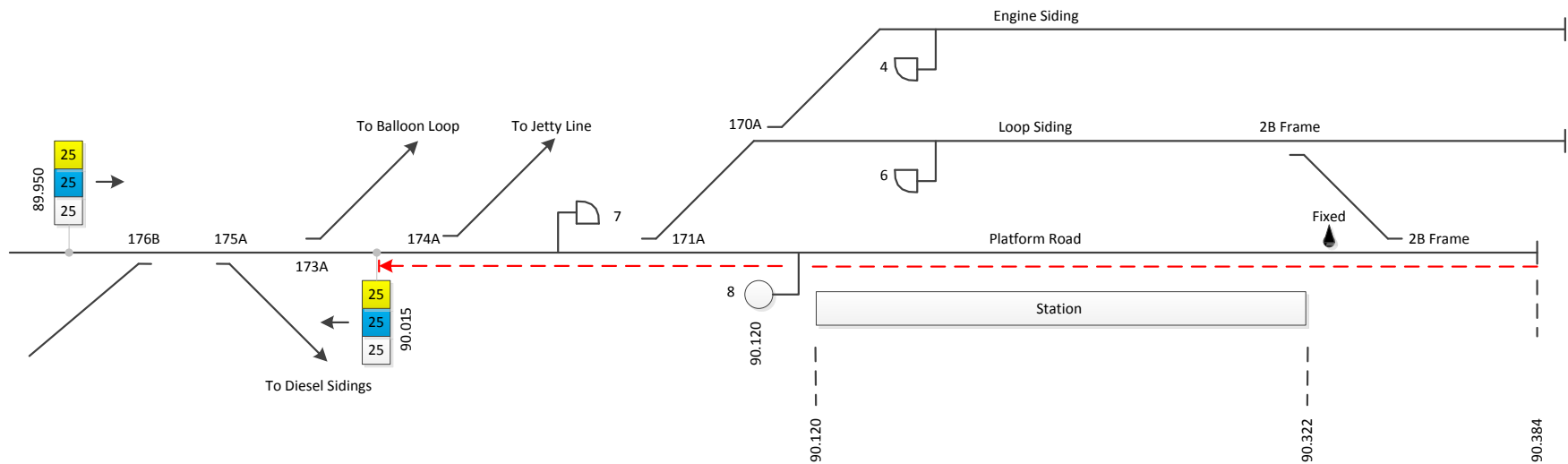


Figure 8: Speed deficiency for a portion of a line

Reference material only

### 5.2.9. Layout 7:

Figure 9 shows a train that has travelled in the down direction on the Main Line and terminated at the station. The train then restarts in the up direction on the Main Line. The first applicable speed sign for the train's direction of travel is approximately 200m from the Sydney side edge of the platform.

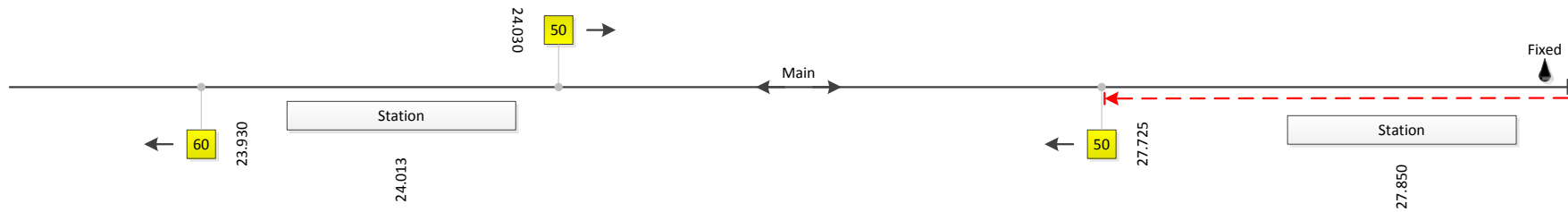


Figure 9: Speed deficiency for a portion of a line

Reference material only

### 5.2.10. Layout 8:

Figure 10 shows a train that has travelled in the down direction on the Down Main and terminated at the station. The train then restarts in the up direction on the Down Main. The first applicable speed sign (52B, X45) for the train's direction of travel is approximately 360m from the Sydney Side edge of the platform.

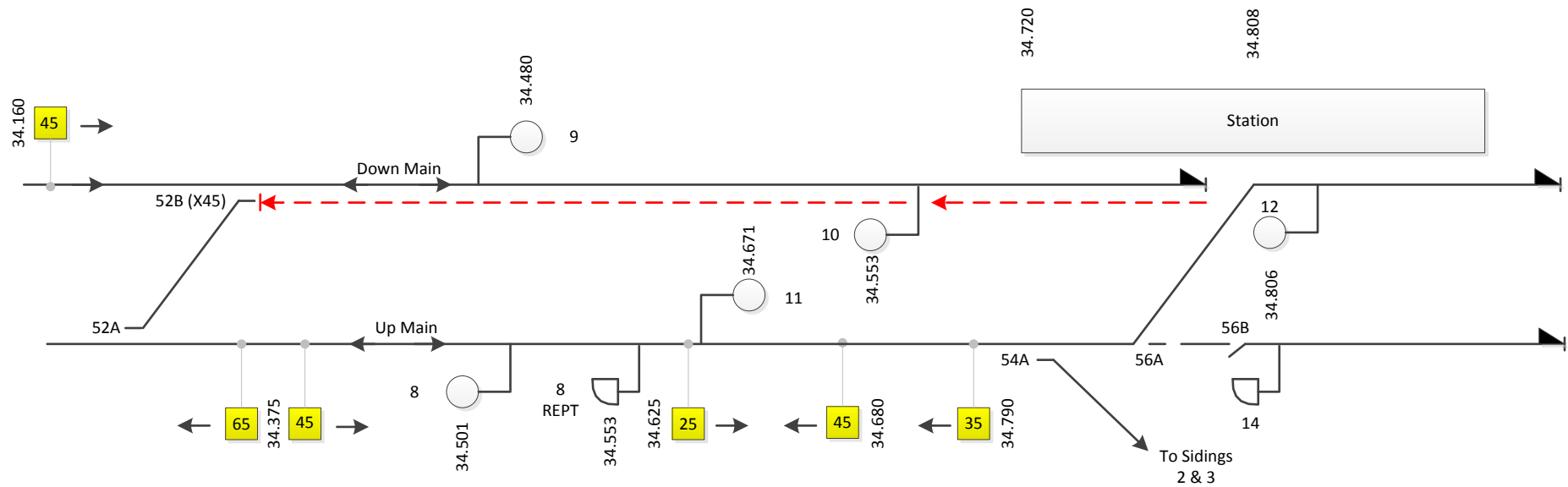


Figure 10: Speed deficiency for a portion of a line

Reference material only

### 5.2.11. Layout 9:

Figure 11 shows a train commencing a main movement from signal 595 in the down direction on the Down Main, traverses 335 points and enters the Down Refuge. Alternatively, a train commencing a main movement from signal 556 in the up direction on the Down Main, traverses 317/318 points and enters the Down Refuge. There are no speed signs applicable in either direction for the duration of the Down Refuge.

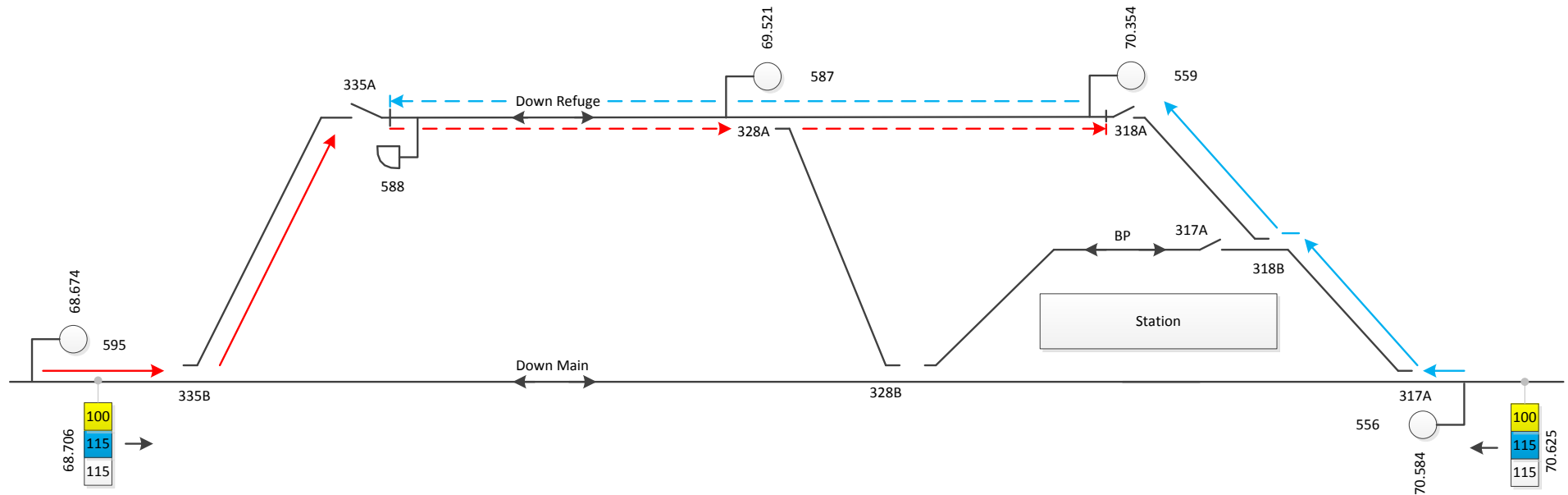


Figure 11: Speed deficiency for a duration of a line

Reference material only

### 5.2.12. Layout 10:

Figure 12 shows a train commencing a main movement from signal 42.5 in the down direction on the Main, traverses 51 points and enters the Loop. Alternatively, a train commencing a main movement from signal 42.6 in the up direction on the Main, traverses 52 points and enters the Loop. There are no speed signs applicable, in either direction, for the duration of the Loop.

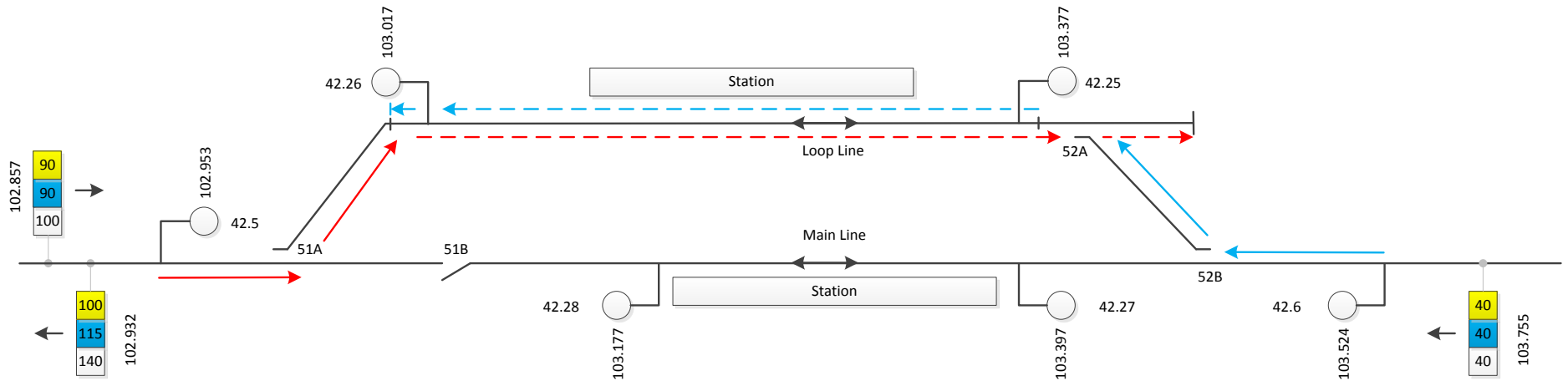


Figure 12: Speed deficiency for a duration of a line

Reference material only

### 5.2.13. Layout 11:

Figure 13 shows a train commencing a main movement from signal 57 in the down direction on the Down Main, traverses 165 points and enters the Down Refuge Loop. There are no speed signs applicable for the duration of the Loop, in the direction of travel.

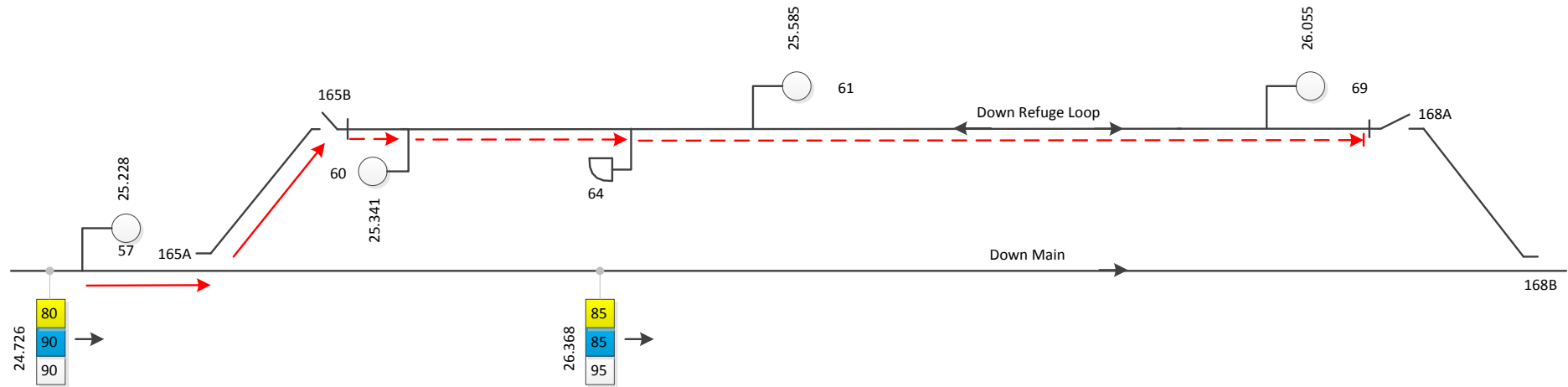


Figure 13: Speed deficiency for a portion of a line

### 5.3. Design rules

From the above layouts, a number of design rules can be established to enable an AEO to address the speed sign coverage deficiencies in the interim to allow design to progress.

The maximum allowable speeds derived from the design rules, are to be defined from the following infrastructure:

- The exit toe of the applicable points (if available) or
- The first block joint beyond the turnout / catch point (if no exit toe exists) or
- The commencing platform starting signal (if speed sign deficiency originates from the signal) or
- The Buffer stop or end of line.

Note: When traversing turnouts, as per driver training, it is assumed the driver will maintain the turnout speed for a minimum train length beyond the exit toe of the turnout, in the train's applicable direction of travel.

Reference material only

### 5.3.1. Design rule 1

Where a signalling main movement leads to a portion of line where no maximum allowable speed is defined in the direction of travel:

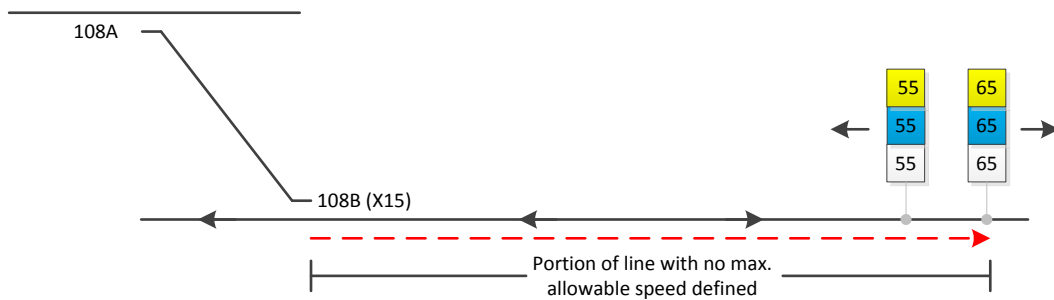
The maximum allowable speed for the portion of line is defined as the lower of the following:

- The next defined maximum allowable speed in the direction of travel vs.
- The maximum allowable speed for the portion of line in the opposing direction of travel,

Note: where an entry turnout speed leading to the portion of line is greater than the result of Design Rule 1 above, consultation is required, refer to Section 7.

Rationale:

Design rule 1 (refer to **Figure 14**) adopts a conservative approach with regard to track geometry, considering the track will likely accommodate the lower of the two opposing maximum allowable speeds, for the duration of the speed sign deficiency. The rule also negates the need for a driver to decelerate unnecessarily when approaching the next speed sign (beyond the deficiency) in the applicable direction of travel. The note ensures the rule is revisited if found to be detrimental to operations.



**Figure 14:** Deficiency in maximum allowable speed

As per **Figure 15**, applying design rule one consists of comparing the existing opposing maximum allowable speeds for each category which results in lowest speed category being defined for the duration of the deficiency, in this case applicable from the toe of 108B points.



Reference material only

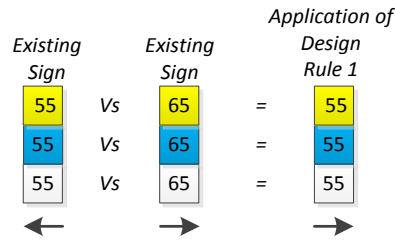


Figure 15: Application of Design rule 1

### 5.3.2. Design rule 2

Where a signalling main movement leads through a turnout, onto a portion of line where:

- There is no maximum allowable speed defined (for the portion) in the direction of travel and
- There is no maximum allowable speed in the opposing direction of travel,

The maximum allowable speed for the portion of line is defined as the lower of the following:

- The next defined maximum allowable speed in the direction of travel vs.
- The entry turnout speed leading to the portion of the line

Rationale:

Design rule 2 adopts a conservative approach with regard to track geometry, considering the track will likely accommodate the lower of the turnout vs maximum allowable speed(s) ahead, for the duration of the speed sign deficiency. The rule also negates the need for a driver to decelerate unnecessarily when approaching the next speed sign (beyond the deficiency) in the applicable direction of travel. As per **Figure 16**, a train would adopt a 35km/h maximum allowable speed until the posted speed sign some distance ahead.

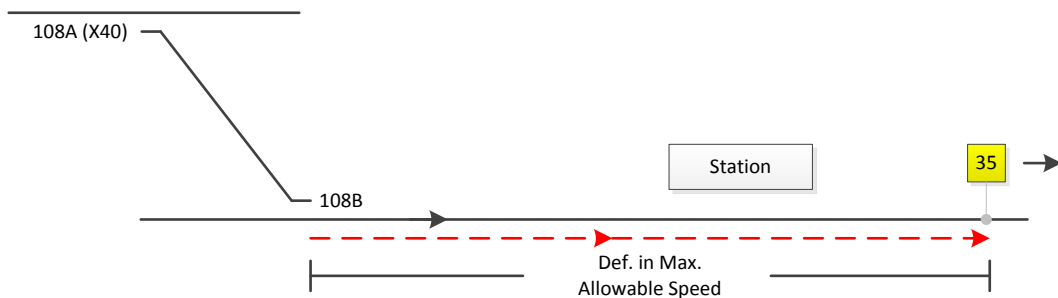


Figure 16: Deficiency in maximum allowable speed

### 5.3.3. Design rule 3

Where a signalling main movement enters a portion of line where:

- There is no maximum allowable speed defined in the direction of travel and
- There is an entry turnout speed beyond the portion of track in the direction of travel and
- There is a maximum allowable speed for the portion of line in the opposing direction of travel

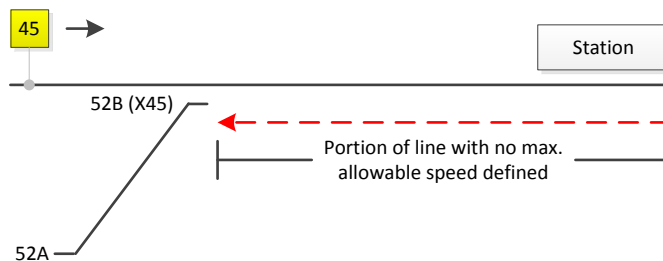
The maximum allowable speed for the portion of line is defined as the lower of the following:

- The maximum allowable speed for the portion of line in the opposing direction of travel,
- The entry turnout speed ahead in the direction of travel.

Note: where the entry turnout speed ahead is lower than the result of Design Rule 3 above, consultation is required, refer to Section 7.

Rationale:

Design rule 3 adopts a conservative approach with regard to track geometry, considering the track will likely accommodate the lower of the turnout vs maximum allowable speed(s) ahead, for the duration of the speed sign deficiency. The rule also negates the need for a driver to decelerate unnecessarily when approaching the next speed sign (beyond the deficiency) in the applicable direction of travel. As per **Figure 17**, the exit turnout (x45) is compared with the speed in the opposing direction to define a maximum allowable speed of 45/45/45 for the portion of the line. The note ensures the rule is revisited if found to be detrimental to operations.



**Figure 17:** Application of Design rule 3

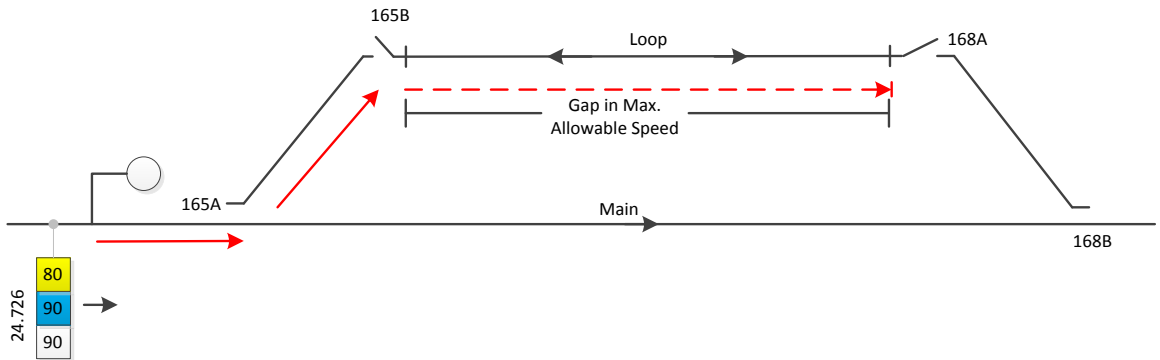
### 5.3.4. Design rule 4

Where a signalling main movement leads through a turnout, onto a line where no maximum allowable speed in the direction of travel, is defined for the duration of a line:

The entry turnout speed defines the maximum allowable speed for the duration of the line in the direction of travel.

Rationale:

A driver will comply with the previous speed sign, in this case dictated by a turnout, until encountering another speed sign in the applicable direction of travel. If there is no speed sign at a turnout, the driver must not travel faster than 25km/h through the turnout.



**Figure 18:** Application of Design rule 4

Reference material only

### 5.3.5. Design rule 5

The Signalling system needs to be assessed to accommodate any maximum allowable speeds defined through application of design rules 1, 2, 3 and 4 in this guideline. If the signalling system cannot accommodate the maximum allowable speed then the lowest of the following defines the speed, for the duration of the speed sign deficiency:

- Service braking
- Trip braking

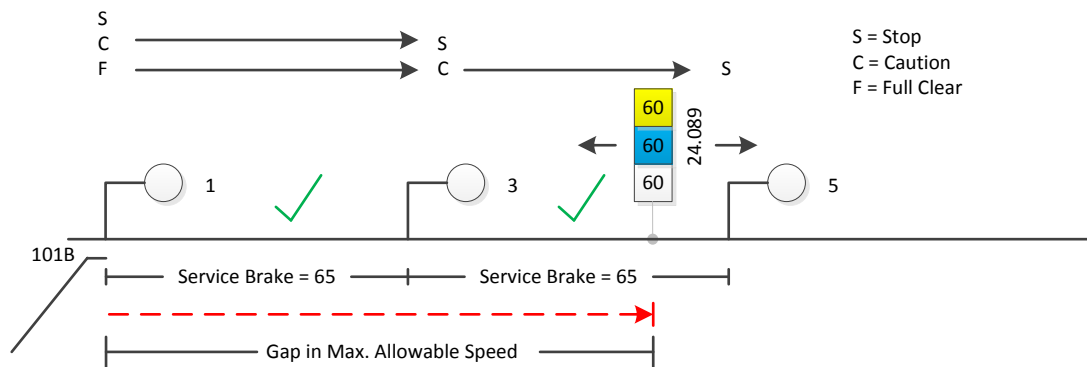
If the signalling system imposes an unduly low speed, consultation is required, refer to Section 7.

Rationale:

The signalling system needs to accommodate the proposed speed for the duration of the newly defined maximum allowable speed. This ensures a train accelerating to the maximum allowable speed is capable of:

- Coming to a stand prior to a signal at stop
- Coming to a stand in the overlap in case of a Signal Passed At Danger (SPAD).

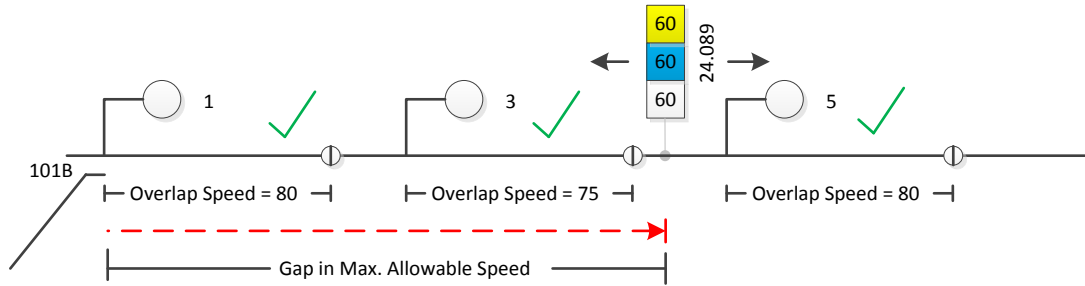
As per **Figure 19**, all service braking within the deficiency can accommodate the 60/60/60 proposed maximum allowable speed.



**Figure 19:** Service braking assessment

Reference material only

As per **Figure 20**, all signalling overlaps within the deficiency can accommodate the 60/60/60 proposed maximum allowable speed.



**Figure 20:** Emergency braking assessment

From the above assessment, the newly defined 60/60/60 to address the speed sign deficiency commences from the toe of 101B points.

Reference material only

## 5.4. Application of rules

The established rules can now be applied to each layout to address the maximum allowable speed deficiencies as detailed in the table below.

Layout	Red Route	Blue Route (if applicable)
1	Rule 1 considers the existing opposing speeds and defines the maximum allowable speed of 55/55/55, commencing from the toe of 207A points.	
2	Rule 1 considers the existing opposing speeds and defines the maximum allowable speed of 60/60/60, commencing from the toe of 100B points.	
3	Rule 1 considers the existing opposing speeds and defines the maximum allowable speed of 60/60/60, commencing from EG41 signal.	
4	Rule 1 considers the existing opposing speeds and defines the maximum allowable speed of 60/85/85, commencing from the toe of 165A points.	

Reference material only

Layout	Red Route	Blue Route (if applicable)
5	Rule 2 considers the existing speed / entry turnout speed to define the maximum allowable speed of 35/35/35, commencing from the first block joint beyond 151B points.	
6	Rule 1 considers the existing opposing speeds and defines the maximum allowable speed of 25/25/25, commencing from the end of line.	
7	Rule 1 considers the existing opposing speeds and defines the maximum allowable speed of 50/50/50, commencing from the end of line.	
8	Rule 3 considers the opposing speed / entry turnout speed to define the maximum allowable speed of 45/45/45, commencing from the end of line.	
9	Rule 4 considers the entry turnout speed to define the maximum allowable speed of 25/25/25, commencing from the block joint beyond 335A points.	Rule 4 considers the entry turnout speed to define the maximum allowable speed of 25/25/25 commencing from the block joint beyond 318A points.

Layout	Red Route	Blue Route (if applicable)
10	Rule 4 considers the turnout entry speeds to define the maximum allowable speed of 25/25/25, commencing from the block joint beyond 51 turnout.	Rule 4 considers the turnout entry speeds to define the maximum allowable speed of 25/25/25, commencing from the toe of 52A points.
11	Rule 4 considers the entry turnout speed to define the maximum allowable speed of 25/25/25, commencing from the block joint beyond 165B catch point.	

The Layouts 1 to 11 require application of Design rule 5 to ensure the maximum allowable speeds can be accommodated by the signalling system.

Note that the above design rules have been generated to cater for the layouts found over the TfNSW network that are depicted in this guideline. If any additional layouts deviate from those depicted in this guideline consultation is required, refer to Section 7.

Reference material only



## 6. Speed sign discrepancies

### 6.1. Speed sign documentation baseline

Site or desktop correlation activities should compare:

The TOC Manual (in conjunction with the Weekly Notices) maximum allowable speeds vs the actual site speed sign profile and

The TOC Manual (in conjunction with the Weekly Notices) speed sign location vs the actual site speed sign location.

### 6.2. Design rule

The following rules can be established to enable an AEO to address any of the above speed sign discrepancies in the interim to allow design to progress.

#### 6.2.1. Design rule 6

Where there is a discrepancy between the TOC Manual (in conjunction with the weekly notices) maximum allowable speeds and the actual site speed sign profile, the AEO will comply with the actual site speed sign profile for design purposes.

Rationale:

The drivers comply with the actual site speed sign profile as opposed to those published in the TOC Manual / Weekly Notices. Adopting the speed profile defined in the TOC / Weekly notices if it differs from the actual site speed sign profile, will impact drivers' adherence to NSG604 Indicators and Signs.

#### 6.2.2. Design rule 7

Where there is a discrepancy between the TOC Manual (in conjunction with the weekly notices) speed sign location and the actual site speed sign location, the following rules should be applied:

### 6.2.2.1 Where TOC vs Site Discrepancy is Equal To or Less Than 20 Metres

The balise should be designed and installed at the physical speed sign location.

Sydney Trains are to be informed of the discrepancy via an RFI, which is to state that the discrepancy is LESS THAN OR EQUAL TO 20 metres.

### 6.2.2.2 Where TOC vs Site Discrepancy is Greater Than 20 Metres

The balise should be designed and installed at the physical speed sign location.

Sydney Trains are to be informed of the discrepancy via an RFI, which is to state that the discrepancy is GREATER THAN 20 metres.

### 6.2.2.3 Where TOC Manual Specifies a Speed Profile Location but No Speed Sign Is Found On Site

The balise should be designed and installed at the OHW structure closest in advance of the TOC location for a speed increase, and the closest in rear of the TOC location for a speed decrease.

Sydney Trains are to be informed of the discrepancy via an RFI, which is to state that there is a missing speed sign on site.

### 6.2.2.4 Where There is a Speed Sign On Site But None is Specified in the TOC Manual

If the speed sign is recorded in GIS, balise group placement design is to be carried out using the physical speed sign site location. GIS should be used to derive the relative distance between the speed sign site location and the nearest infrastructure.

If the speed sign is not recorded in GIS, then the speed signal location should be derived using site measurements from the nearest infrastructure, and recorded on the Site Certification Form by the installer.

Sydney Trains are to be informed of the discrepancy via an RFI, which is to state that there is a missing speed sign in the TOC manual.

Reference material only

### 6.2.2.5 Where a Balise Group Cannot Be Placed in the Vicinity of a Speed Sign

The balise group should be designed and placed as close to the speed sign as practicable (refer to section 7.4.3 of AMS Signal Design Principles), taking into consideration the optimal AMS configuration. The installed location should be recorded on the Site Certification Form by the installer.

An RFI detailing the balise group placement proposal should be submitted to Sydney Trains for confirmation.

## 7. Design process

### 7.1. Speed sign coverage deficiency process

As per section 5.2, existing layouts today have coverage deficiencies. In such circumstances, as per **Figure 21**, the AEO will:

- Notify ASA of the deficiency
- Apply the guideline (if inadequate, request ASA track to provide a new/revised rule) and record the deficiency / resolution in the design documentation e.g. SFS
- Comply with the design rules defined in this document for design purposes,

If the ASA advises of an update to the TOC Manual / Weekly Notices within a timescale to suit the project, the design documentation shall be updated to reflect the change.

### 7.2. Speed sign TOC vs Site discrepancy process

Discrepancies as a result of auditing / correlation activities may arise. In such circumstances, as per **Figure 21**, the AEO will:

- Notify Sydney Trains of the discrepancy and
- Apply the guideline and record the discrepancy / resolution in design documentation e.g. SFS

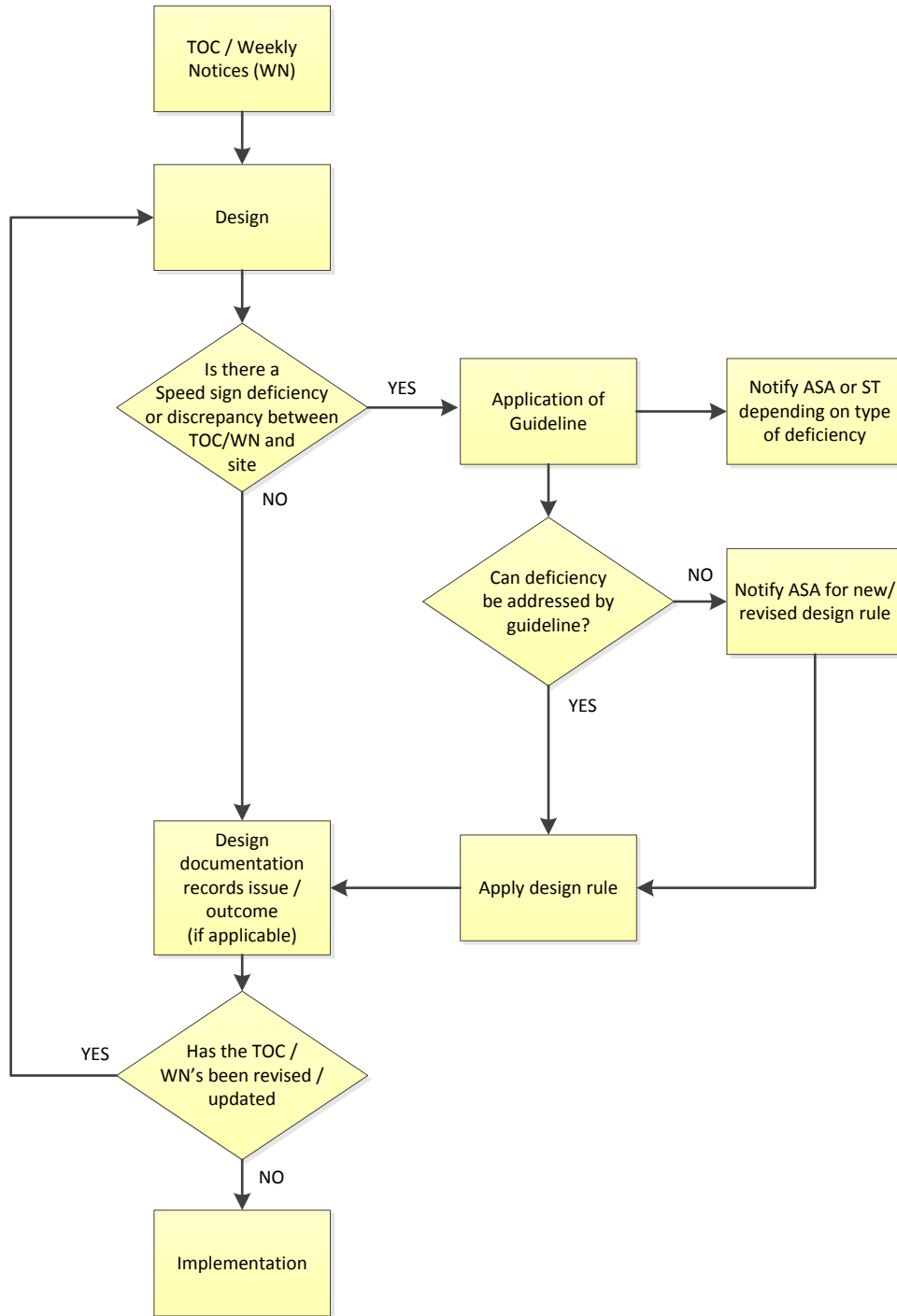
Reference material only

- Comply with the design rules defined in this document for design purposes.

If the ASA advises of a change to the TOC Manual / Weekly notices within a timescale to suit the project, the design documentation shall be updated to reflect the change.

Reference material only

Reference material only



**Figure 21: Design process**