For queries regarding this document
standards@transport.nsw.gov.au
www.transport.nsw.gov.au

Technical Direction – TD 00018:2022

Issue date: 25 May 2022

Effective date: 25 May 2022

Title: Inclusion of requirements for balise plans – Amendments to T MU MD 00006 ST, v6.0

This technical direction is issued by the Asset Management Branch (AMB), formerly known as Asset Standards Authority, as an update to T MU MD 00006 ST *Engineering Drawings and CAD Requirements*, version 6.0.

The updates include requirements to create balise plans and ETCS tables produced for TfNSW and corrections to address errors in figures noted in this technical direction.

1 Background

A balise plan is a new ETCS artifact that represents a simplified layout of ETCS information points (balises) and their primary functions. The balise plan requirements ensure standardisation of drawings and achieve consistency.

2 Amendment to T MU MD 00006 ST

The sections in T MU MD 00006 ST *Engineering Drawings and CAD Requirements*, version 6.0 are to be amended as follows:

Section 14.1.4 Signalling, track insulation and balise plans

Replace the first sentence under Section 14.1.4 with the following:

Signalling plans, track insulation plans and balise plans shall use the title block as shown in Figure 130.

© State of NSW through Transport for NSW 2022

Section 14.3 Cell libraries for signal drawings

Add the following dot point, a new cell library for balise plan, to the list after the last dot point.

- SD_BP_Cells.cel

Section 14.8.8 Curve and gradient

Replace Figure 137 with the following.

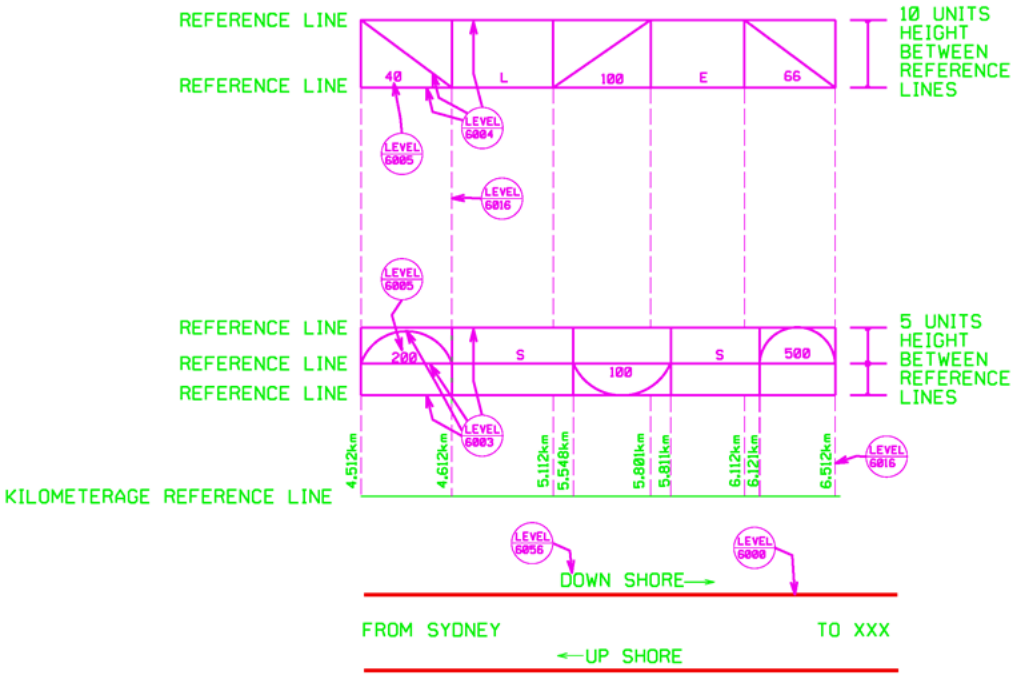


Figure 137 – Gradients and curvatures

© State of NSW through Transport for NSW 2022

Section 14.8.9 Placing equipment and text on signalling plans

Replace Figure 145 with the following:

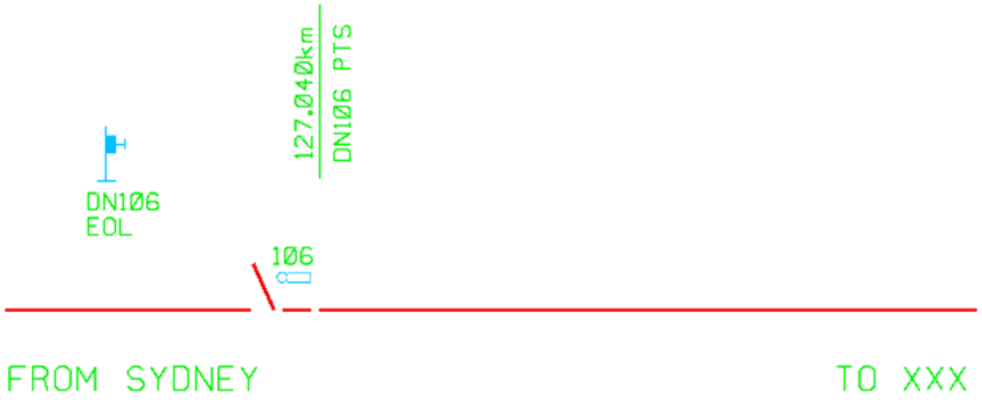


Figure 145 – Catchpoints

Replace Figure 146 with the following:

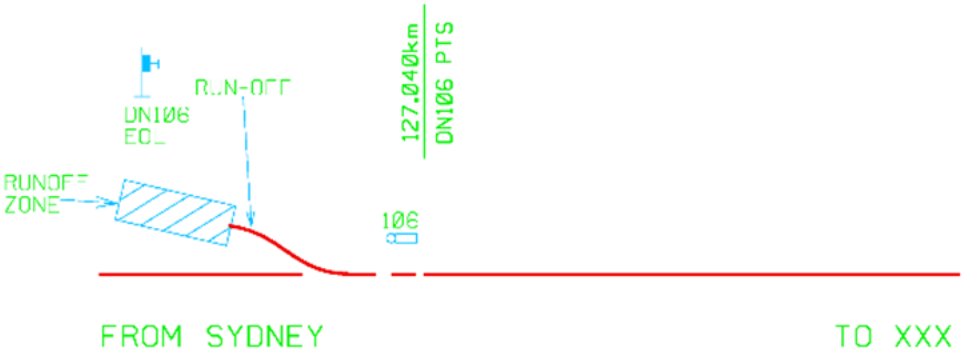


Figure 146 – Run-off points

© State of NSW through Transport for NSW 2022

Replace Figure 147 with the following:

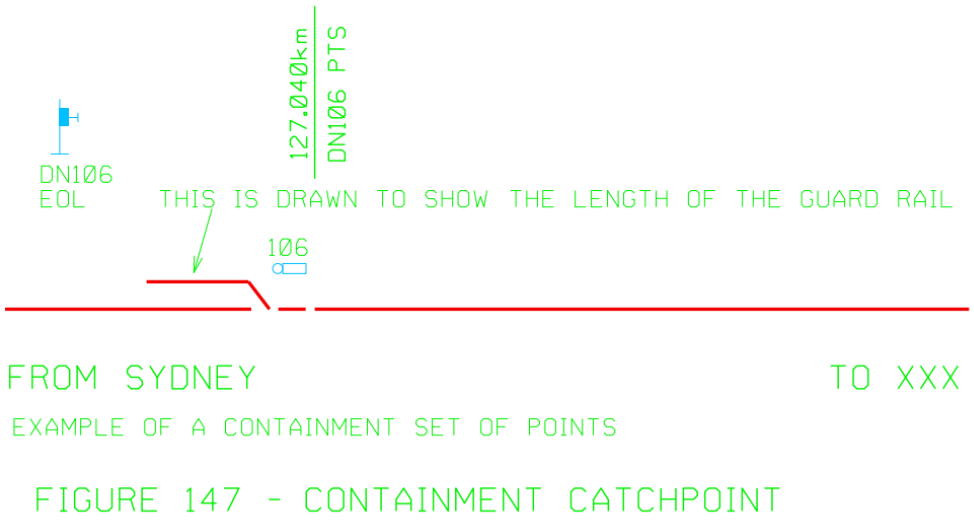


Figure 147 – Containment catchpoints

Add the following new sections after Figure 168 in Section 14.9.12, before the existing Section 14.10 Mechanical drawings:

Section 14.10 Balise plans

A balise plan represents a simplified layout of ETCS information points (balises) and their primary ETCS functions in a given direction. Each balise plan shall cover a geographical area of the network. The signalling circuit book provides a section of the network, as a guide. The limits of each balise plan corresponds to the location of the signalling infrastructure (signals and points) in the circuit book. The title of the balise plan shall be the same as the corresponding title in the circuit book.

Section 14.10.1 Balise plan composition

A balise plan shall include the following:

a. ETCS level 1 fitted lines with line names shall be shown in black colour. Non-fitted ETCS lines shall be shown in grey colour.

b. Fixed balises and controlled balises shall be shown on top of the track.

c. Turnouts and crossovers with points numbers, including the points end letters shall be shown in black colour. If there is a set of points leading to an unfitted line, then point number shall be shown in black. Only the facing point end shall be shown in grey colour.

d. Kilometre post reference points and kilometre values shall be shown in accordance with the signalling plan. All kilometre values shall be integers (that is, no decimal point or 0's preceding –, for example, '159km'). Half kilometre markers shall not be shown.

e. Station names, platforms and platform numbers shall be shown in black colour.

© State of NSW through Transport for NSW 2022

f. Level and pedestrian crossings and names with active protection, shall be indicated in black colour by two parallel dashed lines crossing the track at right angles.

g. Signals (main and shunt) shall be shown.

h. Co-acting and repeater signals shall be shown only if it is relevant to the ETCS design.

i. Trainstops (signal and intermediate) shall be shown.

j. Fixed trainstops shall be shown if it is relevant to the ETCS design (for example, at fixed red signals).

k. Shunting limit signs shall be shown with the text ’LOS’.

l. Stop signs shall be shown with text ’STOP’.

m. Speed signs shall be shown without kilometre` value. Abbreviated line names shall be included below the speed signs if there are more than two tracks in the speed sign vicinity.

n. Speed signs that do not have balise groups fitted and aligned with the signs shall have the text ’NO BG‘ above or below the speed signs. Only the text shall be coloured red.

o. Deficient line speed shall be shown with a speed sign symbol at the point, where deficient speed is applied from the text ’NO SS‘ above or below the speed sign. Both the speed sign and text shall be coloured magenta.

p. Approaching train speeds from the adjacent balise plan (circuit book area) shall be shown with a speed sign symbol outside the balise plan border.

q. TSM curves along with the line name shall be shown between redundant TSM balise group and the high-risk target location.

r. Hazard points shall be shown.

s. Level transition signs shall be shown along with level numbers in transition, coloured red.

t. BMM shall be shown.

Section 14.10.2 Scale

Balise plans are schematic diagrams and shall not be drawn to scale or to a measured scale.

Section 14.10.3 Text styles and sizes for balise plan

The ‘working’ text style should be used for balise plans. The text style in T MU MD 00006 R7 is available for download from the TfNSW website.

The text should be placed using the appropriate style with the assigned height and width. The text should not be copied, and the height and width then modified.

© State of NSW through Transport for NSW 2022

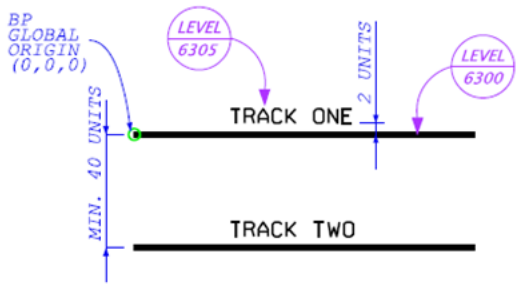
Section 14.10.4 Global origin

The global origin is the primary set out point for the drawing. It is the basis for the diagram and the starting point for the linear track measurement for the section being documented.

The sheet origin shall be 0,0 [bottom left corner on 0,0], drawn in millimetres at 1 to 1 scale.

The spacing between tracks should be 40 units. However, if the largest sheet size (A0R) is unable to accommodate multiple tracks in an area, the spacing can be reduced to 30 units.

The following figure shows an example of global origin marked in the drawing.

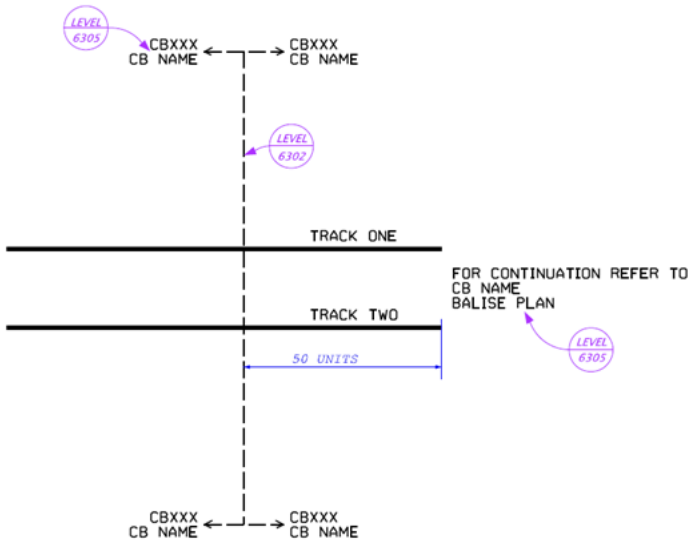


Global origin

Section 14.10.5 Balise plan continuation

Dotted lines together with the adjoining balise plan names and circuit book numbers in the format ‘CBXXX’ in black colour shall be added at both the ends of the balise plan.

The following figure shows the typical continuation of ETCS information in the balise plan.



ETCS information in balise plan

Section 14.10.6 Curvature and gradient

The curve and gradient shall not be shown in the balise plan.

© State of NSW through Transport for NSW 2022

Section 14.10.7 Placing equipment and text on balise plans

All the equipment shall be shown in a way to avoid visual clutter and maintain clarity and readability. They shall be represented by the approved cells and texts. Track identification, track lengths, track names, point machines, IRJs and tuned loops shall not be shown.

Section 14.10.7.1 Signals and trainstops

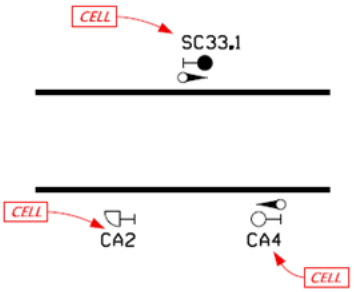
Signals shall be placed according to their actual site position in relevant signalling plan as follows:

a. Filled circles shall be placed for automatic signals.

b. Hollow circles shall be placed for controlled running signals.

c. Hollow quadrants shall be placed for shunt signals.

The following figure shows the typical signal and trainstop arrangement on a balise plan.

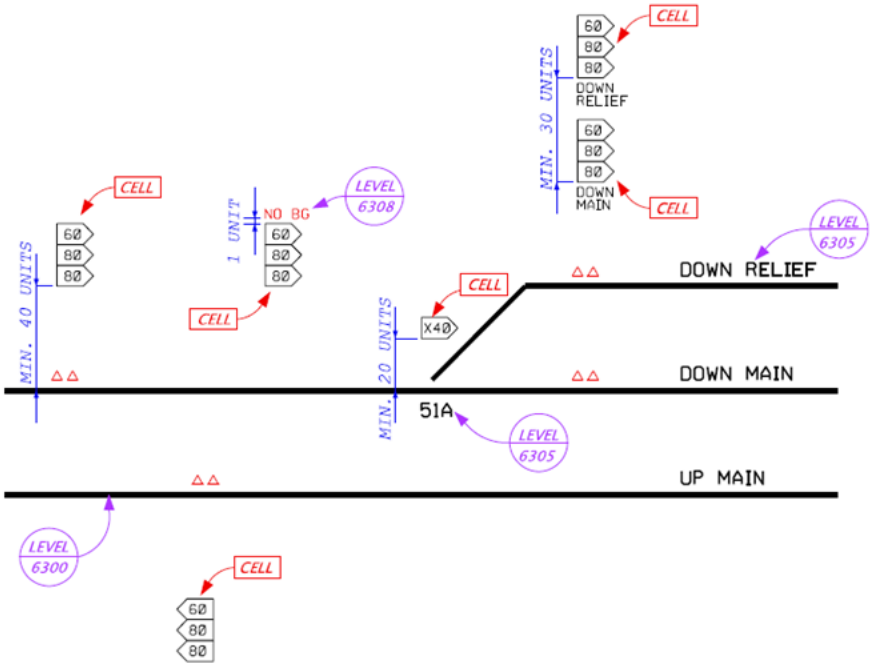


Typical signal and trainstop arrangement in a balise plan

Section 14.10.7.2 Speed sign

The following figure shows the typical speed sign arrangement on a balise plan. Where balise groups are not placed for a speed sign, then the text ’NO BG‘ shall be added above or below a speed sign in red colour.

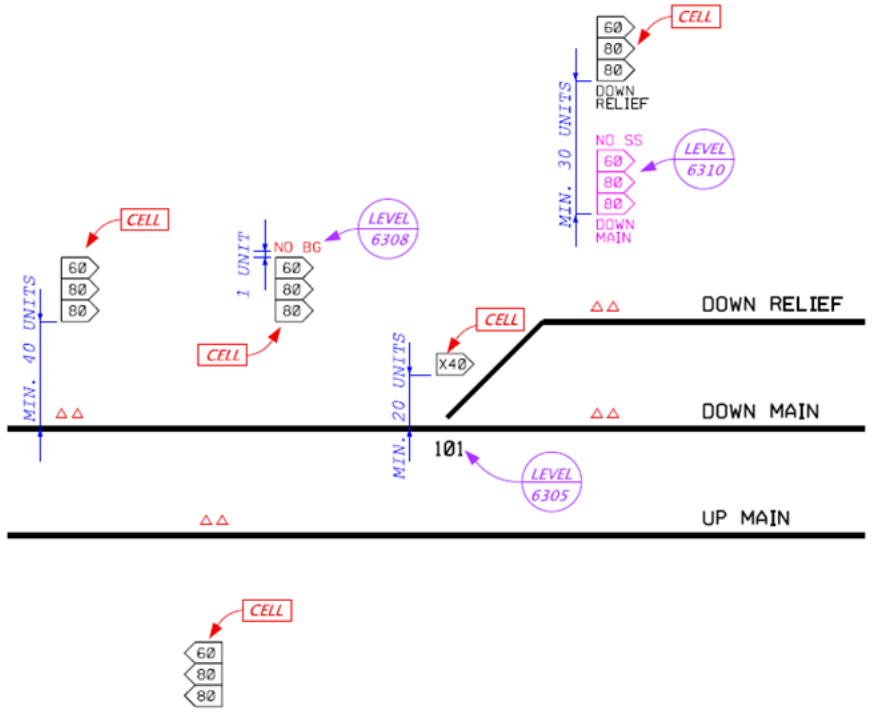
© State of NSW through Transport for NSW 2022



Typical speed sign arrangement on a balise plan

Section 14.10.7.3 Deficient line speed

The following figure shows the typical deficient line speed arrangement in a balise plan.

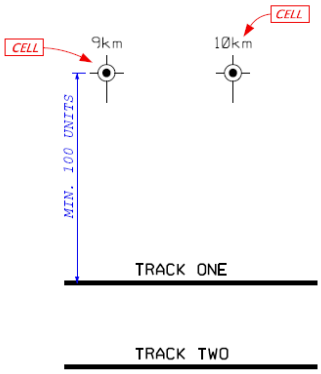


Typical deficient line speed arrangement in a balise plan

Section 14.10.7.4 Kilometrage posts

The following figure shows the typical kilometre posts that shall be shown with the distance noted above the post.

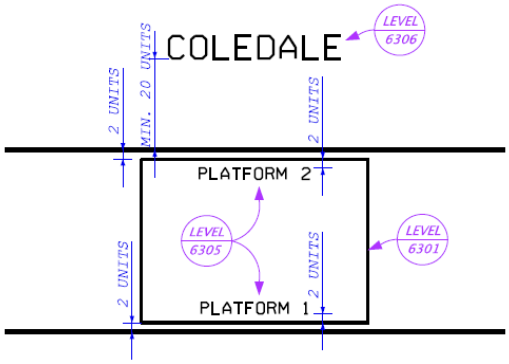
© State of NSW through Transport for NSW 2022



Typical kilometre posts

Section 14.10.7.5 Station names and platforms

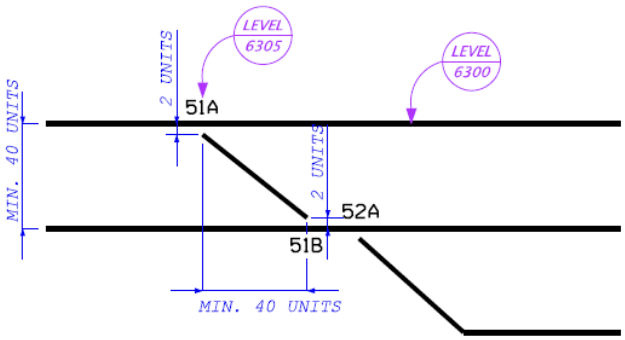
The following figure shows a typical station platform name in relation to the running tracks. The station name is placed in relation to the platform.



Station platform name in balise plan

Section 14.10.7.6 Crossovers and turnouts

The following figure shows the typical crossovers and turnouts in a balise plan.

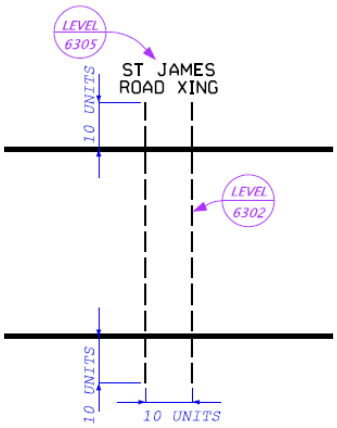


Crossovers and turnover in balise plan

Section 14.10.7.7 Level crossing

The following figure shows an arrangement of a level crossing in a balise plan.

© State of NSW through Transport for NSW 2022



Arrangement of a level crossing in balise plan

Section 14.10.7.8 Balises

Balises shall be drawn above the track line. A fixed balise shall be shown in a hollow balise symbol. A controlled balise shall be shown in a filled balise symbol.

The position in group number (N_PIG) shall be shown below each balise.

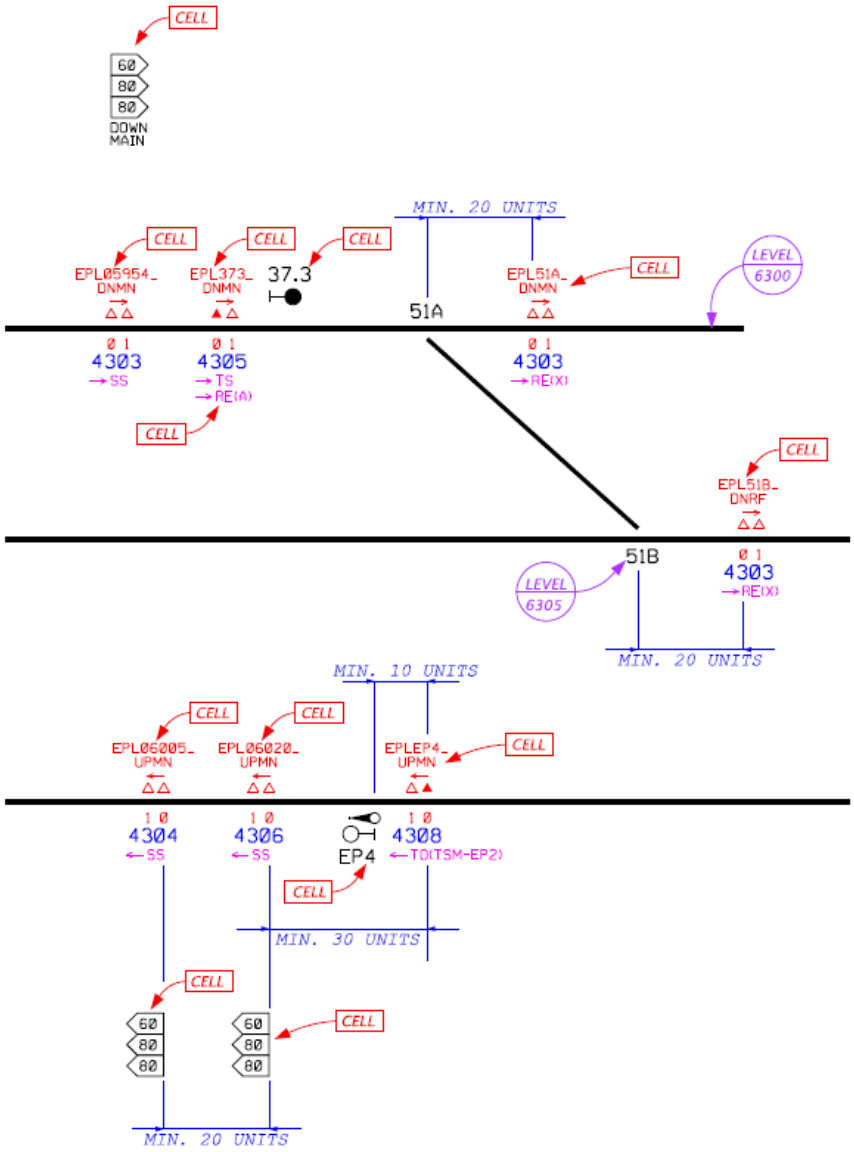
Arrows shall be placed above each balise group, indicating the nominal direction.

Balise group names shall be shown horizontally above each balise group. The top line shall have the first part of the balise group name followed by an underscore. The second line shall have the four letter abbreviated line name portion of the balise group name. The exception to this is in congested areas as it may be required to show the balise group name to the nearest available space on the plan and use arrows or pointers to the referenced balise group.

Balise group identity numbers (NID_BG) shall be shown below the N_PIG numbers.

The following figure shows the typical balise arrangement in a balise plan.

© State of NSW through Transport for NSW 2022



Balise arrangement in a balise plan

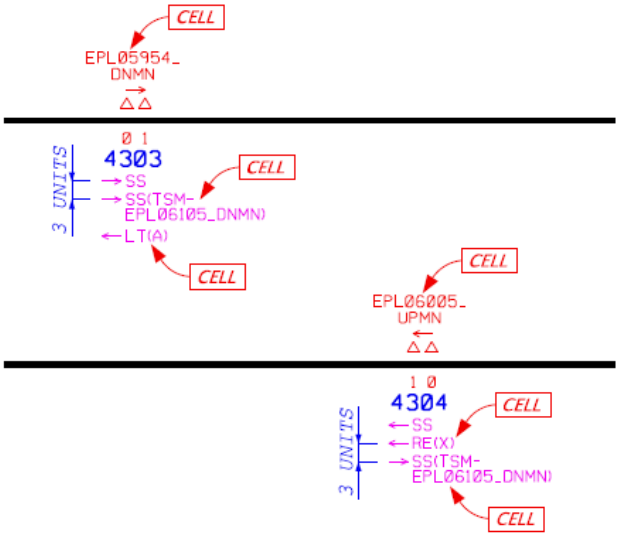
Section 14.10.7.9 Primary functions

Primary functions of a balise group shall be shown below the NID_BG. An indicative arrow shall be added in front of a primary function for each direction. All the primary functions shall be aligned with the ETCS table.

Nominal direction functions shall be listed first. The reverse direction functions shall be listed below the nominal direction functions.

The following figure shows the typical primary functions arrangement on a balise plan.

© State of NSW through Transport for NSW 2022



Primary function arrangement in a balise plan

Section 14.10.7.10 Target speed monitoring curves

The following additional information shall be added on the TSM curves:

a. High risk speed signs: nil.

b. High risk turnouts: a turnout speed sign.

c. High risk overlap: a step back up to line speed (and the target safe speed shown to the left / right of the horizontal target speed line represented as XX km/h or XX/XX/XX km/h where the safe speeds are different for G/M/H).

d. High risk converging junctions (Trailing): nil.

e. Buffer stops: the release speed shown to the left / right of the horizontal target speed line represented as XX km/h).

f. Wrong running level crossing – a step back up to line speed (and the TSR target safe speed shown to the left / right of the horizontal target speed line represented as XX km/h).

g. Small crosses on the TSM curves, in line with and indicating the balise groups providing the redundant and initiating TSM functions.

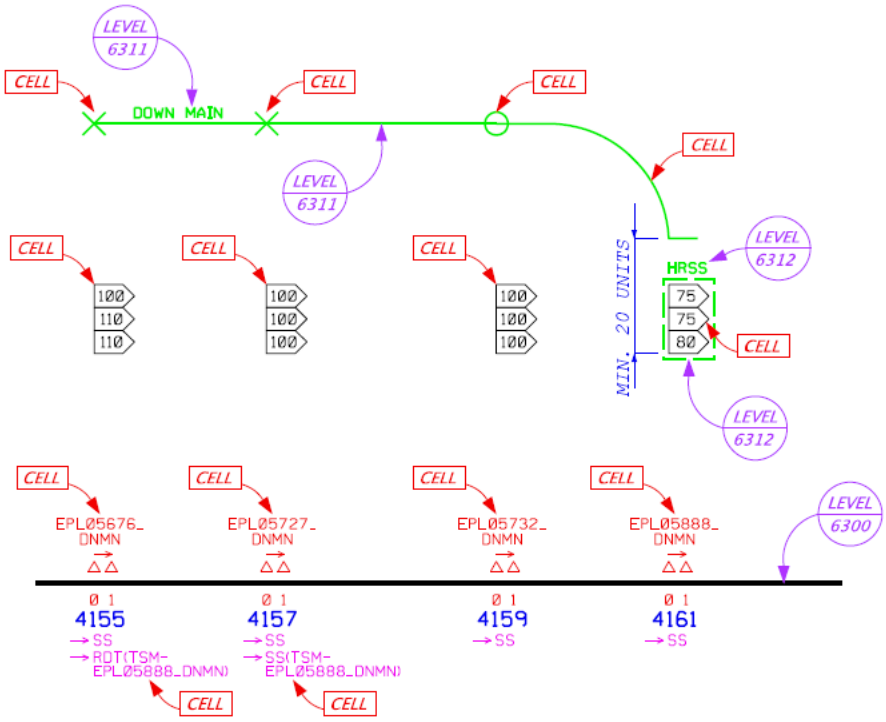
h. Where a TSM curve spans over multiple tracks, then a vertical dotted line shall be used, in line with the toe of the points, to represent where the line changes along the path of the TSM. The new line name shall be shown on the TSM curve. All approaches to the TSM target should be considered and shown where required.

i. Small circles on the TSM curves, in line with and indicating the balise groups resending existing TSM information. This includes approach balise groups and any fixed balise group that resends TSM information. All approaches to the TSM target should be considered and shown where required.

© State of NSW through Transport for NSW 2022

j. Multiple braking curves shall be shown in the cascading TSM cases, targeting each high-risk hazard points.

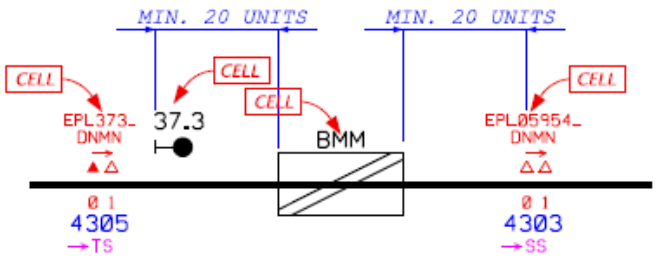
The following figure shows the typical TSM curve arrangement in a balise plan.



TSM curve arrangement in balise plan

Section 14.10.7.11 Big metal mass

The following figure shows the typical big metal mass in a balise plan.



Big metal mass in balise plan

Section 14.10.7.12 Hazard point

All hazard points shall be highlighted with a dashed green box. The following are available labels and the relevant label in green colour shall be placed above or below the box:

a. HRSS – High Risk Speed Sign.

b. HRTO (facing) – High Risk Turnout.

© State of NSW through Transport for NSW 2022

c. HRTO (trailing) – (principally known as a High-Risk Converging Junction). Target to be shown as the turnout speed sign or the toe of the catchpoints (where the converging turnout has an associated catchpoint) or the geometric beginning of the turnout.

d. HROL – High Risk Overlap (including deficient overlaps, catch points and level crossing hazards.

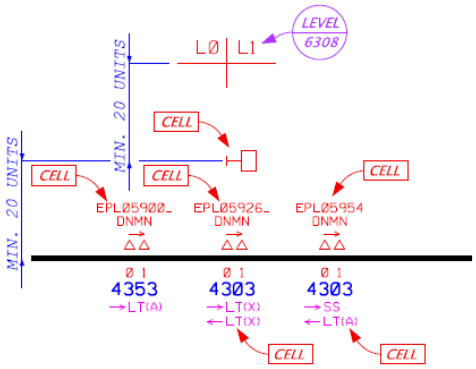
e. BS – Buffer Stop.

f. WRLX – Wrong Running Level Crossing Protection.

Any other relevant ETCS hazard point not listed in the preceding list shall be labelled as 'ETCS HAZARD POINT' with an arrow pointing to the hazard point. This shall be highlighted with a small circle in green colour.

Section 14.10.7.13 Level transition

The following figure shows the typical level transition in a balise plan.



Level transition in balise plan

Section 14.10.7.14 Balise plan key

The balise plan shall display a key of the relevant balise plan colours as shown in the figure below:

Balise plan colour key

Section 14.10.8 Drawing size

The drawing size is a not-to-scale plan, the preferred sheet size is A1 roll size with landscape orientation. Other sheet sizes A0 roll, A2 roll and A3 roll in landscape orientation can be used if required.

© State of NSW through Transport for NSW 2022

Section 14.10.9 Drawing file name

The balise plan shall be named with the prefix letter 'H' as code identification followed by the three circuit book alphanumeric characters and a '0001' number (for example, H1170001.dgn, HLID0001.dgn).

Section 14.10.10 Printing of balise plans

All balise plans shall be printed in colour as PDF. The size and scale of the PDF should be identical to the title block in the CAD file. Levels and layers in the PDF should be disabled. Working units of the PDF should be in mm and not in cm. Dimensions of the PDF should be integers only, that is, whole mm without decimal points.

Section 14.10.11 Title block status

The following are three statuses in the life cycle of a balise plan:

- For Review – used during the design review through to approval design stage of a project
- For Testing – used during the testing stage of a project (prior to simulation- if modified)
- As-Built – used during the as-built stage of a project. At this stage, the balise plan should be submitted to the Central Planroom.

Section 14.10.12 Balise plan alterations

New works, removal works and/or modified works do not have any additional requirements (that is, such works should not include solid and hollow arrows, or red, green and blue colours). To have visibility of all drawing changes, the design history of the CAD drawing file shall be maintained after every amendment that is signed off. See Section 14.4.1 for further information.

Section 14.11 ETCS table

The ETCS table or tables shall provide details of every ETCS balise group and LEU used. All ETCS tables shall be combined into a single book that aligns with its circuit book counterpart. ETCS table shall consist of cover page, control sheet(s), ETCS balise table or tables and ETCS LEU table or tables. An amendment sheet shall also be provided in the as-built version of the ETCS table.

ETCS table shall be prepared in a spreadsheet such as MS Excel and MicroStation (cover sheet only) formats according to the template.

Section 14.11.1 ETCS table composition

ETCS table shall include all the following details that assists circuit book design, balise plan production, data preparation, verification, validation and commissioning activities.

1. cover sheet

© State of NSW through Transport for NSW 2022

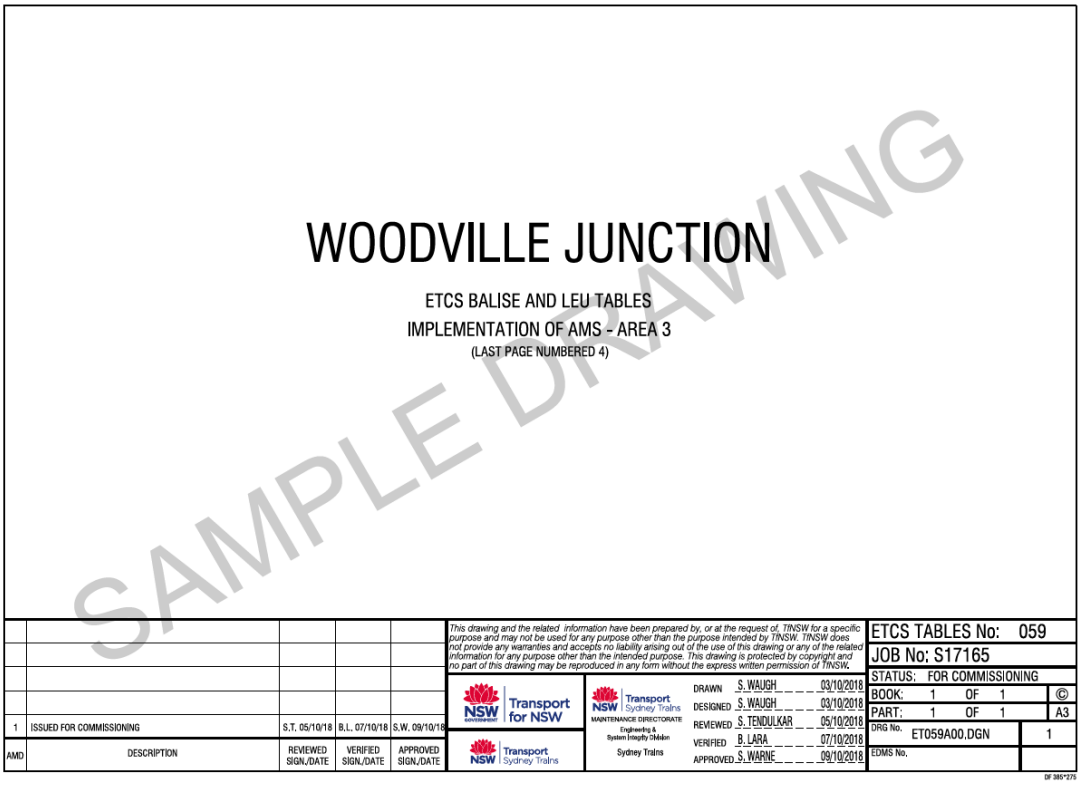
2. control sheet
3. amendment sheet (only for as-built version)
4. balise table, including the following details:
    a. identity number of the country or region
    b. balise group name
    c. balise group identity number
    d. line name
    e. nominal direction
    f. primary function(s)
    g. static speed profile or leu table reference
    h. remarks
5. LEU table including the following details:
    a. LEU Name
    b. actual LEU Name
    c. configuration identity number
    d. function name/lamp name
    e. lamp type
    f. LEU output
    g. signal control/aspect
    h. LEU input bits
    i. M_Mcount
    j. response
    k. speed profile
    l. LSSMA On
    m. notes

Section 14.11.2 ETCS table cover sheet and control sheet

The cover and control sheets shall be completed in the same way as those used for the signalling control tables. Cover sheets shall be produced using MicroStation and control page shall be produced as a spreadsheet such as MS Excel format.

© State of NSW through Transport for NSW 2022

The following figures show a typical cover sheet and control sheet during the design stage, respectively.



WOODVILLE JUNCTION

ETCS BALISE AND LEU TABLES

IMPLEMENTATION OF AMS - AREA 3

(LAST PAGE NUMBERED 4)

SAMPLE DRAWING

AMD	DESCRIPTION	REVIEWED SIGN./DATE	VERIFIED SIGN./DATE	APPROVED SIGN./DATE
1	ISSUED FOR COMMISSIONING	S.T. 05/10/18	B.L. 07/10/18	S.W. 09/10/18

This drawing and the related information have been prepared by, or at the request of, TfNSW for a specific purpose and may not be used for any purpose other than the purpose intended by TfNSW. TfNSW does not provide any warranties and accepts no liability arising out of the use of this drawing or any of the related information for any purpose other than the intended purpose. This drawing is protected by copyright and no part of this drawing may be reproduced in any form without the express written permission of TfNSW.

Transport for NSW

Transport Sydney Trains — Maintenance Directorate — Engineering & System Integrity Division — Sydney Trains

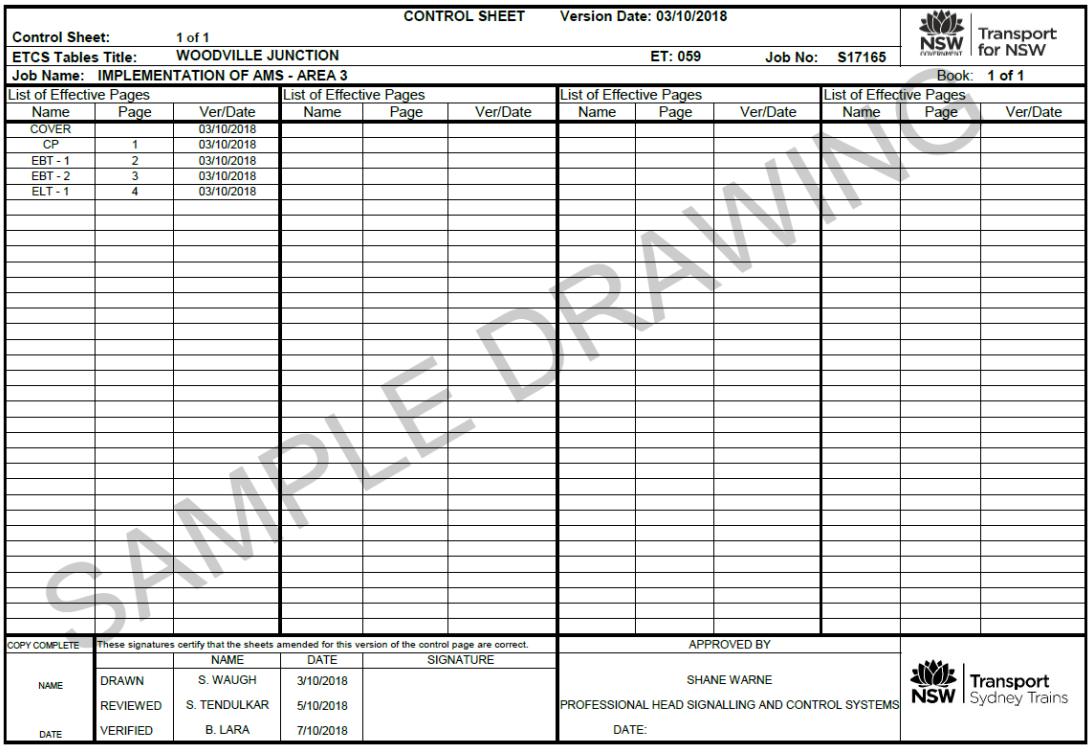
DRAWN	S. WAUGH	03/10/2018
DESIGNED	S. WAUGH	03/10/2018
REVIEWED	S. TENDULKAR	05/10/2018
VERIFIED	B. LARA	07/10/2018
APPROVED	S. WARNE	09/10/2018

ETCS TABLES No:	059
JOB No:	S17165
STATUS:	FOR COMMISSIONING
BOOK:	1 OF 1
PART:	1 OF 1
DRG No.	ET059A00.DGN
EDMS No.	

© A3 1

DF 385*275

Design stage - cover sheet



CONTROL SHEET Version Date: 03/10/2018

Control Sheet: 1 of 1

ETCS Tables Title: WOODVILLE JUNCTION ET: 059 Job No: S17165

Job Name: IMPLEMENTATION OF AMS - AREA 3 Book: 1 of 1

Transport for NSW

List of Effective Pages			List of Effective Pages			List of Effective Pages			List of Effective Pages		
Name	Page	Ver/Date	Name	Page	Ver/Date	Name	Page	Ver/Date	Name	Page	Ver/Date
COVER		03/10/2018									
CP	1	03/10/2018									
EBT - 1	2	03/10/2018									
EBT - 2	3	03/10/2018									
ELT - 1	4	03/10/2018									

SAMPLE DRAWING

COPY COMPLETE

These signatures certify that the sheets amended for this version of the control page are correct.

	NAME	DATE	SIGNATURE
DRAWN	S. WAUGH	3/10/2018	
REVIEWED	S. TENDULKAR	5/10/2018	
VERIFIED	B. LARA	7/10/2018	

NAME

DATE

APPROVED BY

SHANE WARNE

PROFESSIONAL HEAD SIGNALLING AND CONTROL SYSTEMS

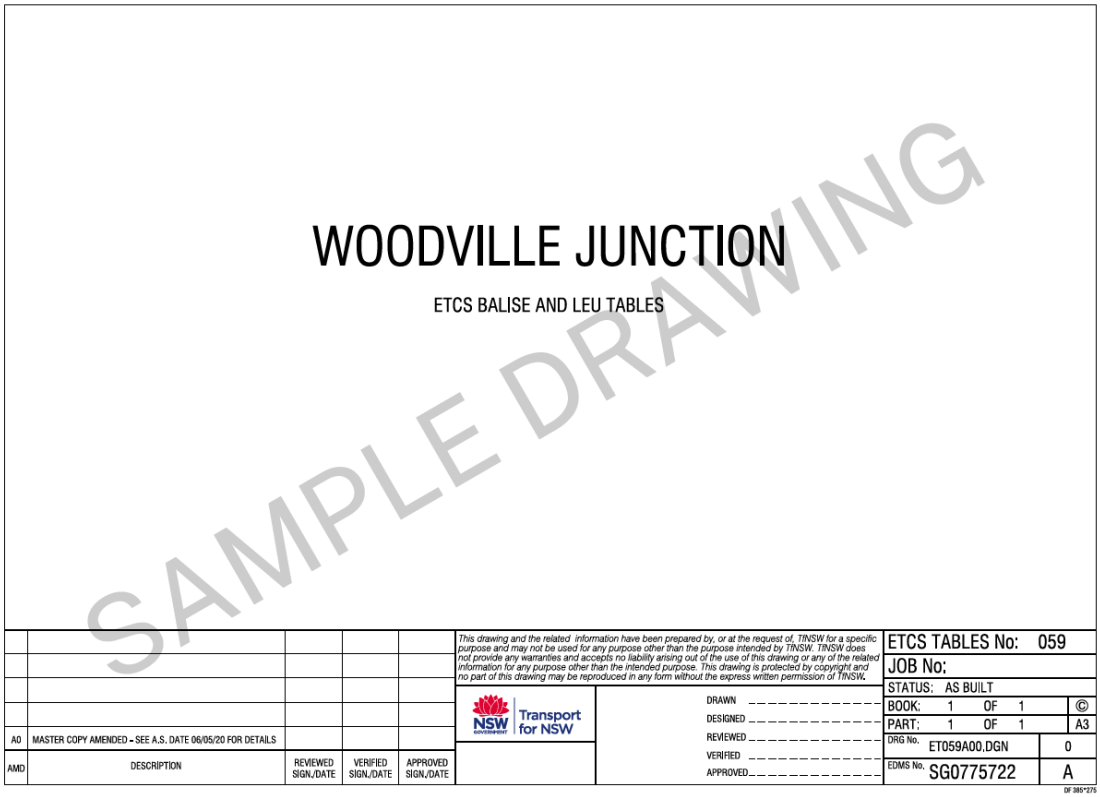
DATE:

Transport Sydney Trains

Design stage - control sheet

© State of NSW through Transport for NSW 2022

The following figures show a typical cover sheet and control sheet during the as-built stage.



WOODVILLE JUNCTION

ETCS BALISE AND LEU TABLES

SAMPLE DRAWING

AMD	DESCRIPTION	REVIEWED SIGN./DATE	VERIFIED SIGN./DATE	APPROVED SIGN./DATE
A0	MASTER COPY AMENDED - SEE A.S. DATE 06/05/20 FOR DETAILS			

This drawing and the related information have been prepared by, or at the request of, TfNSW for a specific purpose and may not be used for any purpose other than the purpose intended by TfNSW. TfNSW does not provide any warranties and accepts no liability arising out of the use of this drawing or any of the related information for any purpose other than the intended purpose. This drawing is protected by copyright and no part of this drawing may be reproduced in any form without the express written permission of TfNSW.

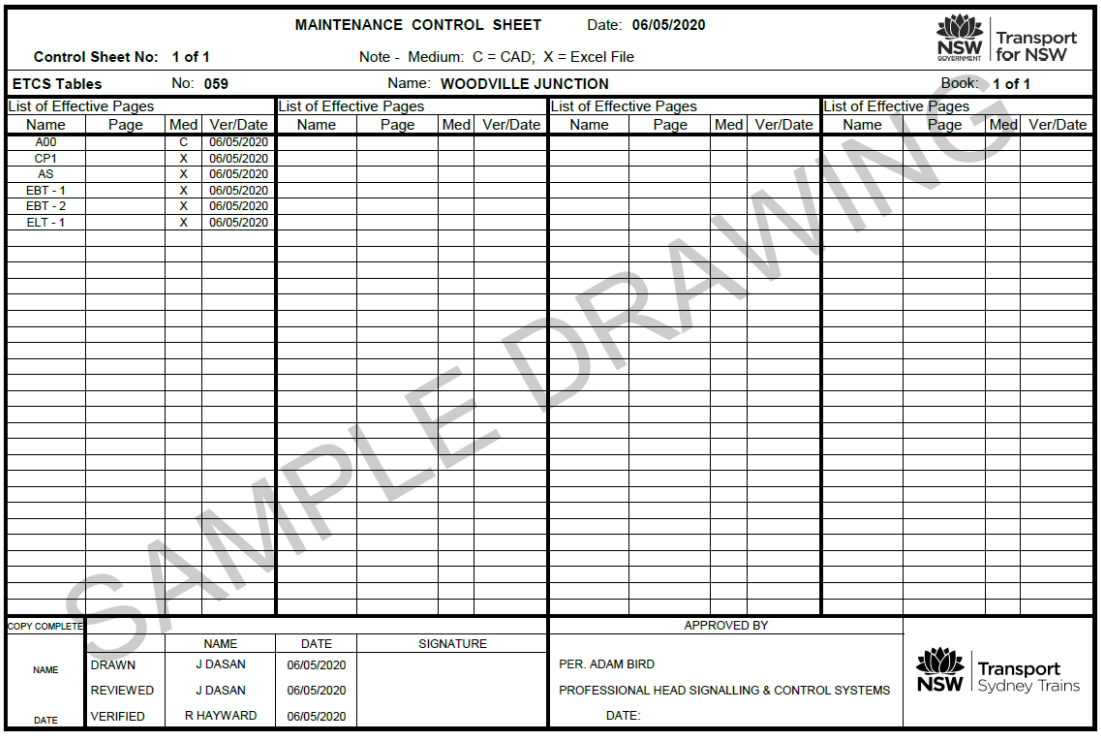
Transport for NSW

DRAWN
DESIGNED
REVIEWED
VERIFIED
APPROVED

ETCS TABLES No:	059
JOB No:	
STATUS:	AS BUILT
BOOK:	1 OF 1 ©
PART:	1 OF 1 A3
DRG No.	ET059A00.DGN 0
EDMS No.	SG0775722 A

DF 385*275

As-built stage - cover sheet



MAINTENANCE CONTROL SHEET Date: **06/05/2020**

Transport for NSW

Control Sheet No: 1 of 1 Note - Medium: C = CAD; X = Excel File

ETCS Tables No: **059** Name: **WOODVILLE JUNCTION** Book: **1 of 1**

List of Effective Pages				List of Effective Pages				List of Effective Pages				List of Effective Pages			
Name	Page	Med	Ver/Date	Name	Page	Med	Ver/Date	Name	Page	Med	Ver/Date	Name	Page	Med	Ver/Date
A00		C	06/05/2020												
CP1		X	06/05/2020												
AS		X	06/05/2020												
EBT - 1		X	06/05/2020												
EBT - 2		X	06/05/2020												
ELT - 1		X	06/05/2020												

SAMPLE DRAWING

COPY COMPLETE		NAME	DATE	SIGNATURE	APPROVED BY
NAME	DRAWN	J DASAN	06/05/2020		PER. ADAM BIRD
	REVIEWED	J DASAN	06/05/2020		PROFESSIONAL HEAD SIGNALLING & CONTROL SYSTEMS
DATE	VERIFIED	R HAYWARD	06/05/2020		DATE:

Transport for NSW Sydney Trains

As-built stage - control sheet

© State of NSW through Transport for NSW 2022

Section 14.11.3 Balise table

All balise tables shall be produced in standard spreadsheet format such as MS Excel. The first page of the balise table shall be numbered as EBT-1. The subsequent pages shall be numbered in the increasing order, such as EBT-2, EBT-3.

The following figure shows typical balise table arrangement on a ETCS table:

ET289 Wollongong
ETCS Balise Table

NID_C: 540

Balise Group Name	NID_BG	Line Name	Nominal Direction	Down Direction		Up Direction		Remarks
				Primary Functions	Static Speed Profile or LEU Table Reference	Primary Functions	Static Speed Profile or LEU Table Reference	
NWG08144_DNIA	3111	Down Illawarra	Down	SS, RDT(TSM-WG475)	[75, 60, 25 (G)], [90, 90, 25 (M+H)]	—	95 (G+M+H)	
NWGWG483_DNIA	3113	Down Illawarra	Down	TO(TSM-WG475), RDT(TSM-WG433), RDT(TSM-CNS08381_UPIA) SS(WOL08249_DNIA)	ELT-1	—	95 (G+M+H)	Down Direction TSM-CNS08381_UPIA not applied as TSM-WG433 is more restrictive.
WOLWG475_DNIA	3122	Down Illawarra	Down	AP(WG475), TO(TSM-WG433), SS(TSM-CNS08381_UPIA), RE(A)	ELT-2	RE(X)	95 (G+M+H)	
WOL280B_DNIA	3124	Down Illawarra	Down	RE(X)	60 (G), 90 (M+H)	RE(X)	95 (G+M+H)	
WOL08277_DNIA	3126	Down Illawarra	Up	RE(X)	60 (G), 90 (M+H)	SS, MC, RE(A)	[95, 25 (G)], [95, 25 (M+H)]	
WOLWG461_DNIA	3128	Down Illawarra	Down	MC, RE(A)	60 (G), 90 (M+H)	—	[70, 95, 25 (G)], [90, 95, 25 (M+H)]	
WOL270B_DNIA	3131	Down Illawarra	Down	RE(X)	60 (G), 90 (M+H)	RE(X)	[70, 95, 25 (G)], [90, 95, 25 (M+H)]	
WOL266B_DNIA	3146	Down Illawarra	Down	RE(A), RE(X)	60 (G), 90 (M+H)	RE(A), RE(X)	[70, 95, 25 (G)], [90, 95, 25 (M+H)]	
WOL265B_DNIA	3147	Down Illawarra	Down	RE(X), RDT(TSM-WG121), RDT(TSM-CNS08420_DNIA)	[60, 60, 25 (G)], [90, 65, 25 (M+H)]	—	[70, 95, 25 (G)], [90, 95, 25 (M+H)]	
CNSWG411A_DNIA	3150	Down Illawarra	Down	TO(TSM-WG121), SS(TSM-CNS08420_DNIA)	ELT-3 Output A2	—	[60, 70, 95, 25 (G)], [90, 90, 95, 25 (M+H)]	
CNS08381_DNIA	3163	Down Illawarra	Up	—	—	SS, TO(TSM-WG466)	[60, 70, 95, 25 (G)], [90, 90, 95, 25 (M+H)]	
CNSWG411_DNIA	3165	Down Illawarra	Down	AP(WG121)	ELT-3 Output A1	RDT(TSM-WG466)	[60, 70, 95, 25 (G)], [90, 90, 95, 25 (M+H)]	Up direction initial speed is deficient until 60/90/90 speed sign.
CNS256B_DNIA	3168	Down Illawarra	Up	—	—	RE(X)	60 (G), 90 (M+H)	Up direction SSP is a deficient speed
CNS255A_DNIA	3171	Down Illawarra	Up	RE(X)	—	RE(A)	60 (G), 90 (M+H)	Up direction SSP is a deficient speed
NWG08144_UPIA	3112	Up Illawarra	Down	SS,RDT(TSM-WG433), RDT(TSM-CNS08381_UPIA)	[75, 60, 25 (G)], [90, 90, 25 (M+H)]	—	95 (G+M+H)	Down Direction TSM-CNS08381_UPIA not applied as TSM-WG433 is more restrictive.
WOL08249_UPIA	3121	Up Illawarra	Down	SS, TO(TSM-WG433), SS(TSM-CNS08381_UPIA)	[60, 25 (G)], [90, 25 (M+H)]	RE(X)	95 (G+M+H)	Down Direction TSM-CNS08381_UPIA not applied as TSM-WG433 is more restrictive.
WOL280B_UPIA	3125	Up Illawarra	Down	RE(A), RE(X)	—	RE(X), RE(A)	95 (G+M+H)	
WOL08279_UPIA	3127	Up Illawarra	Up	RE(X)	—	SS, MC	95 (G+M+H)	
WOLWG463_UPIA	3129	Up Illawarra	Down	AP(WG433), MC, RE(A)	ELT-4	—	70 (G), 90 (M+H)	
WOL275B_UPIA	3130	Up Illawarra	Down	RE(X), RE(A)	—	RE(X)	70 (G), 90 (M+H)	
WOL266B_UPIA	3145	Up Illawarra	Down	RE(X)	[60, 60 (G)], [90, 65 (M)], [90, 70 (H)]	RE(X)	70 (G), 90 (M+H)	

Primary Functions

AP - Approach	LT(A) - Level Transition announcement	OL(TSM) - Overlap TSM initiating	SMTO - L2 Session Termination Order	WRN - Wrong Running entry	VBC - Virtual Balise Cover
BM - Big Metal Mass	LT(X) - Level Transition execution	PLT(LEFT or RIGHT) - Platform information	SS - Speed Sign	WRN(1) - Wrong Running entry 1	TSW - Temporary Speed Warning
BS(TR) - Buffer Stop trip	LX1 - Level Crossing 1st announcement	RDT(TSM) - Redundant TSM	SS(TSM) - Speed Sign TSM initiating	WRN(2) - Wrong Running entry 2	YDN - Yard Entry
BS(TSM) - Buffer Stop TSM initiating	LX2 - Level Crossing 2nd announcement	RE(A) - Repositioning announcement	T(Off) - LSSMA toggle off	WRX - Wrong Running exit	YDX - Yard Exit
BS(RDT-TSM) - Buffer Stop redundant TSM	MC - Mode Change	RE(X) - Repositioning execution	TO(TSM) - Turnout TSM initiating	WRX(1) - Wrong Running exit 1	
CA - Calibration	NV - National Values	SMEO - L2 Session Establishment Order	TS - ETCS trainstop	WRX(2) - Wrong Running exit 2	

Version Control

Job Number:
Version Date: 1/21/2021
Page: EBT - 1

SAMPLE DRAWING

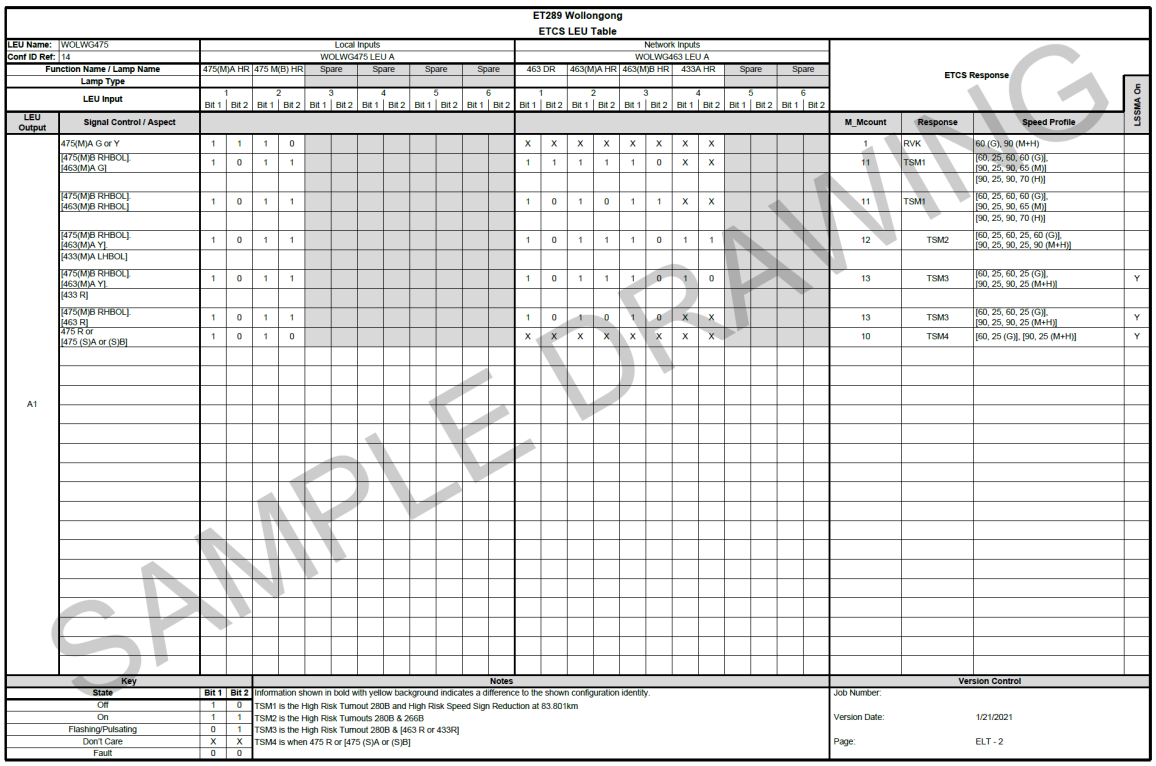
Balise table arrangement on ETCS table

Section 14.11.4 LEU table

All LEU tables shall be produced in standard spreadsheet format such as MS Excel. The first page of the LEU table shall be numbered as ELT-1. The subsequent pages shall be numbered in the increasing order, such as ELT-2, ELT-3.

The following figure shows typical LEU table arrangement on a ETCS Table.

© State of NSW through Transport for NSW 2022



ET289 Wollongong
ETCS LEU Table

LEU Name:	WOLWG475	Local Inputs												Network Inputs											
Conf ID Ref:	14	WOLWG475 LEU A												WOLWG463 LEU A											
Function Name / Lamp Name		475(M)A HR		475 M(B) HR		Spare		Spare		Spare		Spare		463 DR		463(M)A HR		463(M)B HR		433A HR		Spare		Spare	
Lamp Type																									
LEU Input		1		2		3		4		5		6		1		2		3		4		5		6	
		Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2	Bit 1	Bit 2
LEU Output	Signal Control / Aspect																								
A1	475(M)A G or Y	1	1	1	0									X	X	X	X	X	X	X	X				
	[475(M)B RHBOL] [463(M)A G]	1	0	1	1									1	1	1	1	1	0	X	X				
	[475(M)B RHBOL] [463(M)B RHBOL]	1	0	1	1									1	0	1	0	1	1	X	X				
	[475(M)B RHBOL] [463(M)A Y] [433(M)A LHBOL]	1	0	1	1									1	0	1	1	1	0	1	1				
	[475(M)B RHBOL] [463(M)A Y] [433 R]	1	0	1	1									1	0	1	1	1	0	1	0				
	[475(M)B RHBOL] [463 R]	1	0	1	1									1	0	1	0	1	0	X	X				
	475 R or [475 (S)A or (S)B]	1	0	1	0									X	X	X	X	X	X	X	X				

ETCS Response			
M_Mcount	Response	Speed Profile	LSSMA On
1	RVK	60 (G), 90 (M+H)	
11	TSM1	[60, 25, 60, 60 (G)], [90, 25, 90, 65 (M)] [90, 25, 90, 70 (H)]	
11	TSM1	[60, 25, 60, 60 (G)], [90, 25, 90, 65 (M)] [90, 25, 90, 70 (H)]	
12	TSM2	[60, 25, 60, 25, 60 (G)], [90, 25, 90, 25, 90 (M+H)]	
13	TSM3	[60, 25, 60, 25 (G)], [90, 25, 90, 25 (M+H)]	Y
13	TSM3	[60, 25, 60, 25 (G)], [90, 25, 90, 25 (M+H)]	Y
10	TSM4	[60, 25 (G)], [90, 25 (M+H)]	Y

Key		
State	Bit 1	Bit 2
Off	1	0
On	1	1
Flashing/Pulsating	0	1
Don't Care	X	X
Fault	0	0

Notes
Information shown in bold with yellow background indicates a difference to the shown configuration identity.
TSM1 is the High Risk Turnout 280B and High Risk Speed Sign Reduction at 83.801km
TSM2 is the High Risk Turnouts 280B & 266B
TSM3 is the High Risk Turnout 280B & [463 R or 433R]
TSM4 is when 475 R or [475 (S)A or (S)B]

Version Control
Job Number:
Version Date: 1/21/2021
Page: ELT - 2

SAMPLE DRAWING

LEU table arrangement on ETCS table

Section 14.11.6 Drawing size

The ETCS table shall be in A3 drawing sheet size with landscape orientation.

Section 14.11.7 Drawing file name

The ETCS table shall be named using the prefix letter 'ET' followed by the three circuit book alphanumeric characters (for example, ET010, ET262, ETLID, ETRR1).

Section 14.11.8 Printing of ETCS tables

All ETCS tables shall be printed in colour as PDF. The size and scale of the PDF should be identical to the title block in the CAD file. Levels and layers in the PDF should be disabled. Working units of the PDF should be in mm and not in cm. Dimensions of the PDF should be integers only, that is, whole mm without decimal points.

Section 14.11.9 Title block status

The following are the four statuses in the life cycle of an ETCS table:

- For Review – used during the design review through to approval design stage of a project
- For Construction – used during the construction stage of a project
- For Testing - used during the testing stage of a project (prior to simulation- if modified)
- As-built – used during the as-built stage of a project. At this stage, the ETCS table should be submitted to the Central Planroom.

© State of NSW through Transport for NSW 2022

Existing Section 14.10 Mechanical drawings

Renumber existing Section 14.10 and its subsections as follows:

Section 14.12 Mechanical drawings

Section 14.12.1 Section symbols

Section 14.12.2 Level for mechanical drawing

Section 14.12 3 Text styles for mechanical drawing

Section 14.12.4 Model filenames for assembly, subassemblies and components

Section 14.12.5 Format for bill of materials

Existing Section 14.11 Other signal drawings

Renumber existing Section 14.11 and its subsections as follows:

Section 14.13 Other signal drawings

Section 14.13.1 Equipment housing

Section 14.13.2 Level crossings

Section 14.13.3 Structures and drawings

Section 14.13.4 Clearance diagrams

Existing Section 14.12 Other reference material

Renumber existing Section 14.12 as Section 14.14 Other reference material.

Authorisation:

Approved by	Senior Manager, Data Integration and Governance Asset Management Safety, Environment and Regulation

© State of NSW through Transport for NSW 2022

T MU MD 00006 ST

Standard

Engineering Drawings and CAD Requirements

Version 6.0

Issue date: 02 September 2021

© State of NSW through Transport for NSW 2021

Disclaimer

This document has been prepared by Transport for NSW (TfNSW) specifically for its own use and is also available for use by NSW public transport agencies for transport assets.

Any third parties considering use of this document should obtain their own independent professional advice about the appropriateness of using this document and the accuracy of its contents. TfNSW disclaims all responsibility and liability arising whether directly or indirectly out of or in connection with the contents or use of this document.

TfNSW makes no warranty or representation in relation to the accuracy, currency or adequacy of this document or that the document is fit for purpose.

The inclusion of any third party material in this document, does not represent an endorsement by TfNSW of any third party product or service.

For queries regarding this document, please email Transport for NSW Asset Management Branch at standards@transport.nsw.gov.au or visit www.transport.nsw.gov.au

© State of NSW through Transport for NSW 2021

Standard governance

Owner:	Senior Manager Reporting and Publications, Asset Management Branch
Authoriser:	Director Standards Process Development & Publishing, Asset Management Branch
Approver:	Executive Director, Asset Management Branch on behalf of the AMB Configuration Control Board

Document history

Version	Summary of changes
1.0	First issue December 2015
2.0	Second issue March 2016. Minor updates to provide clarity.
3.0	Third issue 21 March 2018. Changes to this version include updates to the General CAD requirements section and the Detailed Site Survey CAD requirements section.
4.0	Fourth issue 01 June 2018. CAD resource file names and AMB website location included for clarification. Application section expanded to include light rail.
5.0	Fifth issue 22 June 2021. Updates made to reflect organisational changes and resulting changes in responsibilities. Numerous changes made to the detailed site survey section, the electrical CAD requirements section, the signal CAD requirements section, and significant expansion of the fleet CAD requirements section. Minor amendments and clarification to other content made.
6.0	Sixth issue. Changes of references to TfNSW Digital Engineering Standard

© State of NSW through Transport for NSW 2021

Preface

The Asset Management Branch (AMB), formerly known as Asset Standards Authority (ASA) is a key strategic branch of Transport for NSW (TfNSW). As the network design and standards authority for NSW Transport Assets, as specified in the *ASA Charter*, the ASA identifies, selects, develops, publishes, maintains and controls a suite of requirements documents on behalf of TfNSW, the asset owner.

The ASA deploys TfNSW requirements for asset and safety assurance by creating and managing TfNSW's governance models, documents and processes. To achieve this, the ASA focuses on four primary tasks:

- publishing and managing TfNSW's process and requirements documents including TfNSW plans, standards, manuals and guides
- deploying TfNSW's Authorised Engineering Organisation (AEO) framework
- continuously improving TfNSW's Asset Management Framework
- collaborating with the Transport cluster and industry through open engagement

The AEO framework authorises engineering organisations to supply and provide asset related products and services to TfNSW. It works to assure the safety, quality and fitness for purpose of those products and services over the asset's whole-of-life. AEOs are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

Compliance with ASA requirements by itself is not sufficient to ensure satisfactory outcomes for NSW Transport Assets. The ASA expects that professional judgement be used by competent personnel when using ASA requirements to produce those outcomes.

About this document

T MU MD 00006 ST *Engineering Drawings and CAD Requirements* has been developed to achieve consistency in all computer-aided drafting (CAD) work performed in-house by TfNSW or by an Authorised Engineering Organisation (AEO) that can be lodged into the Prescribed Document Repository.

This is the sixth issue. The changes to previous content relate to changes to the TfNSW Digital Engineering Standard.

© State of NSW through Transport for NSW 2021

Table of contents

1. Introduction 8
2. Purpose 8
2.1. Scope 8
2.2. Application 8
3. Reference documents 9
4. Terms and definitions 12
5. Compliance with legal requirements 15
6. General CAD requirements 15
6.1. Engineering drawing classification 16
6.2. Drawing format 18
6.3. Types of engineering drawings 19
6.4. Line weight 19
6.5. Line style 21
6.6. Text 22
6.7. Cell library and blocks 24
6.8. Colours 24
6.9. Levels and layers 25
6.10. Seed files 27
6.11. Drawing sheets 27
6.12. Drawing scale 28
6.13. Drawing orientation 29
6.14. Drawing layout 30
6.15. Dimensioning 32
6.16. Gradients and batters 35
6.17. Abbreviations 36
6.18. Notes and references 36
6.19. Cross-referencing drawings 38
6.20. Printing of drawings in colour 38
6.21. Amendment clouds 39
6.22. Hold clouds 39
6.23. Bill of materials 40
6.24. Drawing amendment – operation and maintenance stage 41
7. Drawing management 42
7.1. Drawing title block 42
7.2. Drawing amendment 49
7.3. Smart tags 51
7.4. File naming convention 55
7.5. As-built drawing presentation 58
8. Drawing submission 58
8.1. EDMS numbers 59

© State of NSW through Transport for NSW 2021

8.2. Submission process flow 61
8.3. Submission package 62
8.4. Superseded drawings 65
8.5. Lodgement to the VPR 67
8.6. Folder structure for drawing submission package 68
9. Track CAD requirements 69
9.1. Title block for track drawings 69
9.2. Seed files for track drawings 70
9.3. Cell libraries for track drawings 70
9.4. Level symbology for track drawings 70
9.5. Types of track drawings 70
9.6. Track drawing requirements 72
10. Civil CAD requirements 105
10.1. Title block for civil drawings 105
10.2. Cell library for civil and structural drawings 105
10.3. Types of civil and structural design drawings 106
10.4. Structural steelwork drawings 107
10.5. Reinforcement drawings 111
10.6. Precast concrete drawings 114
10.7. Order of sheets in a set 114
11. Detailed Site Survey CAD requirements 116
11.1. Application of DSS CAD requirements 117
11.2. Data Capture 117
11.3. DSS drawing files 118
11.4. Title block for DSS drawings 119
11.5. Route code and layer definitions for services identification 124
11.6. Symbols for DSS drawings 130
11.7. Colours for DSS plans 134
11.8. Text for DSS drawings 134
11.9. Work as executed 135
12. Architectural CAD requirements 136
12.1. Title block for architectural drawings 136
12.2. Seed files for architectural drawings 137
12.3. Level symbology for architectural drawings 137
12.4. Railway drawing convention 137
13. Electrical CAD requirements 138
13.1. Title block for electrical drawings 138
13.2. Seed files for electrical drawings 139
13.3. Cell libraries for electrical drawings 139
13.4. Types of electrical drawings 140
13.5. General drawings 140
13.6. Site-specific design drawings 140

© State of NSW through Transport for NSW 2021

14. Signal CAD requirements 160
14.1. Title block for signal drawings 160
14.2. Seed files for signal drawings 178
14.3. Cell libraries for signal drawings 178
14.4. Signal drawings general requirements 180
14.5. Types of signal drawings 182
14.6. Signalling circuit diagrams 182
14.7. Compressed air system diagrams 185
14.8. Signalling plans 186
14.9. Track insulation plans 195
14.10. Mechanical drawings 204
14.11. Other signal drawings 206
14.12. Other reference material 206
15. Fleet CAD requirements 207
15.1. Developments 207
15.2. Standard graphics used on fleet drawings 207
15.3. Drawing sign off 208
15.4. Reference list 209
15.5. Item or parts list 209
15.6. Title block for fleet drawings 209
15.7. Section, auxiliary and detail view symbols 212
15.8. Text styles for mechanical drawing 212
15.9. Line styles 212
15.10. Dimensions 213
15.11. Types of drawings 213
15.12. Amendments to fleet drawings 213
15.13. Item numbering 214
Appendix A AMB CAD support documents 215
Appendix B Format and examples of smart tag and metadata fields 216

© State of NSW through Transport for NSW 2021

1. Introduction

This standard specifies the drawing management and drafting requirements for engineering drawings produced for Transport for NSW (TfNSW).

This standard includes the general computer-aided drafting (CAD) requirements section that applies to all engineering disciplines producing drawings for TfNSW. The general CAD requirements section is to be read in conjunction with the transport mode and engineering discipline specific requirements as detailed within this document.

Any matters of drafting not covered by this standard are required to comply with AS 1100 series *Technical Drawing*. Refer to HB 7 *Engineering Drawing Handbook* for guidance information on complying with AS 1100.

T MU MD 00006 ST is supplemented by T MU MD 00006 TI *Engineering Drawings and CAD Requirements*. T MU MD 00006 TI does not include any mandatory requirements and is meant for references purpose only. It provides additional information, samples and examples of engineering drawings.

2. Purpose

The purpose of this standard is to achieve consistency in the drafting content presented on the drawings for TfNSW and standardise the drawing submission process.

2.1. Scope

This standard specifies TfNSW requirements for creating and amending engineering drawings using CAD and Digital Engineering technologies. In addition to the CAD requirements for drawings, it covers the drawing management and the drawing submission process for engineering drawings.

2.2. Application

The requirements in this standard apply to assets related to rail, road and ferry transport or assets that are used in conjunction or connection with transport. Rail transport includes heavy rail, light rail and rapid transit.

While this standard predominantly refers to heavy rail assets, it is intended that the requirements of this standard can also apply to projects primarily relating to light rail infrastructure.

CAD files depicting light rail assets should be structured in the same manner as that of heavy rail. These CAD files and signed off drawings should be submitted to the Virtual Planroom as prescribed in Section 8.

© State of NSW through Transport for NSW 2021

Drawings, CAD files and Model files created for approved projects managed under DMS-ST-202 *Digital Engineering Standard, Part 1 – Concepts and Principles* and DMS-ST-207 *Digital Engineering Standard, Part 2 – Requirements* shall not be required to comply with this standard in relation to the following:

- The use of Smart Tags in drawing title blocks (design or construction). A completed Metadata spreadsheet will be submitted in accordance to T MU MD 00006 F1 *Metadata Spreadsheet for Engineering Drawings* with added tag/attributes for the VPR Planroom.
- The design of the general drawing title blocks for contractors (design or construct). The current version of the title block depicted in DMS-ST-207shall be used and accepted for submittal to the VPR Planroom.
- Conversion to the CAD layering system as prescribed in Section 6.9 and T MU MD 00006 T1.
- Submission of composite models as described in Section 8.3.9. All composite models shall be created and submitted in accordance with Digital Engineering Standard DMS-ST-207.

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.

Where multiple parts of a standard are published as separate documents, unless reference to a specific section has been made the main document number has been cited.

Australian standards

AS 1100.101 Technical drawing Part 101: General principles

AS 1100.201 Technical drawing Part 201: Mechanical engineering drawing

AS 1100.301 Technical drawing Part 301: Architectural drawing

AS 1100.401 Technical drawing Part 401: Engineering survey and engineering survey design drawing

AS 1100.501 Technical drawing Part 501: Structural engineering drawing

AS 1101.1 Graphic symbols for general engineering Part 1: Hydraulic and pneumatic systems

AS 1101.3 Graphical symbols for general engineering Part 3: Welding and non-destructive examination

AS 2067 Substations and high voltage installations exceeding 1 kV a.c.

AS 4799 Installation of underground utility services and pipelines within railway boundaries

AS 5488 Classification of Subsurface Utility Information (SUI)

© State of NSW through Transport for NSW 2021

AS/NZS 1102 series (1102.102 to 1102.113) Graphical symbols for electrotechnical documentation

AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS ISO 15489.1 Information and documentation – Records Management Part 1: Concepts and principles

HB 7 Engineering Drawing Handbook

Transport for NSW standards

DMS-ST-202 Digital Engineering Standard – Part 1 – Concepts and Principles

DMS-ST-207 Digital Engineering Standard – Part 2 - Requirements

EP 20 00 04 06 SP Underground Cable - Location Recording

ESG 100 Signal Design Principles

ESG 100.29 Naming of Locations, Track and Sidings

SDG 002 Circuit Design Standard Obsolete Signalling Circuits

SPG 0703 Signalling Documentation and Drawings

TMG 1310 Locating of underground services

TMG 1440 Requirements for the Locating of Underground Services in the Rail Corridor

TMGG 1550 Signalling Documentation Guidelines

T HR CI 12190 ST Service Installations within the Rail Corridor

T HR EL 08014 ST Overhead Wiring Layouts

T HR EL 10001 ST HV Aerial Line Standards for Design and Construction

T HR EL 11001 F1 SCADA Sample I/O Schedule

T HR EL 11001 PR Design Technical Reviews for Electrical SCADA Equipment

T HR EL 12005 ST Bonding for 1500 V DC Traction Systems

T HR EL 20004 ST High Voltage AC and 1500 V DC Traction Power Supply Cable Infrastructure – Standards for Design and Construction

T HR EL 20008 ST Underground Cables and Cable Enclosures – Location Data Recording

T HR SC 00001 ST Circuit Design Standard – Typical Circuits

T HR SC 00003 ST Circuit Design Standard – ETCS Level 1 Interface Circuits

T HR SC 00004 ST Signalling Design Requirements - Signalling Symbols

T HR SC 00719 SP Computer-Based Interlocking Equipment

T MU AM 01007 TI Asset Reference Codes Register

© State of NSW through Transport for NSW 2021

T MU AM 01009 TI Technical Maintenance Coding Register

T MU AM 04001 PL TfNSW Configuration Management Plan

T MU MD 00006 F1 Metadata Spreadsheet for Engineering Drawings

T MU MD 00006 TI Technical Information for CAD and Engineering Drawings

Transport for NSW drawings

EL0435527 Toongabbie SS Electrical Communication Cabling Block Diagram

Transport for NSW resource files

T MU MD 00006 R0 Title Blocks CAD Resources

T MU MD 00006 R1 Common CAD Resources

T MU MD 00006 R2 Track CAD Resources

T MU MD 00006 R3 Civil CAD Resources

T MU MD 00006 R4 DSS CAD Resources

T MU MD 00006 R5 Architecture CAD Resources

T MU MD 00006 R6 Electrical CAD Resources

T MU MD 00006 R7 Signals CAD Resources

T MU MD 00006 R8 Project Code Description CAD Resources

Other reference documents

GL A 00512 Guide to interpretation of Detailed Site Survey (DSS) – Plan Symbols and Numeric Route Codes

PR A 00492 Detailed Site Survey - Data Capture Procedure

PR A 00493 Detailed Site Survey - Scope Procedure

PR A 00498 DSS Survey and Drafting

RS 0041CM Fleet Architecture Manual

SafeWork NSW – Excavation work code of practice

SafeWork NSW – Work near underground assets guide 2007

SMS-06-GD-0268 Working Around Electrical Equipment

SMS-06-GD-3066 Guide to Managing Construction Hazards

The Australian Building Codes Board, National Construction Code, Volume one

© State of NSW through Transport for NSW 2021

4. Terms and definitions

The following terms and definitions apply in this standard:

AEO Authorised Engineering Organisation

AFC approved for construction

AHD Australian Height Datum

AMB Asset Management Branch

approved appears on the drawing sheet; the approver who certifies that design outputs have been verified as meeting design input specifications and requirements and that the design has been completed in accordance with relevant regulations and standards

ASA Asset Standards Authority

AutoCAD proprietary CAD software provided by Autodesk

B&W black and white, that is, monochrome

BIM building information modelling; a digital representation of physical and functional characteristics of a facility

CAD computer-aided drafting

Central Planroom the physical location where drawing information is stored and managed

composite a combination of multiple 3D CAD models in a single file, which can be used for additional value added tasks

concession a deviation from an AMB requirement approved by AMB in advance

DE digital engineering; a collaborative way of working, using digital processes, to enable more productive methods of planning, designing, constructing, operating and maintaining TfNSW assets

design check appears on the drawing sheet; the person responsible for checking the technical content of the drawing

This includes conformance to technical standards are met; safety-in-design approach, construction and operation issues are addressed. This check also considers any design interface issue with other disciplines.

design company the AEO responsible for design and drawing content on the drawing

designed appears on the drawing sheet; the person responsible for the design of the technical content of the drawing

drawing check appears on the drawing sheet; the person responsible for the drafting check of the drawing

© State of NSW through Transport for NSW 2021

This includes checking the drafting aspects of the drawing and its compliance with TfNSW CAD requirements. This check also considers any drafting interface issues with other disciplines.

drawn appears on the drawing sheet; the person responsible for drafting the technical and graphical content of the drawing

DTM digital terrain model

EDMS engineering document management system

engineering drawing a design drawing created using CAD software to fully and clearly define requirements for an engineering asset

hybrid drawing a composite construct of raster and vector data, where raster data is attached to or referenced in a vector based drawing (CAD)

IFC industry foundation class

ISG Integrated Survey Grid

MGA Map Grid of Australia

MicroStation proprietary CAD software provided by Bentley Systems.

nonconformance a deviation from an AMB requirement that has occurred without prior approval from AMB

NTS not to scale

OHW overhead wiring

Prescribed Document Repository (PDR) an area for storing engineering documentation

project interface person (for the purpose of this standard) a person within the TfNSW cluster responsible for managing the drawing and other information submissions to the Central Planroom or to the Virtual Planroom for a particular project or a program by a contracted AEO or AEOs

ProjectWise proprietary electronic document management software provided by Bentley Systems

raster graphic an electronic image file containing computer graphics;` a raster is usually in a dot matrix structure, typically a rectangular or grid-like, of pixels or points stored in files including TIF, JPG, GIF or Bitmap

Revit proprietary CAD software provided by Autodesk

smart tags predefined data entry fields that permit automated transfer of metadata between drawing file and the Virtual Planroom

SolidWorks proprietary CAD software provided by Dassault Systems

© State of NSW through Transport for NSW 2021

Sydney metropolitan rail area the rail freight network and the rail passenger network within the metropolitan rail area bounded by Newcastle (in the north), Richmond (in the northwest), Bowenfels (in the west), Macarthur (in the southwest) and Bomaderry (in the south), and all connection lines and sidings within these areas, but excluding private sidings

symbology a combination of colour, line-weight, and line-style

TfNSW Transport for New South Wales

TfNSW Transport Network the transport system owned and operated by TfNSW or its operating agencies upon which TfNSW has power to exercise its functions as conferred by the Transport Administration Act or any other Act

unbound format CAD drawing in which all references to the drawing are independent drawing files and attached to the CAD drawing

vector an electronic file containing geometric primitives such as points, lines, curves, shapes, or polygons arranged in a meaningful manner. Types of vector files include DGN, DWG, DXF, STEP, SLDPRT, and SLDASM

verified appears on the drawing sheet; the person responsible to ensure that the output of a design stage meets the design input requirements

Virtual Planroom TfNSW engineering document management system used for storing and managing electronic data and information for Rail related assets.

VPR Virtual Planroom

2D CAD use of CAD software to prepare two-dimensional lines for graphical representation of physical objects

3D CAD use of CAD to prepare three-dimensional lines, surfaces or solids for graphical representation of physical objects

File extensions are shown in Table 1.

© State of NSW through Transport for NSW 2021

Table 1 - File extensions

File extension	Description
dgn	MicroStation CAD file format.
dwg, dxf	AutoCAD CAD file format.
dgnlib	MicroStation library file used for storage and distribution of shared resources.
rsc	MicroStation resource file containing symbology information.
stp, step	ISO 10303-21 Standard Data Exchange format encoded in ASCII structure.
pdf	Portable document format (Adobe Acrobat format).
plt	A vector based plotter file used by CAD applications.
nwd, nwf	Navisworks file format used by AutoCAD and Revit applications.
i-model	A container holding compressed graphical and BIM or digital engineering (DE) information in a single portable file.
tif	Tagged image file format for storing raster graphics images.
jpg / jpeg	Joint photographic expert group – formatting method for lossy compression for digital images.
sldprt, sldasm, slddrw	SolidWorks CAD file.
rvt, rft, rfa	Revit CAD file.
gif	Graphic interchange format – a bitmap image format.

5. Compliance with legal requirements

The design company carrying out the design shall comply with all design and drawing codes and regulation requirements, whether or not described in this standard.

Drawings shall not include disclaimers and certifications. When required, the design company carrying out the design shall provide the disclaimers and certifications as a separate document with the drawing numbers and amendment levels referenced.

6. General CAD requirements

The general CAD requirements apply to all engineering drawings submitted to TfNSW.

The general CAD requirements shall be read in conjunction with the discipline specific requirements provided in Section 9 through to Section 15. Where conflict exists between the general CAD requirements and the discipline specific requirements, then the discipline specific requirements shall take precedence over the general CAD requirements, unless the general section expressly states otherwise.

All engineering drawings shall be created using CAD and in third angle orthographic projections. Auxiliary sections, isometric, oblique, and other views should be used to supplement the

© State of NSW through Transport for NSW 2021

orthographic projections and provide clarity for features that would otherwise be difficult to understand.

The drawing shall be read in conjunction with the design specifications, if any. Where conflict exists between the two, the design specification shall take precedence over drawings, unless the drawing expressly states otherwise.

Completed and approved drawings shall show sufficient details to meet the purpose of the drawings and satisfy TfNSW design and CAD requirements.

6.1. Engineering drawing classification

Engineering drawings are classified as follows:

- sketch
- standard drawing
- design drawing
- production drawing
- as-built drawing

6.1.1. Sketch

A sketch is a rough unfinished drawing that is used to assist in the making of a final engineering drawing. Project participants often use sketches in the first stage of a project to assess the feasibility of proceeding with a project, or to investigate various options. Sketches can include data sheets, charts, design graphs, concept designs, proposals, or options leading up to the final drawings. Sketches can be included in reports to depict concept proposals. They cannot be used for contractual purposes or for wide distribution.

Sketches should be prepared in accordance with the drafting requirements specified in this standard. EDMS number shall not be applied to sketches.

6.1.2. Standard drawing

A standard drawing eliminates repetition by showing details that are typical or repetitive for a particular type of project, system or equipment. Standard drawings can be issued without alteration to different clients for different projects. Standard drawings are divided into the following two categories:

- project standard drawing
- AMB standard drawing

© State of NSW through Transport for NSW 2021

Project standard drawing

A project standard drawing is specific to a particular project only. It cannot be used across multiple projects. Project standard drawings shall be prepared, registered and submitted to the Virtual Planroom (VPR), the same way as other project drawings.

In a drawing title block, the 'Job Description' field should contain the words 'STANDARD DRAWING'. The design company shall register and submit these drawings to the VPR.

Figure 1 shows a typical example of a completed title block for a project standard drawing.

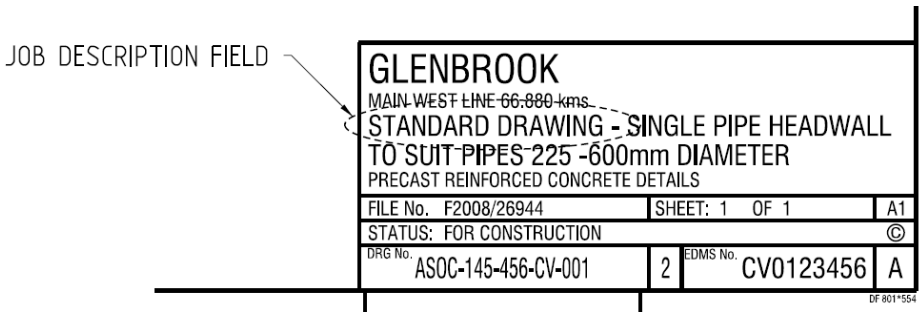


Figure 1 - Project standard drawing

For each project, a full set of design drawings, production drawings and project standard drawings are brought together to form the project drawings. A complete set of project drawings shows the full extent of the work.

AMB standard drawing

An AMB standard drawing is a part of an AMB standard document that is created, managed and published as an independent document using CAD software. An AMB standard drawing shall always have a reference in an AMB standard document. An AMB standard drawing eliminates repetition by showing details that are typical or repetitive for a particular type of project, system or equipment, and can be applied across multiple projects, systems or equipment.

Typical characteristics of an AMB standard drawing are as follows:

- a standard design that can be used for production without any changes throughout the TfNSW Transport Network (for the purpose of which it has been developed and issued)
- a typical configuration to provide consistency in an arrangement
- a design that can be used as a template to create a new design with minor changes

In addition to the drawing approval process, an AMB standard drawing shall be accepted for network use by AMB and signed in the drawing title block accordingly.

In the drawing title block, the 'Location' field shall contain the words 'AMB STANDARD DRAWING' and the 'Corridor and kilometrage' field shall contain the transport mode. AMB shall issue EDMS numbers, register and submit these drawings to the VPR.

© State of NSW through Transport for NSW 2021

The respective AMB Lead Engineer or Director shall be consulted on the development of AMB standard drawings.

Figure 2 shows an example of a completed title block for an AMB standard drawing.

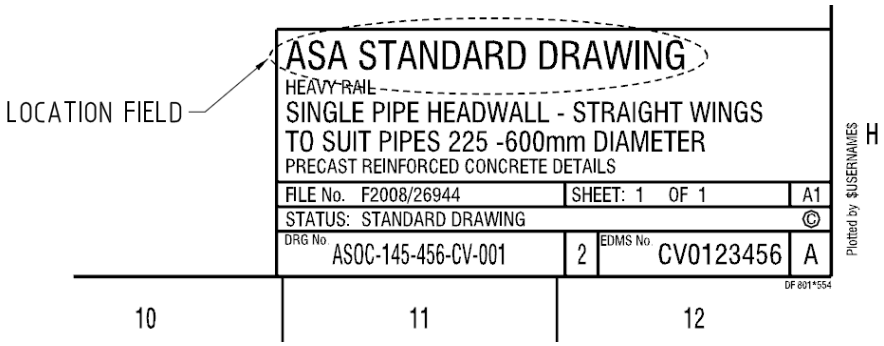


Figure 2 - AMB standard drawing

6.1.3. Design drawing

A design drawing is created during the design phase and planning phase. A set of design drawings includes 3D models, 2D models and 2D drawings to provide sufficient detail for the design of the project.

6.1.4. Production drawing

A production drawing applies to construction, manufacture, and assembly, and forms part of the contract documentation of the project. Production drawings include shop drawings, assembly drawings and subassembly drawings.

6.1.5. As-built drawing

An as-built drawing represents a record of the completed works. It is based on design drawings and standard drawings and is updated to reflect any changes or alterations undertaken during construction. The as-built drawing becomes part of the final drawing package submitted to the VPR at the completion of a contract or project.

6.2. Drawing format

All drawings shall be produced using CAD only. The design company can use any appropriate CAD or Digital Engineering software to produce engineering drawings, however the final submission drawings shall be converted to either dgn or dwg format with smart tags attributes for title block extraction. Refer to Section 8 of this standard for more details on the drawings submission process.

© State of NSW through Transport for NSW 2021

6.3. Types of engineering drawings

Engineering drawings are divided into the following two types:

- drawing
- model

6.3.1. Drawing

A drawing is a CAD design file that contains the drawing sheet and title block information. The title block information assists in lodging the drawings to the VPR.

A MicroStation drawing shall contain one sheet model and one design model.

An AutoCAD drawing shall contain one paper space and one model space.

The design model or model space within the drawing shall contain the design data. This includes references, extractions and assembly files. References with geo-referenced design data (for example, survey data) should be attached to the model space using global coordinates.

The sheet model of the CAD design file shall reference the design model in the drawing sheet at the appropriate scale or scales for publication.

All annotations and dimensioning shall be done in the sheet model or the paper space.

The sheet model shall display a referenced standard size drawing sheet plotted at 1:1, the title block information, and the design data referenced from the design model as indicated in this section.

All drawings created for a project shall have an EDMS number assigned. See Section 8.1 for details on EDMS numbers.

6.3.2. Model

A model is a design file that does not contain the drawing sheet and title block information. A model can contain design model data referenced by multiple drawing files, and is used to form a base for the design; for example, track alignments, overhead wiring, detail survey, and so on.

MicroStation models shall contain only one design model and no sheet model. AutoCAD models shall contain only one model space and no paper space.

An EDMS number shall not be assigned to a model.

6.4. Line weight

The line weight is the pen width value assigned to graphical elements in CAD. The line weight varies with the type of element. A line weight that is assigned to an element should be

© State of NSW through Transport for NSW 2021

consistent throughout the drawing and be readily distinguished from other line weights in the drawing.

Table 2 provides the allowed values of line thicknesses associated with line weight for MicroStation.

Table 2 - Line weight for MicroStation

Weight of line	Thickness (mm)
0	0.18
1	0.25
2	0.35
3	0.50
4	0.70
5	1.00

Table 3 provides the required values of line thicknesses associated with element colour for AutoCAD.

Table 3 - Line weight for AutoCAD

Colour #	Colour	Full scale plotted pen thickness	Plotted # /colour
1	Red	0.18	7 / Black
2	Yellow	0.35	7 / Black
3	Green	0.50	7 / Black
4	Cyan	0.70	7 / Black
5	Blue	0.70	7 / Black
6	Magenta	1.00	7 / Black
7	White	0.25	7 / Black
8	Dark grey	0.10	8 / Dk grey
9	Light grey	0.09	9 / Lt Grey
10-255*	As per AutoCAD	Object lineweight	Object colour

* except the following:

249	As per AutoCAD	2.0	250,250,250
255	As per AutoCAD	1.0	250,250,250

© State of NSW through Transport for NSW 2021

6.5. Line style

The line style defines the appearance of a continuous or non-continuous line on an engineering drawing that is created using CAD. The line styles are categorised as follows:

- standard line style
- customised line style

6.5.1. Standard line style

A standard line style is part of standard CAD install. Refer to AS 1100.101 for details on preparation of these standard line styles.

Figure 3 shows the standard line styles for all TfNSW drawings.

LINE STYLE	DESCRIPTION	APPEARANCE
0	SOLID	
1	DOT	
2	MEDIUM DASH	
3	LONG DASH	
4	DOT DASH	
5	SHORT DASH	
6	DASH DOT DOT DASH	
7	LONG DASH, SHORT DASH	

Figure 3 - Standard line styles

6.5.2. Custom line style

A custom line style is a special line style created to cover a broader requirement in CAD. It is made up of a series of defined requirements including dashes, symbols, intervals or a combination of these. Custom line styles shown in Figure 4 can be utilised by all engineering disciplines. In addition to these, other line styles specific to an engineering discipline may also be used.

Line style resource files are available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R1 *Common CAD Resources*.

© State of NSW through Transport for NSW 2021

Linestyle	Description	Appearance
RC-CAIR-CL	ABOVE GROUND COMPRESSED AIR SERVICE LINE	
RC-CAIR-UG	UNDERGROUND COMPRESSED AIR SERVICE LINE	
RC-DISP-HLITE-LN	GENERAL DISPLAY HIGHLIGHT LINE	
RC-DISP-RAIL-GAUG-LN	GENERAL RAIL GAUGE MULTIPLE LINE	
RC-DISP-RAIL-TICK-LN	GENERAL DISPLAY RAIL WITH TICKS CENTRELINE	
RC-DRAN-CL	DRAINAGE SERVICE LINE ABOVE GROUND	
RC-DRAN-UG	DRAINAGE SERVICE LINE UNDERGROUND	
RC-ELEC-CL	ELECTRICITY (POWER WIRES) ABOVE GROUND LINE	
RC-ELEC-UG	ELECTRICITY (POWER CABLES) UNDERGROUND LINE	
RC-FENC-ARMCO-LN	ARMCO GUARD BARRIER LINE	
RC-FENC-BNDY-LN	FENCE ON BOUNDARY LINE	
RC-FENC-LN	FENCE LINE	
RC-FUEL-CL	FUEL SERVICE LINE ABOVE GROUND	
RC-FUEL-UG	FUEL SERVICE LINE UNDERGROUND	
RC-BASIC-LN	ABOVE GROUND BASIC SYMBOL	
RC-BASIC-UG	UNDERGROUND BASIC SYMBOL	
RC-GENL-DASH-L10	GENERAL DASHED LINE LENGTH OF 10mm	
RC-GENL-DASH-L15	GENERAL DASHED LINE LENGTH OF 15mm	
RC-HVOL-LN	HIGH VOLTAGE SERVICE (WIRES) LINE ABOVE GROUND	
RC-HVOL-UG	HIGH VOLTAGE SERVICE (CABLES) LINE UNDERGROUND	
RC-LVOL-LN	LOW VOLTAGE SERVICE (WIRES) LINE ABOVE GROUND	
RC-LVOL-UG	LOW VOLTAGE SERVICE (CABLES) LINE UNDERGROUND	
RC-MASK-RAIL-HEAD-LN	RAIL HEAD LINE	
RC-NEG-CL	NEGATIVE SERVICE LINE ABOVE GROUND	
RC-NEG-UG	NEGATIVE SERVICE LINE UNDERGROUND	
RC-NGAS-CL	NATURAL GAS SERVICE LINE ABOVE GROUND	
RC-NGAS-HPRE-CL	NATURAL GAS HIGH PRESSURE SERVICE LINE ABOVE GROUND	
RC-NGAS-HPRE-UG	NATURAL GAS HIGH PRESSURE SERVICE LINE UNDERGROUND	
RC-NGAS-UG	NATURAL GAS SERVICE LINE UNDERGROUND	
RC-OFBR-LN	OPTIC FIBRE SERVICE CABLE ABOVE GROUND	
RC-OFBR-UG	OPTIC FIBRE SERVICE CABLE UNDERGROUND	
RC-OILS-HPRE-CL	OIL HIGH PRESSURE SERVICE ABOVE GROUND	
RC-OILS-HPRE-UG	OIL HIGH PRESSURE SERVICE UNDERGROUND	
RC-PIPE-CL	PIPELINE SERVICE (UNKNOWN) UNDERGROUND	
RC-PIPE-OVHD-CL	PIPELINE SERVICE (UNKNOWN) OVERHEAD	
RC-POS-CL	POSITIVE SERVICE ABOVE GROUND	
RC-POS-UG	POSITIVE SERVICE UNDERGROUND	
RC-RETG-WALL-LN	RETAINING WALL (GENERIC) CENTRELINE	
RC-SERV-DUCT-LN	SERVICE DUCTING CENTRELINE	
RC-SEWR-CL	SEWER SERVICE LINE ABOVE GROUND	
RC-SEWR-UG	SEWER SERVICE LINE UNDERGROUND	
RC-SIGL-COMS-CL	SIGNAL & COMMUNICATION SERVICE LINE ABOVE GROUND	
RC-SIGL-COMS-UG	SIGNAL & COMMUNICATION SERVICE LINE UNDERGROUND	
RC-SIGL-RODG-CL	SIGNAL RODING LINE ABOVE GROUND	
RC-TELE-CL	TELSTRA SERVICE LINE ABOVE GROUND	
RC-TELE-UG	TELSTRA SERVICE LINE UNDERGROUND	
RC-TRGH-AGT	SIGNALS TROUGHING ABOVE GROUND CENTRELINE	
RC-TRGH-GLT-CL	SIGNALS TROUGHING GROUND LEVEL CENTRELINE	
RC-WATR-CL	WATER SERVICE LINE ABOVE GROUND	
RC-WATR-UG	WATER SERVICE LINE UNDERGROUND	

Figure 4 - Custom line styles

6.6. Text

The text on drawings shall appear in upper case and be consistent in size and placement. The text should not overlap with the lines or symbols. The text in the drawing shall be readable with the title block at the bottom right corner. A visual representation of this concept is provided in Figure 5.

© State of NSW through Transport for NSW 2021

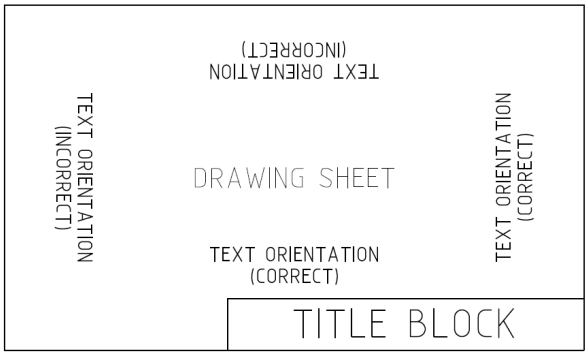


Figure 5 - Correct orientation of text on a drawing

English shall be used as the primary language on a drawing. In case other additional languages are required, the text in other languages shall be a direct translation of English text and should be presented in a similar font. In all of these cases, the text in English takes precedence over any translations.

6.6.1. Text style

A text style is a named set of text attributes such as font, width, height, and colour that allows the user to place text in a drawing in a consistent and automated manner. Text styles shall be based on requirements set out in AS 1100.101 *Technical drawings – General principles*. AMB has defined the basic text styles required for the most common drawings. These text styles are available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R1.

6.6.2. Fonts

Table 4 provides the list of fonts to be used on drawings.

Table 4 - Fonts

Font name	Application
INTL_ISO, STANDARD, ARCHITECTURAL, ISO3098b, INTL_ISO_EQUAL, isocp3	MicroStation fonts
ISO3098b, iso, isocp3	AutoCAD fonts
ISOCPEUR, Arial, Arial Narrow, ISO3098b	TrueType fonts

6.6.3. Height and line weight of text

The height of the text characters, in relation to the size of the drawing sheet used shall comply with AS 1100.101. Table 5 provides the minimum recommended height of the text for different sheet sizes. Where the drawing is required to be reduced, the character height shall be selected so that the reproduced text height is not less than 1.7 mm.

© State of NSW through Transport for NSW 2021

Table 5 - Recommended minimum height of text

Character use	A0 size sheet (mm)	A1, A2 size sheet (mm)	A3 size sheet (mm)
Title block – Locality and EDMS number	7	7	5
Titles, headings, view and section designation, drawing numbers, version or amendment numbers	5	5	3.5
General notes, dimensions, material lists	3.5	2.5	2.5

The maximum thickness of the lines used to form the text shall be 0.1h, where h is the height of the characters.

6.7. Cell library and blocks

A cell is a drawing of a frequently used feature. TfNSW has created the cell libraries for these frequently used features. The design company can download these cell libraries from the AMB website and use these features to develop the engineering drawings. AutoCAD equivalent blocks for these cells are also available on the AMB section of the TfNSW website.

The design company is responsible for the appropriate use of cells on the engineering drawing.

Download file T MU MD 00006 R1.

6.8. Colours

The screen colours from the AMB MicroStation colour table ‘RCSTcolor.tbl’ as shown in Figure 6 should be used for various elements. This colour table is attached to the standard seed files listed in Section 6.10 of this standard. AutoCAD files shall use the standard AutoCAD colour table as shown in Figure 7.

Download file T MU MD 00006 R1.

© State of NSW through Transport for NSW 2021

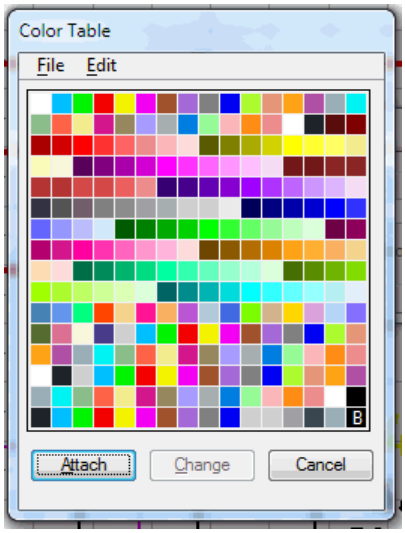


Figure 6 - AMB MicroStation colour table

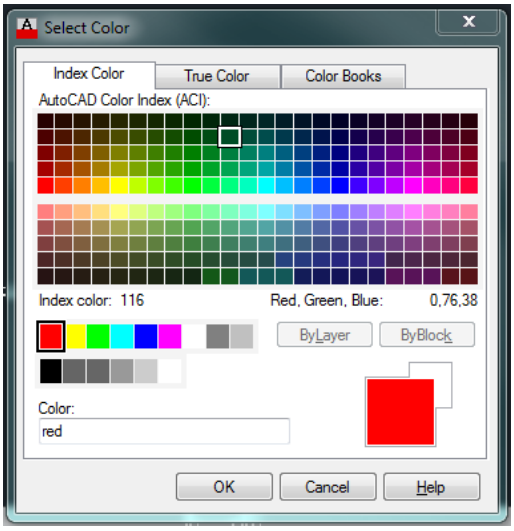


Figure 7 - AutoCAD colour table

6.9. Levels and layers

MicroStation and AutoCAD both use level names or layer names as their primary labelling functionality. This functionality is used to create a reserved range of level numbers for assignment to the level names. Table 6 provides the level number grouping structure.

The grouped ranges of numbers are created for familiarity in sharing design file data. This allows the CAD user to analyse the level, and to understand the design group from which it was created.

© State of NSW through Transport for NSW 2021

Table 6 - Level numbering grouping structure

Level number band	Discipline code	Discipline group	Description
0 – 999	R	General	Levels accessible for all design groups, containing global shared data.
1000 – 1999	F	Field survey	Field survey data (DTM's, detail survey plans, and so forth).
2000 – 2999	D	Design global	Levels specific to globally shared design work.
3000 – 3999	A	Architectural	Levels specifically related to architectural design work.
4000 – 4999	C	Civil design	Levels specifically related to civil design work.
5000 – 5699	E	Electrical design	Levels specifically related to electrical design work.
5700 - 5999	E	Electrical operating diagrams	Levels specifically related to electrical operating diagrams.
6000 – 6999	S	Signal design	Levels specifically related to signal design work.
7000 – 7999	T	Track design	Levels specifically related to track design work.
8000 – 8499	G	Geotechnical	Levels specifically related to geotechnical design work.
8500 – 8999	RS	Fleet	Levels specifically related to fleet design work.

6.9.1. CAD level naming format

The CAD level names that are used within MicroStation and AutoCAD shall have the format A-BBBB-CCCC-DDDD-EEEE, where the letter groupings refer to the following:

- A - discipline code
- BBBB - major element
- CCCC - minor element
- DDDD - minor element
- EEEE - minor element

Table 7 provides further explanation of the format.

© State of NSW through Transport for NSW 2021

Table 7 - CAD level naming format description

Character	Description
Discipline	Discipline prefix 1 character alpha code (track, civil, and so on) – based on Table 6
Major element	Parent element abbreviated code for element (feature)
Minor element	Sub element abbreviated code for part

Some examples of this format include the following:

- F-BRDG-ABUT (Field data - bridge - abutment level)
- F-BRDG-ABUT-TEXT (Field data - bridge - abutment - text level)

A complete range of CAD level tables can be obtained by downloading the resource file from the AMB section of the TfNSW website.

Download file T MU MD 00006 R1.

6.10. Seed files

Seed files are templates used to create a new engineering drawing. Use the following MicroStation seed files as appropriate:

- model2DseedV8.dgn (2D design model (no sheet model))
- model2Dsheet2DseedV8.dgn (2D design model/2D sheet model)
- model3DseedV8.dgn (3D design model (no sheet model))
- model3Dsheet2DseedV8.dgn (3D design model/2D sheet model)

These files are available for download from the AMB website.

AutoCAD equivalent of these files are also available on the AMB section of the TfNSW website.

Download file T MU MD 00006 R1.

6.11. Drawing sheets

All drawing sheet sizes shall comply with AS 1100.101. Table 8 provides the dimensions of drawing sheets that are acceptable for lodgement in AMB's Planroom; drawing sheets other than those listed will not be accepted. For all drawings, the preferred size is A1 drawing sheet size with landscape orientation. Other sheet sizes A0, A2, A3, RA0 and RA1 in landscape orientation can be used if required. The width of roll over drawing RA0 shall be 860 mm and RA1 shall be 610 mm while length can be determined by the requirements of a particular engineering drawing in multiples of 500 mm. The title blocks for all standard designation sizes are available for download from the AMB section of the TfNSW website in both MicroStation format and AutoCAD format.

© State of NSW through Transport for NSW 2021

Download file T MU MD 00006 R0 *Title Blocks CAD Resources*.

Table 8 - Dimensions of drawing sheets

Standard designation	Cut sheet and drawing sheet dimensions (mm)
A0	1189 x 841
A1	841 x 594
A2	594 x 420
A3	420 x 297
RA0	860 x 1220 (minimum)
RA1	610 X 860 (minimum)

6.12. Drawing scale

Scales used for drawings varies with size and character of the feature, and with the degree of the details to be shown. Table 9 shows the scales for full size, enlargement, and reduction ratios.

Views should be drawn to scale. Use distorted scales only in special cases, where the required detail does not show effectively on an undistorted scale. Scales shall be indicated under each heading on the drawing. Views not drawn to scale shall be marked as NTS (not to scale).

Table 9 - Engineering drawings recommended scales

Full size and enlargement scales	5:1	NA	2:1	10:1 1:1
Reduction scales	1:2 1:20 1:200 1:2000	1:25 1:250 1:2500 1:25000	1:5 1:50 1:500 1:5000 1:50000	1:10 1:100 1:1000 1:10000 1:100000

When using different scales for horizontal and vertical dimensions, such as high voltage (HV) aerial lines and cables line, overhead wiring (OHW), and bridge profiles, each scale shall be clearly indicated on the drawing sheet.

For example,

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:100

The number of different scales used on any one drawing shall be kept to a minimum. Scales shall be large enough to permit clear interpretation of the information and ensure clarity of information on prints. All drawing sheets shall include a scale bar representing the scales used on the drawing.

© State of NSW through Transport for NSW 2021

The scale bar for all scales used on the drawing should be shown on the lower left corner of the drawing sheet.

6.13. Drawing orientation

Drawings should be produced in accordance with the rules of orientation explained in this section. However, if these rules are likely to cause confusion with other drawings, then the clarity of the drawing should not be compromised.

Whenever it is necessary to depart from the rules of orientation, the system adopted shall be clearly noted. Regardless of the system used, the orientation of all views on the drawing should be consistent with that of the site plan view.

Figure 8 - Standard north point arrow

Site plans and locality maps should be oriented with north or assumed north to the top of the sheet. If this orientation is not convenient, then north should be towards the left side of the sheet. In special cases, where coordination between disciplines is required, north can be in the direction agreed to between the disciplines.

Site plans and locality maps shall contain a standard north point arrow. Figure 8 shows the AMB standard north point arrow.

Where required, plans and maps should show sufficient grid lines of the relevant grid system to locate accurately the area covered by the drawing. The standard north point arrow symbol that should be used on a drawing is available in the cell library. Standard north points can be downloaded from the AMB section of the TfNSW website.

Download file T MU MD 00006 R1.

Once extracted the north points are located in Rc_NorthPoint_v8.cell and Rc_NorthPoint_v8.dwg for MicroStation and AutoCAD respectively. The arrow should be marked ‘North’, or ‘Assumed North’ as applicable, and placed in the upper left corner of the plan.

For heavy rail drawings depicting track information (such as track layouts, plan views, elevations and sections of rail infrastructure), tracks shall be drawn horizontally on the sheet, with Sydney on the left. Label the Sydney end of the track as ‘From Sydney,’ and the other end as ‘To …’ (the next main railway station). Where it is necessary to orientate the drawing with Sydney on the right, for example, drawings showing views of retaining walls on the UP side of the track, the orientation shall be clearly labelled.

© State of NSW through Transport for NSW 2021

Plans for overbridges shall be drawn with the track vertical and Sydney at the bottom. Label the Sydney end of an underbridge as 'From Sydney,' and the other end as 'To …' (the next main railway station after the bridge site). Drawings should show cross-sections perpendicular to the track through bridges as viewed from the Sydney side that is facing country (towards increasing kilometrage).

Similar drawing orientation approach shall be adopted for drawings pertaining to other modes that depict track information.

6.14. Drawing layout

A drawing should be properly laid in a third angle orthographic projection to show all relevant aspects of an engineering feature; where necessary, additional cross-sections and details of an engineering feature should be drawn to fully illustrate them. A layout should not show hidden lines unless they give details that are not readily apparent on other views. In most cases, interior details should be shown in additional cross-sections, rather than showing hidden lines. Additional isometric views, photographs or rendered sections can be used to add clarity to an engineering feature; however, this should not be used as an alternative to orthographic projections.

6.14.1. Headings

All headings shall be underlined. Headings for sections shall include an 18 mm diameter circle enclosing the identifying letter and, where applicable, a reference drawing number. Similarly, headings of details shall include a hexagon inscribed in an 18 mm diameter circle enclosing the identifying number and, where applicable, a reference drawing number. The scale for all headings shall be indicated below the heading. All these aspects of headings are shown in Figure 9.

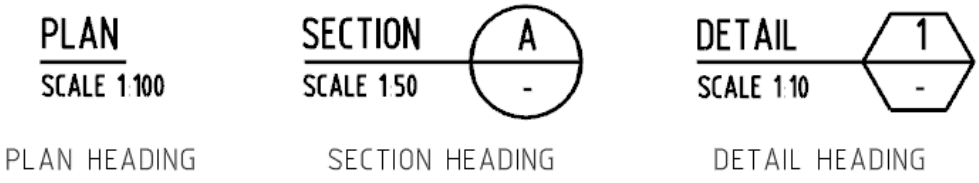


Figure 9 - Headings for plan, section and detail

6.14.2. Sections

Standard section arrows provided in the cell library shall be used to indicate clearly the location of the cutting plane. Figure 10 shows the sections and details symbols. One set of arrows is sufficient for each section; in some cases, a repetition of the arrows may be necessary on other views.

© State of NSW through Transport for NSW 2021

A letter placed inside a circle shall identify a section. The orientation should be consistent with the rules of projection. Sections shall be drawn to the same or larger scale than the original view, using third angle projection. The letters I, O and Q shall not be used as section letters. The sections should be placed as near as possible to the view from where they are cut.

Where a section is drawn on a different sheet to that of the original view, then the last three digits of the section sheet's EDMS number shall be shown in the lower half of the section circle on the original view. The section heading shall include the last three digits of the EDMS number of the original sheet from which the section has been taken, as shown in Figure 10. The last three digits of the design company document number can also be used as an acceptable alternative, provided requirements in Section 6.19 are met. If the section is on the same sheet, as that of the original view, then a dash '-' shall be placed in the lower half of the section circle and section heading as shown in Figure 10.

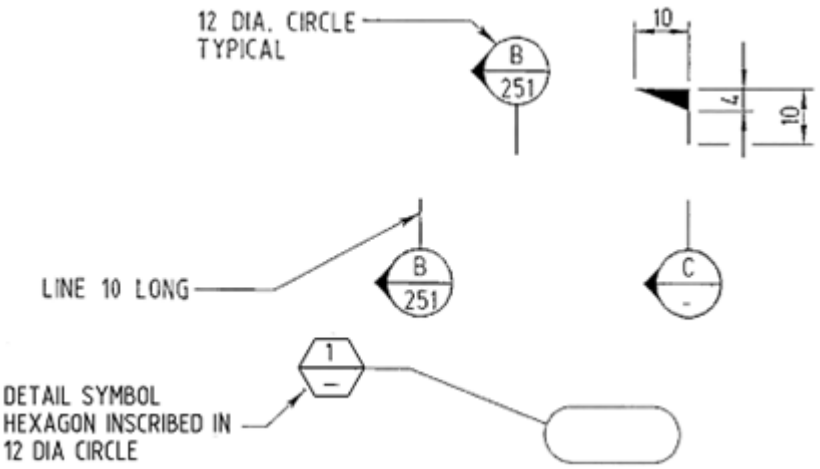


Figure 10 - Sections and details symbols

6.14.3. Details

The details identify particular areas that need clarity and the areas that are not covered by a section. A number shall identify the details. An arrow can be placed as a detail pointer if the item that is detailed is small; however, a circle or an ellipse (solid line and size to suit) should be placed around the area to be detailed. Refer to Figure 10 for sections and details symbols.

Where a detail is drawn on a different sheet to that of the original view, then the last three digits of the detail sheet's EDMS number shall be shown in the lower half of the detail hexagon on the original view. The detail heading shall include the last three digits of EDMS number of the original sheet from where the detail was taken, as shown in Figure 10. The last three digits of the design company document number can also be used as an acceptable alternative, provided the requirements in Section 6.19 are complied. If the detail is on the same sheet as that of the original view, then a dash '-' shall be placed in the lower half of the detail hexagon.

© State of NSW through Transport for NSW 2021

6.15. Dimensioning

All relevant drawing features shall be completely detailed with dimensions. All dimensions for a particular feature should be shown on a single view where possible. Duplication of dimensions should be avoided. Dimensions shall not be scaled from the drawing.

All dimensions should be in millimetres. Dimension text should be placed on dimension lines. Dimensions should be readable from the bottom or right side of the drawing, similar to text orientation as shown in Figure 5.

All dimensions should be produced using the CAD applications dimensioning tool set. Dimensions shall not be dropped or exploded.

All angular dimensions shall be expressed in the format stated in AS 1100.101.

Where it is necessary to use tolerances on a drawing relevant reference to tolerance scheme shall be provided in the 'Notes' section on the drawing.

6.15.1. Dimension lines

All dimension and extension lines should be thin, with a nominal thickness of 0.18 mm on printout.

Extension lines should extend half of the text height beyond the dimension line and start at the same distance clear of the outline of the feature. Extension lines should extend half of the text height past intersection points (IPs) and points on surfaces.

Dimension lines wherever practicable, should be placed outside the outline of the feature. Dimensions should be placed above the dimension line, not below or where the dimension line is disturbed. Dimension lines should terminate with easily readable standard filled arrowheads, normally 1.0 to 1.5 text heights long and 0.5 text heights wide. An exception to this is when the application calls for a stroke or a dot. In such cases, the discipline specific requirements should be defined.

A centreline or a line that is an extension of a centreline, or a part of an outline, should not be used as a dimension line. Figure 11 illustrates these characteristics of extension lines and dimension.

© State of NSW through Transport for NSW 2021

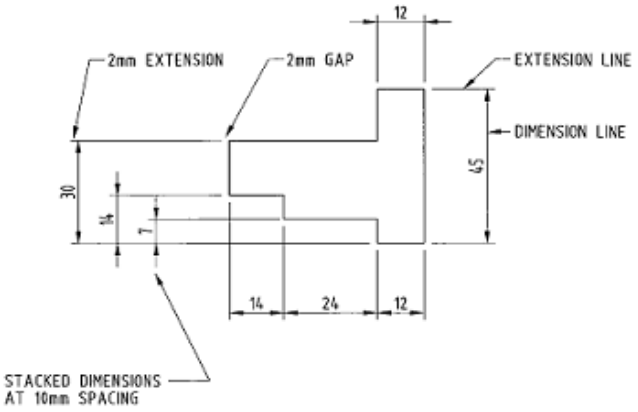


Figure 11 - Dimension lines

If the overall dimension of a chain of dimensions is a critical value, then one of the dimensions in the chain should be omitted as shown in Figure 12. Stacked dimension lines should be spaced at 10 mm intervals.

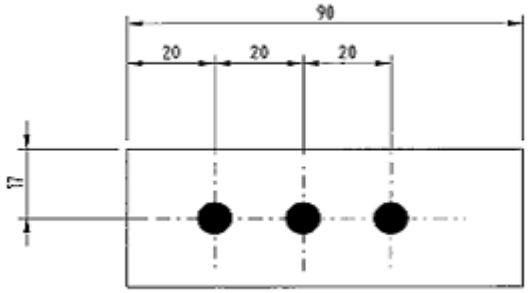


Figure 12 - Dimension chain

Leaders for notes should terminate in arrowheads or filled circles and should originate either at the beginning of a note or at the end of a note (not above or below). Arrowheads should always terminate on a line. Dots should be within the outline of the feature. Figure 13 shows the typical leaders.

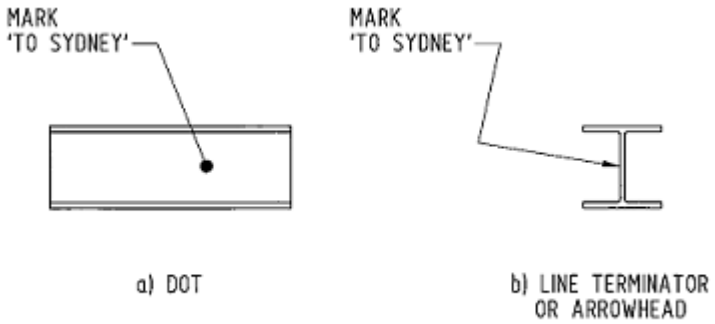


Figure 13 - Typical leaders

Leaders should be drawn as near as possible to and as perpendicular as possible to other lines. Figure 14 depicts the leaders touching other lines. They should not be drawn parallel or adjacent to dimensions or projection lines. The use of long leaders should be avoided.

© State of NSW through Transport for NSW 2021

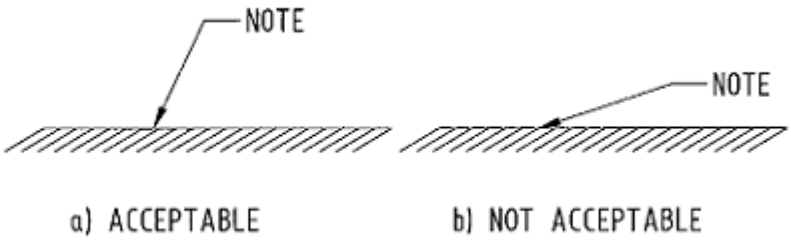


Figure 14 - Leaders touching other lines

6.15.2. Dimension text

Dimension text shall be readable from the bottom or right side of the drawing, similar to the text orientation as shown in Figure 5.

Where it is necessary or desirable to indicate that a particular dimension is not to scale, the abbreviation NTS (not to scale) should be added next to the dimension text as shown in Figure 15.

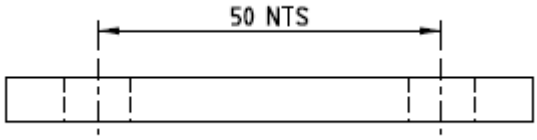


Figure 15 - Not to scale dimension

Radii should be dimensioned by a dimension line that passes through, or in line with the centre of the arc. The dimension line should have one arrowhead only and the abbreviation ‘R’ should always lead the dimension.

6.15.3. Units

All survey design units and set out points mentioned on drawings should be in the Map Grid of Australia (MGA) coordinate system in metre units. If the project largely involves alterations to the asset owner’s existing network and the survey for that network is only available in Integrated Survey Grid (ISG) coordinates, then the new work can use ISG coordinates. This shall be agreed with TfNSW prior to commencing design work for the project.

When a point on a drawing is located by reference to the grid system, the coordinates should be written correct to three decimal places of a metre, as mentioned in the following example:

- E 363 241.271
- N 1 240 401.750

Coordinates shall be written in accordance with the grid system adopted and the grid system shall be populated as smart tag in the title block.

© State of NSW through Transport for NSW 2021

All levels (elevations) should be to the Australian Height Datum (AHD) in metre units.

Decimal numbers usually indicate metres. Whole numbers indicate millimetres. Dimensions in millimetres requiring accuracy to a number of decimal places shall be expressed with the millimetre suffix, that is, '12.5mm'.

The position of the decimal point shall be the same as a full stop and no space shall be left between the number and its units. An example of this format is '9.010m'.

6.15.4. Track kilometrage

Track kilometrages for heavy rail shall be measured from Sydney along the centreline of the track and are expressed in kilometres; for example, '54.321km'. If they are used for a specific purpose, the kilometrages are measured to the nearest millimetre and written as '54.321 789km'. Views should be oriented with Sydney on the left and so the track kilometrages increase from left to right across a drawing.

All light rail networks and transport modes depicting track information shall adopt a kilometrage origin and develop kilometrage in accordance with common TfNSW practice and as adopted in heavy rail environment and documented in T MU AM 01006 ST *Asset Reference Codes*.

6.16. Gradients and batters

The term ‘gradient’ should be used to refer to the features with gradual slopes such as tracks, roadways, and tunnels. The term ‘batter’ should be used to refer to steeper slopes such as excavations and faces of walls. The term ‘fall’ should be used to refer to gradients for drainage systems. ‘Slope’ is a general term of indefinite meaning and shall not be used.

6.16.1. Gradients

Gradients can be expressed as a percentage. A gradient of 5.0% indicates a displacement of five units vertically in 100 units horizontally.

Gradients can also be expressed as a unit of vertical displacement in a horizontal distance, such as ‘1 in 20’, where 1 is always the vertical dimension and 20 is the horizontal.

In plan views, and where a gradient is given for a surface that is close to the horizontal, such as 1 in 100, an arrow should indicate the direction of the fall. Alternatively, a small right-angled triangle is used to show the gradual gradients or cross falls, with the two sides including the right angle dimensioned, one being unity.

Figure 16 shows examples of gradients with the direction of the fall.

© State of NSW through Transport for NSW 2021

Figure 16 - Indicating gradients

6.16.2. Batters

Batters should be expressed as a horizontal displacement relative to a vertical distance. One of these dimensions is given as unity; for example, ‘2 to 1’, or ‘0.7 to 1’, where the first number should always be the horizontal dimension. A small right-angled triangle can be drawn and dimensioned to indicate batters. Figure 17 shows an example of a batter.

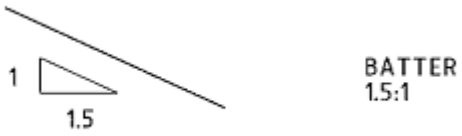


Figure 17 - Indicating batter

6.17. Abbreviations

All abbreviations shall comply with AS 1100.101. Abbreviations shall be in upper case letters. If an abbreviation that is not in AS 1100.101 is used, then the drafter shall define it in the notes or provide a legend on each drawing in which it is used.

6.18. Notes and references

The notes and references should occupy a space of not more than 140 mm wide from the right side margin above the title block for A0 or A1 sheets, and 125 mm wide for A2 or A3 sheets.

Where several notes on particular subjects are required, the notes should be grouped under separate headings such as steelwork, concrete, reinforcement, and so on. Each note, under these headings, should be numbered in sequence.

6.18.1. Notes

Notes should be kept to a minimum. The information related to a particular feature of the drawing should appear in the body of the drawing at the point where it applies.

Where description of materials or similar information is given on third party drawings, the notes should comply with the appropriate specification.

© State of NSW through Transport for NSW 2021

For larger groups of drawings, the general arrangement should include notes that are common to all drawings of the group. The first note of other drawings should be a reference to the general arrangement drawing for general notes.

General arrangement drawings should show the principal design basis; for example, design loading, live loads and wind loads.

Any concession or nonconformance received for a drawing or set of drawings shall be stated along with its description under notes of that drawing or set of drawings.

6.18.2. References

Reference drawings should be listed below the notes. The list should include relevant drawings to enable the construction or fabrication, or both, of a particular feature.

References listed on a particular drawing should include only those drawings necessary to cover that particular part of the work. The general arrangement (or the cover sheet if any) should list all drawings that are relevant to the project.

Drawings by other disciplines that have a direct bearing on a particular drawing (associated drawings) shall be listed on the general arrangement sheet.

In some instances, a reference to a drawing that gives details of a particular section of the work can be added in the body of the drawing at the appropriate place. Such references should be included under the references heading, and in the body of the drawing. Refer to Figure 18 for sample notes and references.

The EDMS numbers should be used to refer the drawings that are listed under reference headings. The design company document number can be used as an acceptable alternative to EDMS numbers, provided the requirements in Section 6.19 are complied.

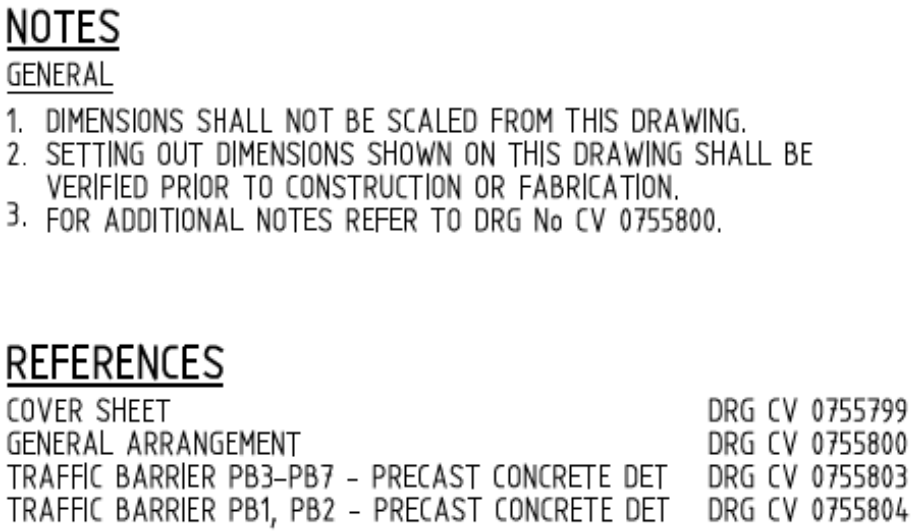


Figure 18 - Typical notes and references

© State of NSW through Transport for NSW 2021

6.19. Cross-referencing drawings

When there are cross-references to other drawings, then the EDMS numbers of the drawings should be preferably used. Where this is not possible, the design company document number may be used as an acceptable alternative, provided the following requirements are satisfied:

- A cover sheet or sheets shall be provided that contains a schedule of all drawings for the design package. The cover sheet shall be complete with drawing title description, EDMS number and corresponding design company document number for each drawing. The amendment version and issue date of the drawings shall also be provided.
- Cover sheets shall comply with discipline specific specifications or other discipline specific standards.
- For all drawings in the design package, either the EDMS number or the design company document number shall be used consistently for cross-referencing. The drawings in the design package shall not use a combination of these numbers for cross-referencing.
- When referring to drawings that are not part of the project drawings, then the EDMS number shall be used for cross-referencing those drawings. All of these non-project drawings shall be listed under 'OTHER REFERENCED DRAWINGS' on the cover sheet.

6.20. Printing of drawings in colour

Colour on drawings shall only be used when it would otherwise be difficult to interpret the information on the drawing, if printed in black and white, or greyscale. If a colour is used in the engineering content of a drawing, then a box containing the note as shown in Figure 19 shall be added at the bottom of the drawing, centrally aligned above the title block. Use of coloured logos on a drawing would not necessitate the placement of drawing colour coded box.

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

Figure 19 - Drawing colour coded box

When using colours on a drawing, the following requirements shall be satisfied:

- colour shall not be used for text, dimension lines, and other thin line styles with line thickness less than 0.18 mm
- light shades of colour such as light blue and light colours such as yellow shall not be used
- red and shades of red shall only be used for warning signs and notices or when it is the actual colour of the feature drawn

© State of NSW through Transport for NSW 2021

6.21. Amendment clouds

Amendment clouds are shown on a drawing to draw the attention of the subsequent reader to the changes carried out in the current drawing amendment. Drawing amendment clouds on 'pre-approved for construction' issues are not mandatory. After the first issue of the drawing as approved for construction, all subsequent changes shall be clouded. With every new amendment to a drawing, the previous amendment clouds shall be deleted.

All deletions shall also be clouded and the word ‘DELETED’ shall be added in an amendment cloud.

A number or character related to an amendment of a drawing enclosed in a hexagon shall be drawn within each amendment cloud.

Figure 20 shows an example of an amendment cloud.

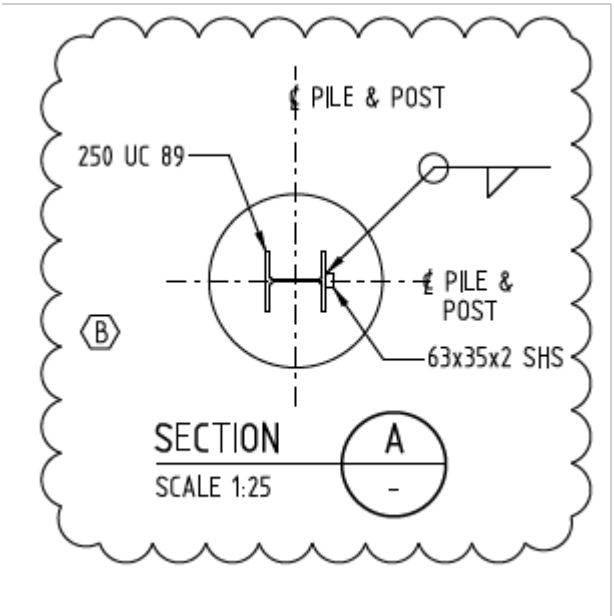


Figure 20 - Amendment clouds

In case where a drawing has many changes, and where clouding each amendment would make the drawing difficult to interpret, then the whole drawing can be clouded as one amendment cloud and the amendment box populated with the words ‘Drawing Redrawn’.

When submitting the as-built issue, all amendment clouds referring to previous amendments shall be removed, and the drawing shall be issued without any amendment clouds.

6.22. Hold clouds

Hold clouds shall be drawn to segregate tentative design information during the design development stage of a drawing, so that the drawing can be approved for construction prior to the drawing being completed. For example, a drawing is approved for construction, but the vendor is yet to confirm the location of holding down bolts for a machine.

© State of NSW through Transport for NSW 2021

The use of hold clouds on a drawing should be avoided, and the drawing should be approved for construction only after all design information is complete. Hold clouds should be used only in extreme situations when the design data that is not confirmed causes a significant impact on the project.

A light rectangle shall be drawn to represent a hold on a feature in a drawing as shown in Figure 21. Each hold cloud shall be numbered in a sequence; for example, H1, H2. The description of each hold cloud shall be shown next to the drawing notes.

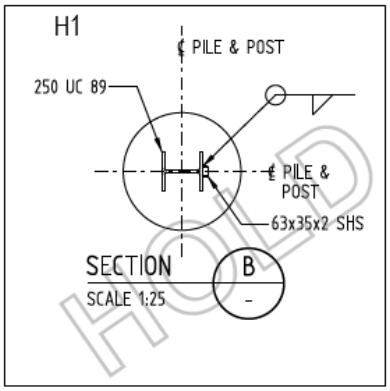


Figure 21 - Example of a hold cloud

When the information that is on a hold cloud is finalised, the relevant hold cloud shall be removed from the drawing, and the related description shall be deleted. The drawing should be re-issued for construction after removal of all such clouds.

6.23. Bill of materials

A bill of materials can be added to the drawing, if required. The preferred location of a bill of material is above the title block on the right side of the drawing. Figure 22 shows an example of a bill of material.

ITEM	LOC'N	DESCRIPTION AND SIZE	PER ASS'Y	MATERIAL SPEC.	PART NUMBER
11	H-7	NICKEL ANTI-SEIZE LUBRICANT			LOCTITE OR EQUIV.
10	H-7	UNF 10-32 x 25 TORX BUTTON HEAD SCREW		SS GRADE 304	BLKWOODS B0104-0028
9	C-12	GLUE LINED HEAT SHRINK - ID 19.1 X 61 LONG			CABAC XDW20BK
8	F-1	LOCTITE 222 / LOCTITE 7649 PRIMER			
7	H-8	M6 X 20 TORX BUTTON HEAD M/T SCREW		SS GRADE 18-8	M620 - XYM
6	C-10	CABLE SLEEVE - ID 9.5 X 2.5 THK X 62 LG		HT SILICON RUBBER - BLACK	JEHBCO
5	C-11	WIRE ROPE (7 X 19) - ø 6 X 64 LONG		SS GRADE 304	
4	C-6	HANDLE CONNECTOR - 35 X ø 15		SS GRADE 304	
3	D-8	TOP PIVOT - 43 X ø 28		SS GRADE 304	
2	G-6	HANDLE FORGED		SEE NOTE 12.	
1	H-2	HANDLE ASSEMBLY			

Figure 22 - Sample bill of materials

© State of NSW through Transport for NSW 2021

6.24. Drawing amendment – operation and maintenance stage

The requirements set out in this section shall only be applied to the drawings that need amendment during the operation and maintenance stage of an asset. These drawings are further subdivided into the following two categories:

- image file amendment
- drawing file amendment

6.24.1. Image file amendment

The requirements set out in this section shall only be applied in the following circumstances:

- for existing Central Planroom registered image files with no associated drawing (CAD) file including hand drawn drawings
- documents registered in Planroom

A hybrid drawing shall be created in this case, using the following approach:

a. A new drawing file with the TfNSW title block shall be created.

b. If a hybrid drawing already exists with RailCAD approved title block, then the old title block shall be updated for the next amendment.

c. The raster data of an existing drawing in the form of an image shall be attached to the drawing. If an image file is created from scanning an existing drawing, then it should be scanned at a minimum resolution of 300 dpi and be set at a scale of 1:1 of the existing title block size.

d. If the raster image has an EDMS number, then the same EDMS number shall be used. The next amendment level of the drawing shall be created and populated in the title block.

e. Documents shall be amended with new EDMS number only and TfNSW title block without copyright disclaimer. Additional note shall be added to the drawing stating ownership for the changes.

f. If the raster image does not have an EDMS number, then the title block shall be populated as that of a new TfNSW drawing.

g. The relevant part or parts of the drawing shall be updated in accordance with the requirements set in Section 6 and add amendment clouds.

h. A box above the TfNSW title block shall be added with the words ‘HYBRID DRAWING – COMPOSED OF BOTH VECTOR AND RASTER DATA’.

i. The drawing shall be signed and submitted in accordance with the requirements set out in Section 7 and Section 8 of this standard.

© State of NSW through Transport for NSW 2021

If more than 50% of the drawing content is either already updated, preference should be given to create a new engineering drawing instead of updating using hybrid drawing methodology.

6.24.2. Drawing file amendment

The drawing file amendment requirements shall only be applied to existing Central Planroom registered drawings with associated CAD file.

A drawing (CAD) file shall be updated, using the following approach:

- Replace the old title bock with updated TfNSW title block in compliance with Section 7 of this standard.
- Drawing shall be updated to next amendment level, using existing EDMS number.
- The relevant part or parts of the drawing shall be updated in accordance with the requirements set in Section 6 and add amendment clouds.
- The drawing shall be signed and submitted in accordance with the requirements set out in Section 7 and Section 8 of this standard.

In case where it is not feasible to replace the existing title block with updated TfNSW title block, then a drawing file that is amended using a RailCAD approved title block is acceptable.

7. Drawing management

Drawing management covers the requirements for title blocks, smart tags, metadata and file naming conventions that apply to all disciplines.

7.1. Drawing title block

The title block setting and filling of details in the title block shall comply with the procedure explained in Section 7.1.1, Section 7.1.2 and Section 7.1.3.

Figure 23 shows an example of a typical drawing sheet template, which consists of the following three components:

- drawing details box
- sign-off box
- amendment box

© State of NSW through Transport for NSW 2021

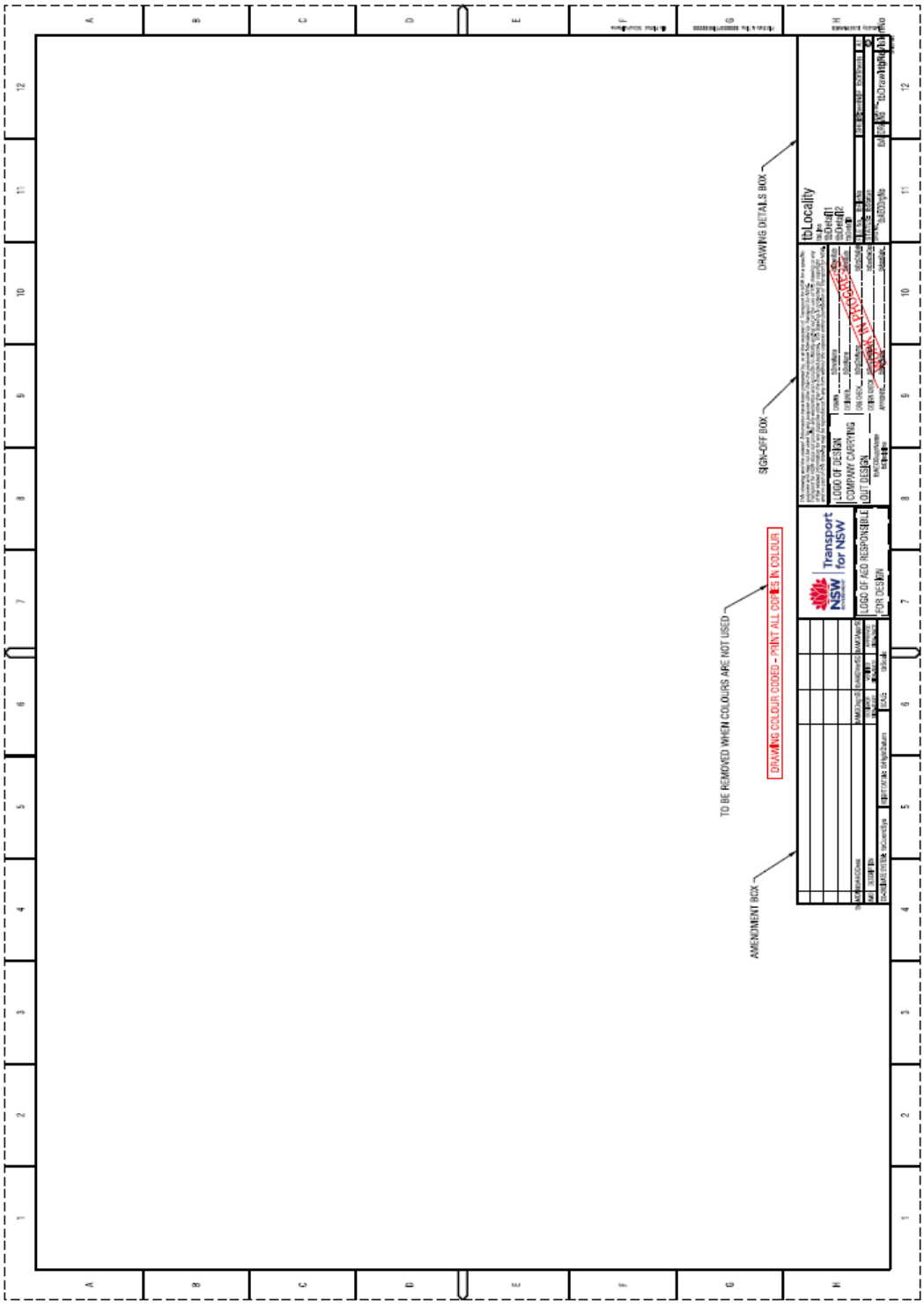


Figure 23 - Typical TfNSW drawing sheet template

7.1.1. Drawing details box

The drawing details box provides details of the drawing subject matter and contains information about the drawing title and revision.

Figure 24 shows the different fields in the drawing details box.

© State of NSW through Transport for NSW 2021

Table 10 provides the details of the fields in the drawing details box. All data entry fields in the drawing details box are included as smart tags. Refer to Section 7.3 for further details on smart tags.

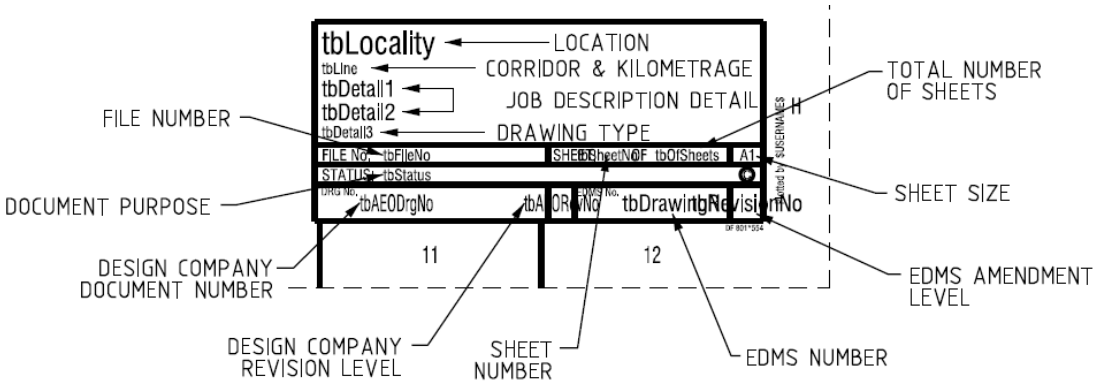


Figure 24 - Drawing details box on a typical TfNSW drawing sheet

Table 10 - Drawing details box - smart tags description

No.	Field name	Tag	Requirements
1	Location	tbLocality	Include the main location of the drawing. Refer to T MU AM 01007 TI *Asset Reference Codes Register* for a list of location names.
2	Corridor and kilometrage	tbLine	Include the formal rail corridor name followed by the kilometres. The kilometres can be a single kilometre location or a range designated as a starting kilometres to an ending kilometres which is applicable to that drawing. Refer to T MU AM 01007 TI for a list of corridors and kilometrages.
3	Job description detail 1	tbDetail1	Include the drawing description. The description can include the engineering discipline (for example, Electrical) and sub-discipline (for example, railway overhead wiring) and a full description of the drawing content. Sets of drawings can be labelled similarly.
4	Job description detail 2	tbDetail2	This requirement is same as tbDetail1.
5	Drawing type	tbDetail3	Indicate the type of drawing.
6	File number	tbFileNo	Optional field; entry is based on the design company to assist the tracking of drawings within their own system.
7	Document purpose	tbStatus	Indicate the status of the revision of the drawing. The document purpose shall not be additionally stamped elsewhere on the drawing. Table 11 shows value of TbStatus field at the various asset design stages.
8	Sheet number	tbSheetNo	Indicate the sheet number of a drawing in a set of drawings. Where there are no other drawings in the set, this sheet is numbered 1.

© State of NSW through Transport for NSW 2021

No.	Field name	Tag	Requirements
9	Total number of sheets	tbOfSheets	Indicate the total number of sheets in a set in which this drawing forms part of. Where there are no other drawings in the set, this sheet is numbered 1.
10	EDMS number	tbDrawingNo	Include the EDMS number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom), and is unique for each drawing. There should be no gap character between letters and numbers. Refer to Section 8.1 for details.
11	EDMS amendment level (revision associated with EDMS number)	tbRevisionNo	Indicate the EDMS amendment level, which is related to the EDMS number and shall be changed only when the drawings are submitted to VPR. Refer to Section 7.5 for details.
12	Sheet size	tbSheetSize	Indicate the size of the drawing.
13	Design company document number	tbAEODrgNo	Include the design company document number. Refer to Section 7.4.4 for details.
14	Design company revision level	tbAEORevNo	Indicate the design company revision level related to the design company document number. Refer to Section 7.5 for details.

The fields in the drawing details box are a combination of either free text or pick list (pre-defined) items. Refer to Appendix B for more details.

For fields with ‘free text’, information shall conform to the following principles:

- Drawing titles shall be correct, comprehensive and compliant with the formats indicated.
- Abbreviations should be avoided but common construction abbreviations are allowed (for example, LV, OHW, DRG and ULX) or ones that are explained on the drawing.
- The drawing title is made up of five lines (location, line and kilometrage, job description detail 1, job description detail 2 and drawing type) and shall contain specific information about the content of the drawing. After a drawing is submitted to the VPR, the drawing title shall not be modified in future amendments.

Table 11 - TbStatus Codes at various asset design stages

Code	Drawing status	Code	Drawing status
AB	As built	P1	Preliminary design 1
AF	Approved for construction	P2	Preliminary design 2
CC	Concept design	PD	Preliminary design
CD	Current design	RD	Reference design
DD	Detail design	ST	Standard
FC	For construction	TN	Tender

© State of NSW through Transport for NSW 2021

The above TbStatus Codes are used for populating the VPR database only and should not be shown on the face of the drawing. The Title Block Status box should contain the full written status of the drawing. For example “Approved for construction”, “As built”, and so on.

7.1.2. Sign-off box

The sign-off box shall contain the full names of the persons who have performed the design, design check, drawing, drawing check and approval of the document at the time of final concept design, approved for construction or subsequent design change. These fields shall not be updated for drawing amendments. Amendments should be entered into the “Drawing Amendments Box”.

Note: Where the first name of a person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.

Figure 25 shows the different fields in the sign-off box.

Table 12 provides the details of these fields. All data entry fields in the sign-off box should be populated as smart tags.

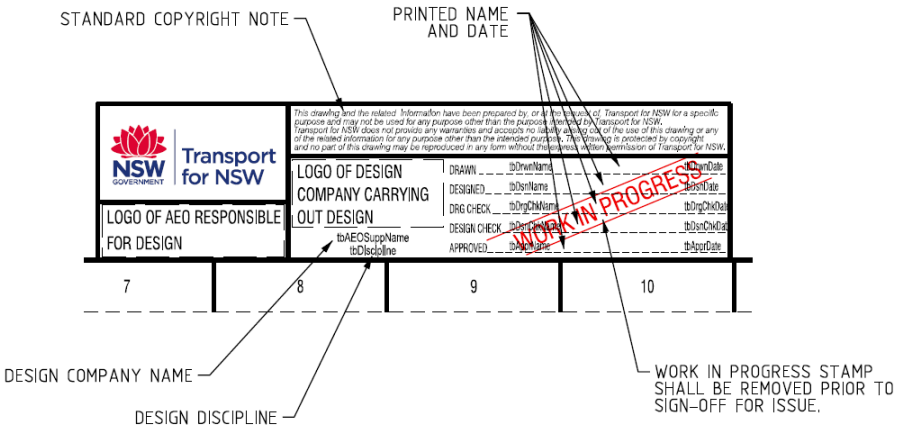


Figure 25 - Sign-off box on a typical TfNSW drawing sheet

Table 12 - Sign-off box - smart tags description

No.	Field Name	Tag	Requirements
1	Drawn by (Name)	tbDrwnName	Include the full name of the draftsperson.
2	Drawn date	tbDrwnDate	Include the date of sign-off by the draftsperson.
3	Designed by (Name)	tbDsnName	Include the full name of the designer who designed the design component of the drawing.
4	Designed date	tbDsnDate	Include the date of sign-off by the designer.

© State of NSW through Transport for NSW 2021

No.	Field Name	Tag	Requirements
5	Drawing checked by (Name)	tbDrgChkName	Include the full name of the person who checked the drafting of the drawing.
6	Drawing checked date	tbDrgChkDate	Include the date of sign-off by the drafting checker.
7	Design checked by (Name)	tbDsnChkName	Include the full name of the person who checked the design component of the drawing.
8	Design checked date	tbDsnChkDate	Include the date of sign-off by the design checker.
9	Approver (Name)	tbApprName	Include the full name of the person who approved the design to be released.
10	Approved date	tbApprDate	Include the date of sign-off by the design approver.
11	Design discipline code	tbDiscipline	Include the discipline code to which the drawing relates.
12	Design company name	tbAEOSuppName	Include the name of the design company.

7.1.3. Amendment box

The amendment box records the details of all amendments made to a drawing. The amendment details include EDMS amendment level or the design company revision level, amendment description along with the initials of the designer, verifier and the approver.

The 'AMD' column records the amendment level of the drawing. Refer to Section 7.5 for details.

A brief but informative description of the changes made to the drawing shall be added to the 'Description' column. The initials of the designer, verifier and approver shall be placed in the amendment box for each drawing issue.

Where possible, at least three letters for the initials are required to minimise the possibility of misidentification of approvers with common first initial and last initial.

The oldest amendment entries shall be displayed at the bottom of the list. The amendment history items should be removed only when all available lines have been used. In this case, the oldest amendment information is removed, and the rest of the entries are moved down to create room for the new amendment at the top of the list.

Figure 26 shows the different fields in the amendment box.

Table 13 provides the details of these fields. All data entry fields in the amendment box are included as smart tags.

© State of NSW through Transport for NSW 2021

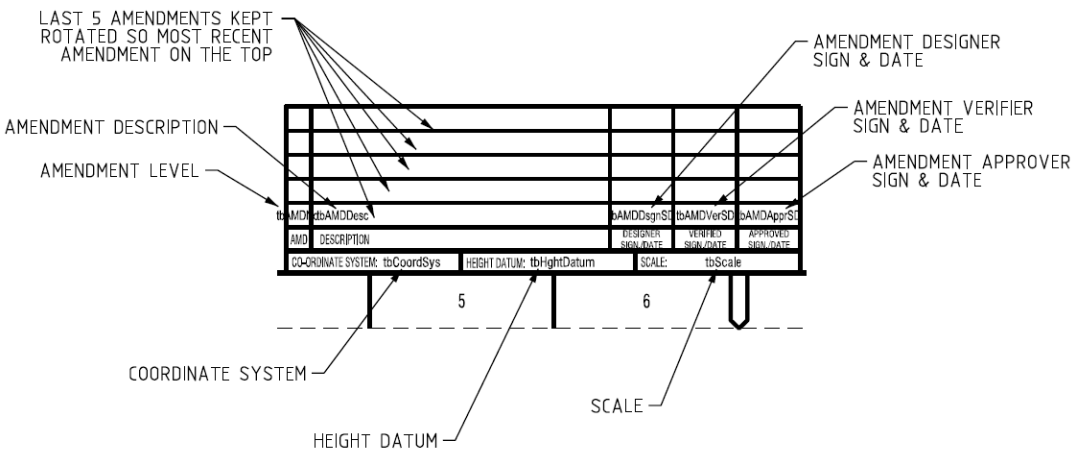


Figure 26 - Amendment box on a standard TfNSW drawing sheet

Table 13 - Amendment box - smart tags

No.	Field name	Tag	Requirements
1	Co-ordinate system	tbCoordSys	Optional field. Required for drawings containing survey coordinates, generally Integrated Survey Grid (ISG) or Map Grid of Australia (MGA) and not required for mechanical drawings or diagrams.
2	Height datum	tbHghtDatum	Optional field. Required for drawings containing survey coordinates, generally AHD and not required for mechanical drawings or diagrams.
3	Scale	tbScale	The major scale of a drawing.
4	Amendment level	tbAMDNo	Indicate the amendment level of current revision. Refer to section 7.5 for details.
5	Amendment description	tbAMDDesc	Include a brief description of the phase of review or approval that the drawing is issued.
6	Amendment designer sign	tbAMDDsgnSD	Include the initials of the person who designed the amendment and the date of signature.
7	Amendment verifier sign	tbAMDVerSD	Include the initials of the person who verified the amendment and the date of signature.
8	Amendment approver sign	tbAMDApprSD	Include the initials of the person who approved the amendment and the date of signature.

© State of NSW through Transport for NSW 2021

7.2. Drawing amendment

The drawing amendment level controls the current version of a drawing. The following two fields in the drawing title block control the current version of the drawing:

- EDMS amendment level

  The EDMS amendment level for a drawing shall always be a letter. When the drawing is submitted to the VPR for the first time, the EDMS amendment level shall be 'A'. All the subsequent amended versions submitted to the VPR shall be B, C, D, and so on, excluding O, I and Q. After EDMS amendment level 'Z', the next amendment level shall be AA, AB and so on.

- design company revision level

  A drawing design company revision level shall always be a number and shall be '1' for the first issue. For subsequent issues, the design company revision level shall be incremented to the next whole number such as 2, 3, 4, and so on.

The description of each amendment update shall be recorded in the drawing amendment box as explained in Section 7.1.3. The 'AMD' column shall be populated by concatenating the EDMS amendment level and the design company revision level as one amendment level. Table 14 provides an example of the drawing amendment level at different stages of a drawing.

Table 14 - Examples of amendment level

Amendment issues	Amendment description	VPR submission	EDMS amendment level (tbRevisionNo)	Design company revision level (tbAEORevNo)	AMD column (tbAMDNo)
First issue	Issued for review	Not required	Blank ( )	1	1
Second issue	Issued for comments	Not required	Blank ( )	2	2
Third issue	Approved for construction	Required	A	3	A3
Fourth issue	Re-issued for construction	Not required	A	4	A4
Fifth issue	Re-issued for construction	Required	B	5	B5
Sixth issue	Re-issued for as built	Required	C	6	C6

Note: Amendment issues and corresponding values shown in Table 14 are examples only. They can vary in real time projects.

© State of NSW through Transport for NSW 2021

When an amendment is required for an issued drawing, a new version shall be created prior to any of the changes being made. A new version shall carry a 'WORK IN PROGRESS' stamp across the drawing sign-off box until it has been signed off and made ready for issue. Drawing image files submitted to the VPR shall not have this stamp.

7.2.1. Signatures

The AEO shall ensure that the design approval process is reliable and trustworthy. The approval process including signatures shall be identifiable, retrievable and accessible. Records management shall be in accordance with the requirements of AS ISO 15489.1 *Information and documentation – Records Management Part 1: Concepts and principles*.

A drawing shall not be issued until all designated people have signed the drawing in the appropriate title block space. Only the names of the persons competent to do the prescribed work, and who have completed the assigned work shall be placed in the title block.

The following are the three types of allowable signatures:

- wet signature
- electronic signature
- digital signature

Each drawing shall be signed using one of the signature types and consistency shall be maintained in the signature type on all amendments of a drawing.

Wet signature

A wet signature is an original handwritten signature in ink on an original drawing. In this case, the design company should keep hard copies of the drawings for future audits. After all wet signatures are obtained the design company should type the name of each individual in the drawing title block, and print a PDF copy for the VPR submission.

Electronic signature

An electronic signature is the electronic equivalent of a handwritten signature, where a person adopts the contents of an electronic message through any electronic means. An electronic signature creates an audit history that cannot be repudiated, which includes verification of who signed the document and the date and time stamp of when it was signed. It can be done by checking a box on a computer, be typed or applied with a mouse or touchpad.

Digital signature

A digital signature is a kind of electronic signature that includes all of the elements mentioned in electronic signature. Additionally, it also includes a certificate of authority issued by a third party

© State of NSW through Transport for NSW 2021

that validates the identity of the signatory and the signature. The application of a digital signature adopts the PKI (public key infrastructure) encryption technology.

After digitally signing the PDF, the participant then opens the corresponding CAD file to edit title block Smart Tags.

The matching title block fields are edited and the names of the employees are added into their respective fields.

7.3. Smart tags

The design company shall use the tag function to fill the attributes in the title block of the CAD file. The drawing title block shall be attached to the drawing sheet as a cell or block containing smart tags, supporting the attribute exchange feature of ProjectWise. This process links the tags in MicroStation and attributes in AutoCAD drawings with ProjectWise as metadata.

MicroStation users are required to use the MicroStation EDIT TAGS command and pick the right bottom corner of the drawing sheet frame with the Constructions view attribute turned on. Refer to Figure 27, which illustrates this. The list of attached tag sets available for editing is shown in Figure 28.

To enter the title block information, choose the title block tag set.

Figure 29 displays the Edit Tags [TitleBlock] dialog box that is available in MicroStation.

To edit the AEO information, choose the AEO tag set. This tag set includes two invisible tags required by the Central Planroom.

Figure 30 displays the Edit Tags [AEO] dialog box that is available in MicroStation.

To enter the coordinate system and height datum, choose the TBNPW tag set.

Figure 31 displays the Edit Tags [TBNPW] dialog box that is available in MicroStation.

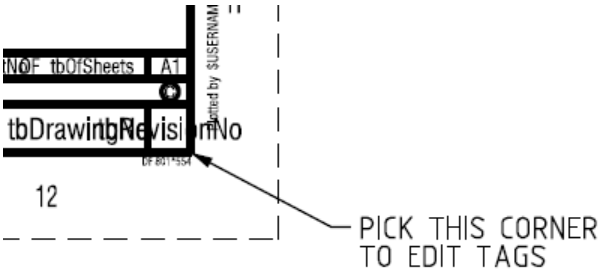


Figure 27 - Pick this corner to edit tag sets in MicroStation

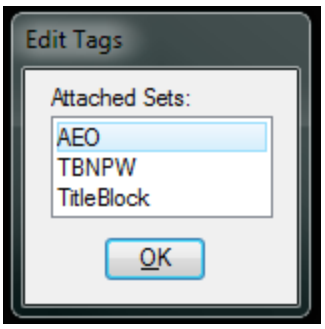


Figure 28 - Edit tags dialog box in MicroStation

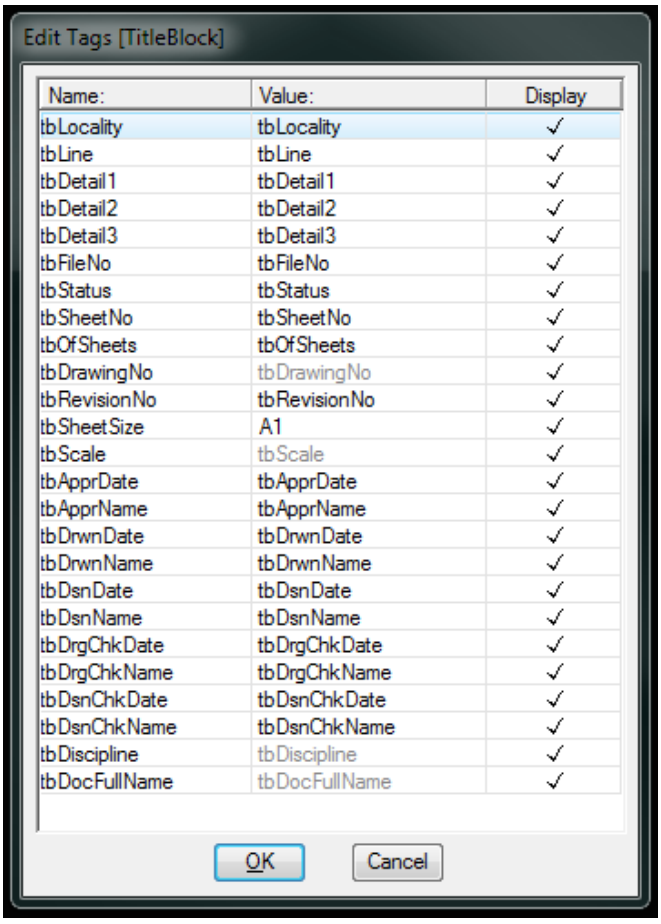


Figure 29 - Edit Tags [TitleBlock] dialog box in MicroStation

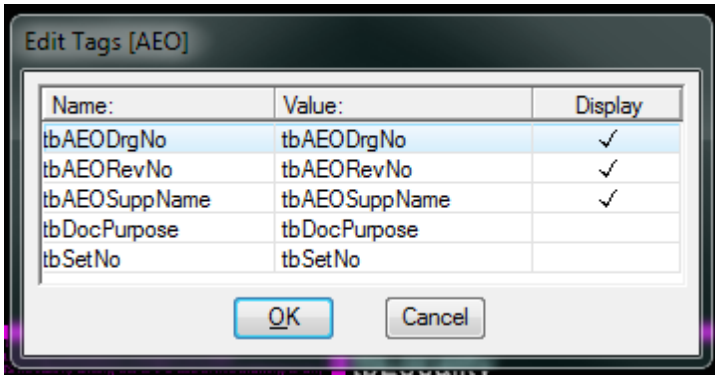


Figure 30 - Edit Tags [AEO] dialog box in MicroStation

© State of NSW through Transport for NSW 2021

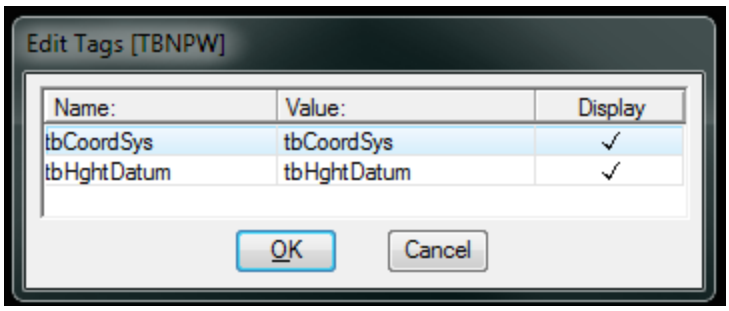


Figure 31 - Edit Tags [TBNPW] dialog box in MicroStation

AutoCAD users are required to use the AutoCAD EATTEDIT command to edit the attributes attached to the TitleBlock, AEO, and TBNPW blocks. Invoke the EATTEDIT command or double click any of the tags to display a dialog box as shown in Figure 32 to Figure 35.

Note: The names of these blocks and the names of the attributes they contain shall not be modified by the users. Modification will result in failure of the VPR data exchange function and rejection of the CAD files.

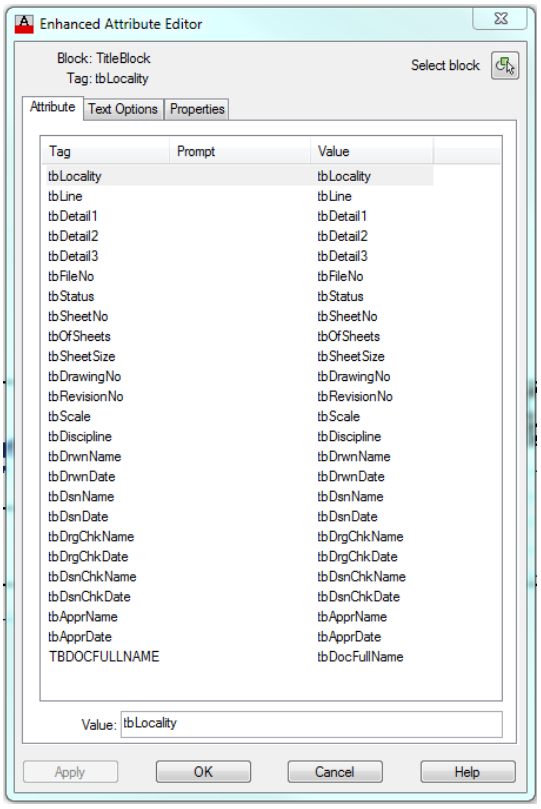


Figure 32 - Enhanced Attribute Editor (TitleBlock) dialog box in AutoCAD

© State of NSW through Transport for NSW 2021

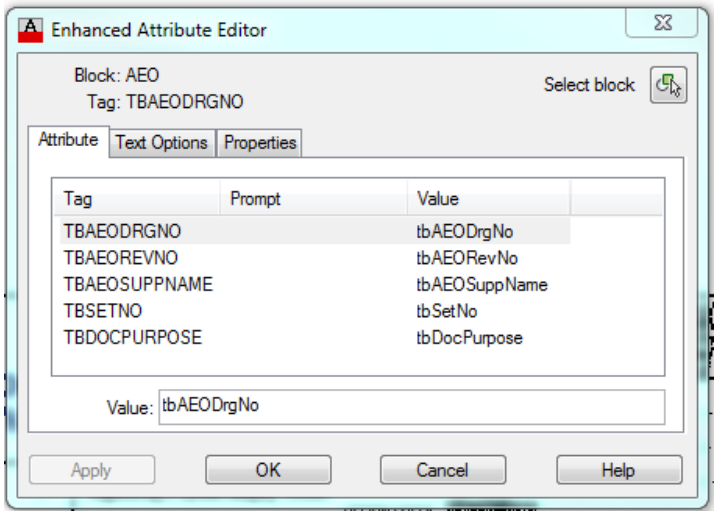


Figure 33 - Enhanced Attribute Editor (AEO) dialog box in AutoCAD

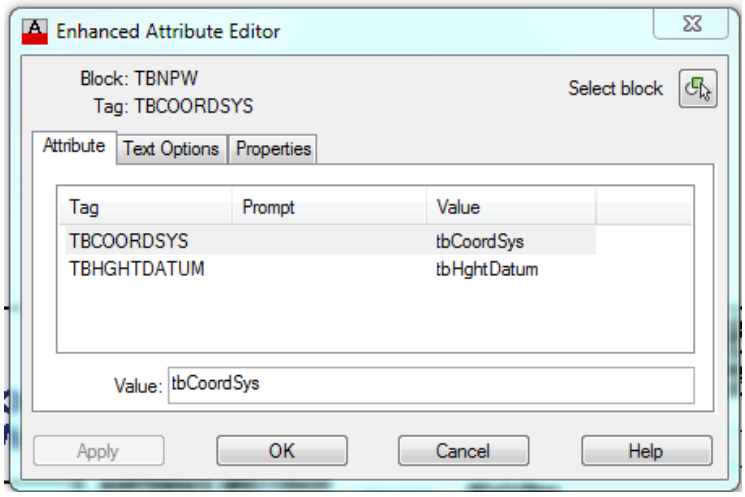


Figure 34 - Enhanced Attribute Editor (TBNPW) dialog box in AutoCAD

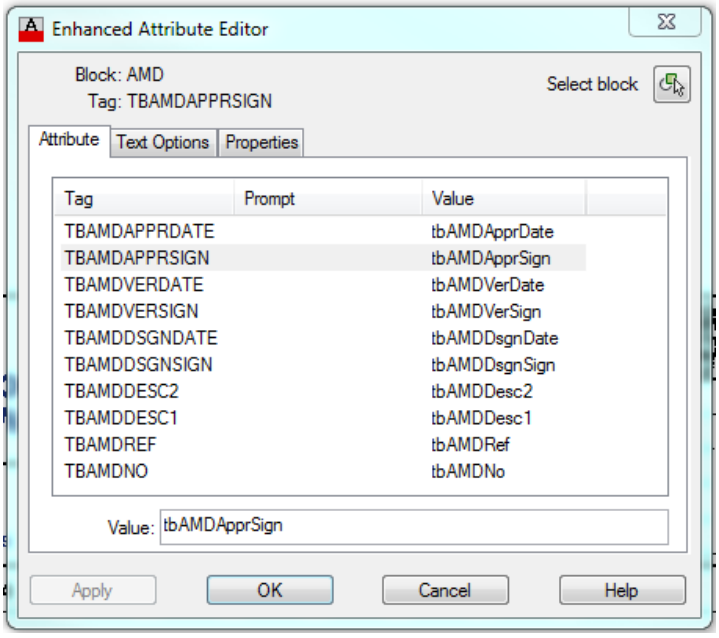


Figure 35 - Enhanced Attribute Editor (TBAMDAPPRSIGN) dialog box in AutoCAD

© State of NSW through Transport for NSW 2021

7.4. File naming convention

All engineering drawings produced for TfNSW shall be identified using the unique file naming convention as described in Section 7.4.1, Section 7.4.2 and Section 7.4.3.

The file naming convention for engineering drawings is broadly divided into the following three categories, based on the file type:

- drawing file
- drawing image file
- CAD supportive files

7.4.1. Drawing file

Drawing files are the CAD files with the title block attached and as described in Section 6.3.1.

An EDMS number shall be obtained for all drawings belonging to this group before work is commenced.

The following are the three components of a typical drawing file name:

- discipline code
- file identifier
- file extension

The text format for the file name shall be in upper case only. The underscore '_' shall be used to separate the file name components. A dash or minus '-' character should not be used.

Table 15 shows a typical example of a CAD drawing filename CV_1234567.dgn, EL_7654321.dwg.

Table 15 - File format

Discipline code	EDMS identifier	File extension
AA	_1234567	.ext

Discipline code

The first component of the drawing file name is defined by the two character alpha code which represents the relevant engineering discipline associated with the drawing file.

Table 16 provides the list of discipline codes and discipline names.

© State of NSW through Transport for NSW 2021

Table 16 - Drawing filename - discipline code

Discipline code	Discipline name
AR	Architecture and Services
CV	Civil and Structures
EL	Electrical
FL	Fleet (Rolling Stock)
SG	Signalling and Control
SS	Surveying
TD	Track

File identifier

The second component of the drawing file name is defined by the seven-digit EDMS identifier. Refer to Section 8.1 of this standard for details on EDMS identifiers.

File extension

The third component of the drawing file name is a three-character file extension. It shall be either dgn or dwg.

Typical examples for a drawing file name are as follows:

- AR_1234567.dgn
- CV_7654321.dwg

7.4.2. Drawing image file

The drawing image file naming convention applies to renditions of drawing files (with a title block) that are submitted to the VPR.

TfNSW requires that the drawing image files be named in accordance with the individual EDMS identifier, which is assigned to the respective drawing.

The typical drawing image file name is determined by the following five components:

- EDMS identifier

  The first component of the drawing image file name is recorded using a seven-digit EDMS identifier.

- amendment level

  The eighth and ninth characters are the representation of the EDMS amendment level of the drawing. When the amendment level of the drawing is only one character, then the eighth character shall be an underscore and the ninth character shall be the amendment level.

© State of NSW through Transport for NSW 2021

- numerical representation

  The tenth character is a numerical representation of the configuration version level of a drawing and shall always be zero (‘0’) for drawings.

- drawing orientation

  The eleventh character shall be a lower case ‘c’ for landscape-oriented images.

- file extension

  The file extension shall match the relevant file type and shall be in lower case; for example, pdf or tif.

Table 17 shows examples of image file names 1234567_A0c.pdf, 7654321_AE0c.pdf.

Table 17 - Drawing image file name

EDMS identifier	Amendment level	Numerical representation	Drawing orientation	File extension
1234567	_A	0	c	.pdf
7654321	AE	0	c	.pdf

7.4.3. CAD supportive files

All other engineering drawings including, but not limited to 3D models, reference drawings, sketches (without title block), reference models, extractions, assembly files, which are part of drawing submission package to TfNSW should follow the naming convention as program code unique number.

Examples of these files are as follows:

- NWRL_CV_MOD_123456.dgn
- NSRU_EL_DEM_123456.pdf

Program code

The first component of the file name is a unique program code that comprises up to four characters. When a new program is commenced, the design company can either request a code from AMB, via email to assetinformation@transport.nsw.gov.au, or create this code and get an approval from the AMB. For existing program codes, refer to
T MU AM 01007 TI (tab 5).

Unique number

The second component of the file name is a unique number assigned by the design company. The unique number shall consist of a mix of letters, numbers or underscore character (_). The design company is responsible to ensure that this number is unique within the program.

© State of NSW through Transport for NSW 2021

7.4.4. Design company CAD file name

In addition to the TfNSW CAD file name, the drawing title block has a provision for another drawing numbering system for the design company CAD file name, which is optional.

The design company can use their own document management system for creating these drawing numbers, in consultation with the TfNSW project team. At the time of submission of the drawings to the VPR, the filename shall be changed so that the drawing file name matches the drawing file name convention, as explained in Section 7.4.1. The design company shall reset all references, extraction and other cross-references across all drawings to make sure that when the drawing file is re-opened all references shall work as required and no missing link is found.

Note: Failure to do this, results in rework for TfNSW. All costs incurred in any rework will be charged to the design company.

7.5. As-built drawing presentation

As-built drawings are required to reflect the final work as executed and not the changes that have occurred during the design stages. The design company shall complete the following updates:

- Apply any required changes to the drawings to represent works as completed.
- Remove any markings showing previous drawing changes, such as clouds or red lines and ensure that the drawing reflects the final status.
- Change any use of future tense to current or neutral tense such as changing ‘proposed fence’ to ‘fence’.
- Ensure notes and cross-references are correct.
- Remove instructions and notes specifically related to the construction process.
- Where numbered notes are no longer relevant, replace the words with ‘REMOVED’ to leave other referenced numbers unchanged.

8. Drawing submission

The TfNSW long-term objectives are to produce all design information in the building information modelling (BIM) or digital engineering (DE) format. If a design company uses BIM or DE capabilities and creates 3D models as per the project agreement, then the design company shall submit the 3D models in a native format, along with other project deliverables.

Design companies, using 2D CAD technologies to develop design deliverables as per the project agreement, shall deliver all other documents except 3D models.

As a minimum, TfNSW requires lodgement of drawings at the final concept stage, approved for construction (AFC) stage and as-built stage of a project. At each of these three stages, both

© State of NSW through Transport for NSW 2021

drawing files and drawing image files shall be lodged into the VPR. Lodgement actions result in an approved drawing being stored in the designated area of the VPR.

The requirements and specifications for submitting the engineering drawings to the VPR are provided in Section 8.1, Section 8.2 and Section 8.3.

8.1. EDMS numbers

An EDMS number is a key item that is required when lodging a drawing to the VPR. The EDMS number shall be included in the drawing's title block prior to lodging the drawing to the VPR.

The EDMS number shall be obtained as early as possible during the development stage of any drawing file that needs to be lodged into the VPR.

All requests for an EDMS number and submissions to the Central Planroom shall be directed through appropriate persons from the design company and the TfNSW project interface person. This ensures that the integrity of the control and management of drawings and document transfers is maintained.

The EDMS number consists of two parts, VPR discipline and EDMS identifier.

The VPR discipline is based on the VPR designated settings.

Table 18 shows the VPR disciplines and their respective codes.

Table 18 - VPR discipline code

Virtual Planroom discipline	Code
Civil	CV
Electrical	EL
Signal	SG
Fleet	FL

Note: Based on the filename discipline code classification, architecture and services drawings, surveying drawings and track design drawings, should be registered under the civil (CV) code in the VPR.

The EDMS identifier is a unique seven-digit number assigned by the Central Planroom to each drawing file.

8.1.1. Requesting EDMS numbers

The design company shall request EDMS numbers via their TfNSW project interface person, who is usually the project manager.

© State of NSW through Transport for NSW 2021

Each request shall include the following information:

- discipline under which the documents should be registered; for example, Civil (CV), Electrical (EL) Signals (SG) or Rolling Stock (FL)
- number of document numbers to be issued for each discipline
- title of the project
- design company name and AEO authorisation number
- design company's contact person’s name
- design company's contact person’s business address
- design company's contact person’s phone number
- design company's contact person’s email address
- name of TfNSW project interface person

The TfNSW project interface person shall email the Central Planroom requesting the issue of the required EDMS numbers.

The Central Planroom staff shall generate the requested EDMS numbers and record the mandatory details as required in the VPR.

The Central Planroom staff shall then send an email to the TfNSW project interface person, with a carbon copy (CC) to the design company representative. This email lists the set of EDMS numbers registered in the VPR. These EDMS numbers act as placeholders for the eventual drawings and prevent another requestor from using the same EDMS numbers.

> *Note: An additional 10% of EDMS numbers should be requested for the project to account for unforeseen circumstances. Unused EDMS numbers should be returned to the Central Planroom at the completion of the project.*

If the original request for EDMS numbers is insufficient to cover the number of drawings, then the design company representative shall request additional EDMS numbers allocation through their TfNSW project interface person.

> *Note: These new EDMS numbers are unlikely to be in sequence or in continuation of the original batch of EDMS numbers obtained.*

The EDMS number for a drawing shall not be carried over from the concept design through to the detailed design stage. If a drawing is required to be further developed during the detailed design stage, then a new EDMS number shall be assigned.

© State of NSW through Transport for NSW 2021

8.2. Submission process flow

Figure 36 shows the process flow chart for the submission process.

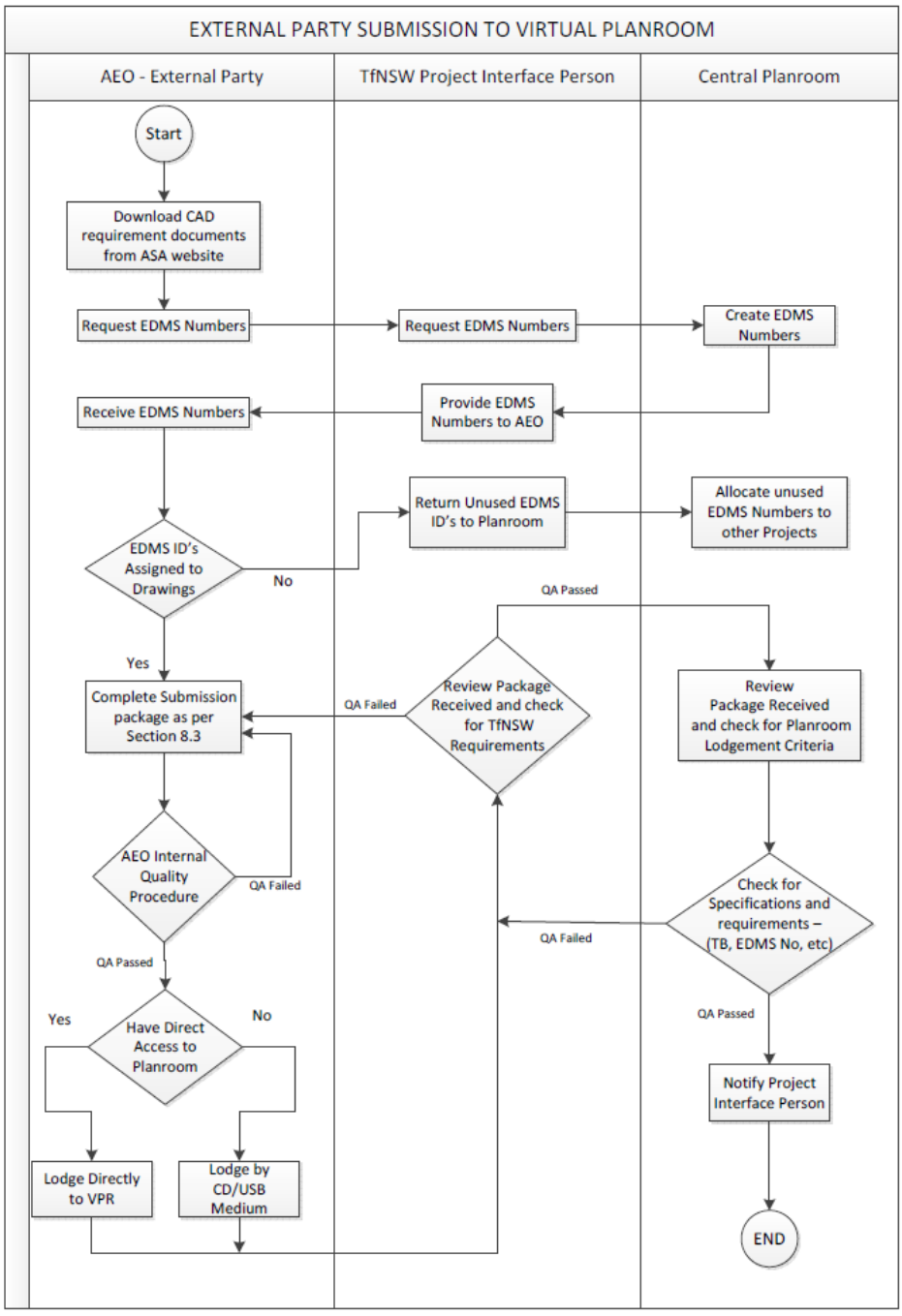


Figure 36 - Design company submission process to the VPR

© State of NSW through Transport for NSW 2021

8.3. Submission package

The submission package to TfNSW shall include the following:

- cover letter
- transmittal
- metadata spreadsheet
- drawing compliance checklist
- drawing files
- drawing image files
- documents
- any other required documentation such as design reports, manuals, specifications, list of Central Planroom drawings that require superseding, handover documentation, and so on

Submission package shall be submitted to the VPR at the following configuration management gates:

- Configuration management Gate 2
- Configuration management Gate 3 – for construction
- Configuration management Gate 5 – asset handover
- Operation and maintenance stage

Refer to T MU AM 04001 PL *TfNSW Configuration Management Plan* for more details.

8.3.1. Cover letter

Any submission made to Planroom shall accompany with a cover letter, which identifies the project, the package and the corresponding design stage. The cover letter should include information on which version of AMB or legacy RailCorp drawing requirements the package has been required to meet, in relation to the contracted requirements. It should also include any AMB concessions and nonconformances that affect the submission requirements of the package.

8.3.2. Metadata spreadsheet

The metadata spreadsheet is an excel spreadsheet (xlsx format only) that contains the drawing title block information for drawing image files submitted to the VPR. The requirements for filling metadata spreadsheet fields are similar to those of the title block of a drawing file. Refer to Table 10 and Table 12 for these requirements.

© State of NSW through Transport for NSW 2021

T MU MD 00006 F1 *Metadata Spreadsheet for Engineering Drawings* shall be used for providing title block information. This metadata spreadsheet is available for download from the AMB section of the TfNSW website.

The VPR team uses this metadata spreadsheet to apply the drawing title block attributes to the drawing image files in the VPR. The design company shall ensure that the description filled in the drawing title block and metadata spreadsheet is identical.

The spreadsheet contains 18 fields in total, of which 16 are mandatory and two are optional.

All of these fields shall be populated either by selecting the options from the drop-down menu, or by typing in the text. Refer to Appendix B for a full list of mandatory and optional fields.

The optional metadata fields are not essential for the VPR submissions; however, these fields should be populated if the data is readily available.

All information entered into the metadata spreadsheet shall conform to the format specified in Appendix B.

The file naming convention for the metadata spreadsheet shall be as follows:

Project code_site_document purpose_meta.xlsx

NSRU_DP03_AFC_META.xlsx is an example of North Strathfield Rail Underpass approved for construction package.

8.3.3. Transmittal

The transmittal should contain a list of all CAD supportive files that are submitted to the VPR, along with the drawing files and the drawing image files. As a minimum requirement, the transmittal shall include the following:

- CAD supportive file name
- amendment level (if any)
- description of CAD supportive file

8.3.4. Drawing hard copies

Submittal of drawings in hard copy is no longer supported in the VPR. All drawings shall be supplied in digital format.

8.3.5. Drawing files

The drawing files shall be submitted in either MicroStation V8i format or AutoCAD 2010 format (even if they have been created using alternative software). In MicroStation files, design history should be initiated. Drawings that are created or amended by hand or using non-CAD software such as Microsoft Paint are not acceptable.

© State of NSW through Transport for NSW 2021

The drawings shall be provided in an unbound format with the electronic drawing file named with the TfNSW drawing name as explained in Section 7.4.1. All model files used for creating the drawing file shall be submitted with their pre-existing names and subfolder locations (as defined by the TfNSW folder structure) so that they are automatically linked to the drawing file when they are opened.

All legacy or unused reference file links from drawing files shall be removed before submission to the VPR. The drawing shall also be purged to remove all unused levels or layers, text styles, and so on.

8.3.6. Drawing image files

All drawing image files shall be created in portable document format (PDF). In case where it is not feasible to create a PDF copy of a drawing, the image file in a lossless compression format (tif), is acceptable as an alternative.

- Each EDMS number shall have one drawing image file.
- The drawing image file shall be correctly oriented so that the drawing can be viewed and read on a computer screen in the correct orientation.
- The maximum size for a black and white drawing image file shall be less than 10 megabytes (MB) and less than 30 MB for colour files.
- No password should be applied to the drawing image files.
- The layers in the PDF version of the drawing image shall be flattened and the fonts embedded.
- The drawing image files shall be created in the same size as that specified in the drawing title block; for example, A1 title block drawings shall be created to A1 size.
- All black and white drawing image files shall be created at a minimum resolution of 300 dpi.
- Scanned colour drawing image files can be created at a lower resolution to reduce the file size to a manageable level, so that the data is not lost and the image quality is retained.

8.3.7. Documents

If a drawing is created for a manufacturer supplied product, for which TfNSW has no control or rights on the design content, but requires the drawing information for maintenance and operation purpose only, then the drawing shall be treated as a document.

These documents shall be stored in the Planroom with an EDMS number printed on them and shall be stamped ‘FOR REFERENCE PURPOSE’. Any update to these documents shall be done by the hybrid drawing methodology and a new EDMS number assigned to hybrid drawing.

© State of NSW through Transport for NSW 2021

8.3.8. Models native format

All models that are used in preparing design along with related files such as extractions, database, and assembly should be submitted in the native format in which they are created. All the references and other cross-references between these models should be in accordance with TfNSW folder requirements as stated in Section 8.6.

8.3.9. Composite models

A composite model should be submitted in either nwd or i-dgn format showing the extent of design. The files should not be password protected or have an expiry date set. The maximum size of these files should be less than 512 MB. If the project composite file is larger than this size, then the composite models should be divided per site.

8.4. Superseded drawings

All drawings that are either replaced by a higher amendment level of the same drawing or explicitly replaced by a separate drawing are known as superseded drawings.

A drawing can be superseded at any stage of the design development and an appropriate approach shall be adopted in superseding the drawings.

The following are some of the reasons for superseding a drawing:

- a design approach which is discarded
- works such as ‘cut and fill’, which are early stage works
- lay down areas, which are for staging of works
- temporary works, which are built and then removed
- demolition works or tree removal
- changes to an existing Central Planroom drawing as a result of a new project
- changes to an existing Central Planroom drawing that interfaces with other areas that are being changed by the new project

8.4.1. Approach to supersede a drawing

Drawings shall be submitted to the Central Planroom during the three stages of design development as explained in Section 8.3.

© State of NSW through Transport for NSW 2021

Based on the submission stages, one of the following approaches should be adopted for superseding a drawing:

- prior to first submission to Central Planroom
- prior to as-built submission to Central Planroom
- existing Central Planroom drawings

Prior to first submission to Central Planroom

If a drawing or set of drawings are not required prior to first submission to Central Planroom, then the drawing or drawings shall be removed from the drawing set, along with any associated references; for example, from the drawing cover sheet, section markers and reference list. The EDMS number shall not be applied to these drawings.

Prior to as-built submission to Central Planroom

If a drawing or set of drawings are not applicable after the approved for construction stage, or during the as-built update of the drawing, then the following approach shall be undertaken:

a. Create a new amendment level of the drawing.

b. Leave the drawing content in place, but add a large diagonal stamp across the centre containing the word ‘REMOVED’.

c. Indicate the reason for removing the drawing in the amendment history; for example, 'Removed - temporary works completed'.

d. Leave the drawing reference in the list, but strikethrough the text where a separate drawing contains a drawing list such as a cover sheet.

Existing Central Planroom drawings

During the course of a project, new drawings (with new EDMS numbers) can supersede existing drawings that were already registered in the Central Planroom. In this case, the following approach should be adopted:

a. Add a note to the new drawing. This note should appear immediately above the title block, 5 mm high in upper case text with the following words:

   'THIS DRAWING SUPERSEDES XX xxxxxxx’.

b. Create a new amendment level of the existing drawing.

© State of NSW through Transport for NSW 2021

c. Leave the drawing content on the existing drawing in place, and add a note to the drawing. This note shall appear above the title block, 5 mm high in upper case text with the following words:

   'THIS DRAWING IS SUPERSEDED by XX xxxxxxx'.

   In situations where an existing drawing is not replaced by a new drawing, then add the note 'THIS DRAWING IS SUPERSEDED'.

d. In the amendment history of the existing drawing, indicate the reason for superseding the drawing.

e. In the case of a part update of an existing drawing, an amendment cloud shall be drawn on the superseded part of the existing drawing, and an appropriate note should be added to both the existing and new drawings.

The design company shall submit a register of superseded drawings, listing both the new and existing (superseded) drawing titles, with the EDMS numbers along with other submissions to the Central Planroom.

8.5. Lodgement to the VPR

The design company can submit the drawing files, CAD files, related reference files and data to the Central Planroom, either through the online VPR application called ProjectWise or through compact disk (CD), DVD, or USB storage medium via a TfNSW project interface person. However, the physical media should only be used if the first option is not available.

8.5.1. Lodge directly online into the Virtual Planroom system

The design company can lodge a submission package to the Virtual Planroom using the ProjectWise application or via the VPR Web Viewer. Upon commencement of a project, the design company should contact the Planroom via their TfNSW project interface person to set up the folder structure in Virtual Planroom and request EDMS numbers. The TfNSW project interface person shall advise the design company of the designated area in the Virtual Planroom where drawings can be lodged and the notification process.

Note: Access to the Virtual Planroom requires prior approval and an account and password established. Email planroom@transport.nsw.gov.au for remote access to the Planroom.

When the design company has uploaded the submission package into the Virtual Planroom, the nominated TfNSW project interface person shall contact the Planroom by sending an email to planroom@transport.nsw.gov.au to process the submission package.

© State of NSW through Transport for NSW 2021

8.5.2. Lodge via a TfNSW project interface person

The alternative method for lodging a submission package into the Virtual Planroom is by delivering the requisite files on a compact disc (CD), DVD, or USB storage medium to the TfNSW project interface person. The TfNSW project interface person shall check the submission package in accordance with CAD requirements. The TfNSW project interface person shall upload the submission package to the designated area in the Virtual Planroom and contact the Virtual Planroom via email to planroom@transport.nsw.gov.au to process the package. The design company shall submit all relevant deliverables in accordance with Section 8.3 and in the folder structure as specified in Section 8.6.

8.6. Folder structure for drawing submission package

Figure 37 shows the folder structure for both online and offline submissions.

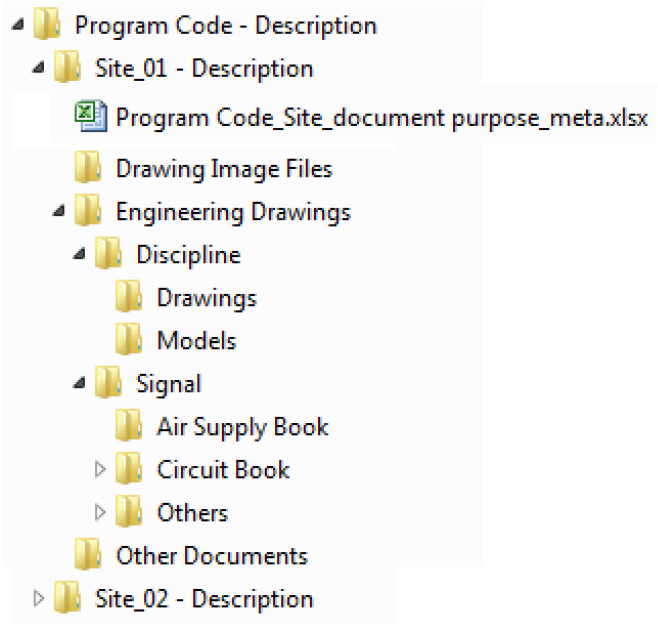


Figure 37 - Folder structure for drawing package

The folder structure should comply with the following:

- The folder structure should comprise a project folder and site-specific folders within the project folder.
- Each site folder shall contain a subfolder for drawing image files, engineering drawings (CAD) and other documents. The metadata spreadsheet shall be at the root level in the site folder.
- The engineering drawing (CAD) folder shall contain subfolders for each discipline as given in Table 16 and each discipline folder shall contain two subfolders, one for the drawing files and another for the models.

© State of NSW through Transport for NSW 2021

- CAD drawing files folder shall have all drawing files with the title block information populated in accordance with Section 7.4.1.
- The models folder shall contain all CAD supportive files such as 3D or 2D models, references, extractions, assembly files and raster images, as described in Section 7.4.3.
- The drawing image folder shall contain copies of all drawing image renditions of design files as described in Section 7.4.2.
- All other project deliverables shall be copied to the 'Other documents' folder.

A sample copy of the folder template is available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R8 *Project Code Description CAD Resources*.

For offline submissions, the entire set of CAD files (including drawings and model files) shall be provided in a folder, which is then compressed into a zip file and presented as one file. The recipient shall be able to open and view each complete drawing when the file is unzipped (including all external links).

9. Track CAD requirements

The track CAD requirements are applicable to track drawings produced for TfNSW rail projects. These requirements shall be read in conjunction with the general requirements provided in Section 6 of this standard.

Where conflict exists between the two sections, then the track CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

9.1. Title block for track drawings

Track drawings shall use the drawing title block as explained in Section 7.1 of this standard. Refer to Figure 38 for an example of a completed drawing details box for track drawings.

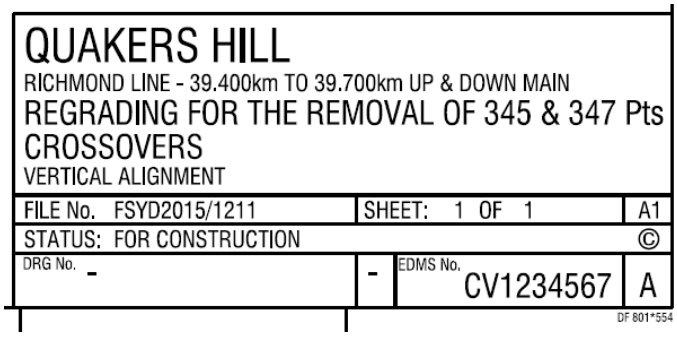


Figure 38 - Typical filled in drawing details box for track drawings

9.2. Seed files for track drawings

Refer to Section 6.10 of this standard for track drawings' seed files.

9.3. Cell libraries for track drawings

The following cell libraries should be used for creating track drawings:

- TD_Trackwork.cel
- TD_Alignment_V8.cel
- TD_MTS_V8.cel
- TP_Features.cel

A complete list of cells can be obtained by downloading these resource files and opening the cell libraries. These files are available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R2 *Track CAD Resources*.

9.4. Level symbology for track drawings

Different drawing features should be drawn on different layers as explained in Section 6.9 of this standard.

9.5. Types of track drawings

Based on the design content, track drawings can be classified into the following drawing types:

- horizontal alignments or setting out details
- vertical alignments
- turnout detail - timbering and plating
- detail surveys
- cross-sections
- miscellaneous drawings and diagrams

These drawing types are explained in Section 9.5.1 through to Section 9.5.6.

9.5.1. Horizontal alignments or setting out details

Horizontal alignment drawings depict the coordinated track alignment; they are often referred to as setting out drawings. They shall be prepared to a prescribed degree of accuracy, and show the detail and information necessary to enable field marking and setting out by surveyors, and to provide records for the full asset life cycle.

© State of NSW through Transport for NSW 2021

The horizontal alignment data shown on a drawing should include coordinated frame points, curve details, transition details, straight details, track centres, turnout details, design speed, applied superelevation and superelevation deficiency, kilometrage values, kilometrage adjustments, control marks, horizontal and vertical coordinate origins, and the coordinate system.

9.5.2. Vertical alignments

Vertical alignment drawings or long sections depict the track grades for track alignment. These drawings, along with horizontal alignment drawings, provide the information necessary to enable field marking and setting out by surveyors, and provide records for the full asset life cycle.

The vertical alignment data should include kilometrage locations, diagrammatic representation of the horizontal alignment, existing rail levels, track lifts, design rail levels, grade values, vertical curve details, grade intersection levels, and existing and proposed design profiles.

All features that affect design grades shall be included in the long section, such as platforms, underbridges, overbridges, underpasses, culverts and turnouts.

9.5.3. Turnout detail

The turnout detail drawings enable the manufacture and installation of the turnouts and turnout components to acceptable standards. These drawings depict and detail track components such as turnout type, turnout parameters and layout configuration.

9.5.4. Detail surveys

The detail survey models depict the existing and natural topographical features. This data can be transformed into a digital terrain model (DTM) for locations where engineering design proposals are planned or considered. The detail survey model also forms the base detail that is necessary for various design procedures, and can be used by other design disciplines. A drawing need not be the product of this process.

9.5.5. Cross-sections

The cross-section models depict a series of cross-sections that are generally perpendicular to the track and are used in the design process. They can be used for determining earthwork formation design, earthwork quantities, and civil works.

The cross-section data shall include levels, offsets from existing or design alignment centreline, labels and features. The kilometrage location for each cross-section should be indicated, and each cross-section viewed and compiled in the direction of increasing metrage, with details specific to the project.

© State of NSW through Transport for NSW 2021

9.5.6. Miscellaneous drawings and diagrams

The miscellaneous drawings can include proposals, layouts, kinematic or clearance investigations, tunnel profiles and diagrams for reports.

9.6. Track drawing requirements

Section 9.6.1 through to Section 9.6.4 provides the minimum requirements for each type of track drawing.

9.6.1. Horizontal alignment drawings

The horizontal alignment drawings are used to document the horizontal track alignment, which can also be used by other engineering disciplines. The horizontal alignment drawings should preferably be drawn on a standard A1 sheet, but can be acceptable as a roll plan to A1 sheet width.

The content orientation shall be Sydney on the left, with rail tracks as horizontal as possible. The content should be represented on the drawing at a scale that is fit for purpose. A North point and grid related to the azimuth of the survey should be provided.

Horizontal alignment drawing

Table 19 provides the minimum drawing content requirements that should be displayed on a horizontal alignment drawing. It also provides the reference to respective figures in a sample horizontal alignment drawing.

Figure 39 shows a sample horizontal alignment drawing and Figure 40 to Figure 50 show elements of the drawing that depict these requirements.

Table 19 - Horizontal alignment drawing content

Requirement	Comment	Figure reference
Detail survey	Detail survey information should be shown in the background in greyscale. Surveyed features should have annotations for all relevant or significant items.	Figure 39
Tracks	Preferably not more than two tracks should be documented on one drawing sheet. Tracks should be documented in pairs, preferably. Track subject to design should be shaded and shown in the legend.	Figure 39 A1-1 Figure 40
Existing alignment	Existing alignment should be depicted graphically with associated labelling.	Figure 39 A1-2 Figure 41

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Horizontal alignment schedule	Horizontal alignment schedule should include point description, kilometrage, centreline name (based on line name), Easting and Northing coordinates. UP and DOWN track frame points should be included in separate schedules.	Figure 39 A1-3 Figure 42
Design centreline	Each drawing sheet should be self-contained. Reference to other sheets to source relevant data need not be made.	Figure 39
Curve details	Curve details should include track name, radius and direction, arc length, design speed, applied superelevation, superelevation deficiency, centre point Easting and Northing coordinates.	Figure 39 A1-5 Figure 44
Transition details	Transition details should include track name, radius, length, Xc, m and ramp rate. Annotate irregular ramps by dimension, with start and finish kilometrage and superelevation values.	Figure 39 A1-6 Figure 45
Straight details	Straights should have bearing and distance information annotated.	Figure 39 A1-4 Figure 43
Design track centres	Where track centres are constant, annotate design value. Where track centres are variable, annotate minimum design value.	Figure 39 A1-11 Figure 50
Turnouts	Basic turnout details should be annotated.	Figure 39
Design speed	Design speeds should be included in the notes.	Figure 39
Kilometrage values	Kilometrage values should be placed perpendicular to the track. Align the drawing in such a way that the kilometrage values can be read in the direction of increasing kilometrage, from top to bottom when the drawing is rotated 90° clockwise.	Figure 39 A1-7 Figure 46
Kilometrage adjustments	Kilometrage adjustments should be placed perpendicular to the track.	Figure 39 A1-8 Figure 47
Survey control marks	Survey control marks should be shown in schedule form. The schedule should include the mark identification number if any, type of mark (State Survey Mark or Brass Triangle) and location. Mark location should also be shown on the drawing, using the appropriate symbol, and labelled from left to right.	Figure 39 A1-10 Figure 49 A1-9 Figure 48
Coordinate system	Horizontal coordinate system (such as MGA, ISG, plane rectangular) and vertical datum origin should be shown in the notes.	Figure 39
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 39

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Multiple sheets	Design information in the area of the drawing sheet beyond the join lines should be deleted.	Figure 39
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 39
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 39
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 39
North point & grid	North point and grid related to the azimuth of the survey should be annotated, with the grid shown over the whole sheet where appropriate.	Figure 39
Railway boundaries / fence line	Railway boundaries or fence line should be indicated as required.	Figure 39

© State of NSW through Transport for NSW 2021

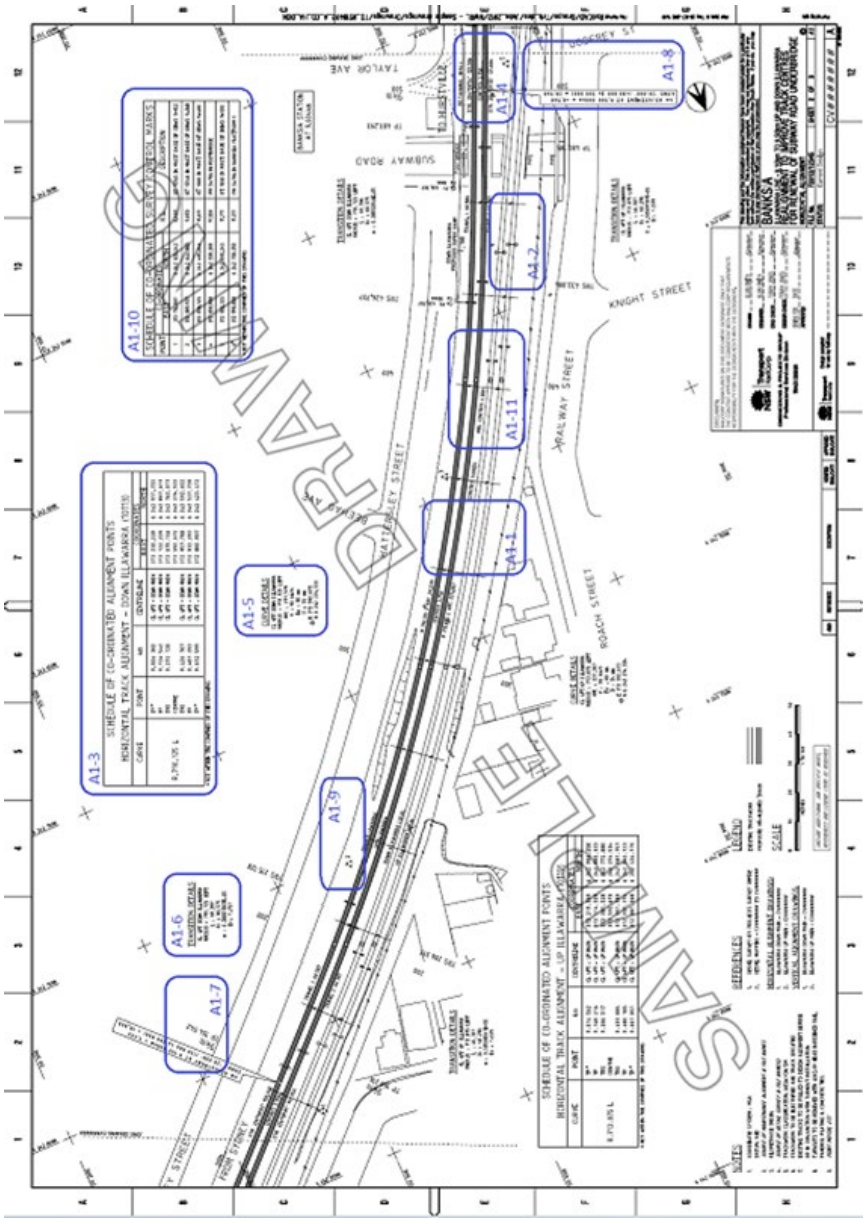


Figure 39 - Horizontal alignment sample drawing

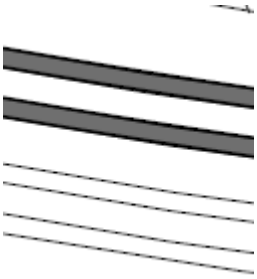


Figure 40 - Tracks

© State of NSW through Transport for NSW 2021

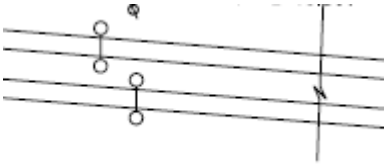


Figure 41 - Existing alignment

SCHEDULE OF CO-ORDINATED ALIGNMENT POINTS
HORIZONTAL TRACK ALIGNMENT - DOWN ILLAWARRA (10113)

CURVE	POINT	km	CENTRELINE	COORDINATES	
				EAST	NORTH
R.710.125 L	TP*	9.004 300	CL 4FT - DOWN MAIN	313 230.539	6 242 911.725
	TP	9.154 542	CL 4FT - DOWN MAIN	313 122.220	6 242 807.611
	TRS	9.215 128	CL 4FT - DOWN MAIN	313 079.146	6 242 765.011
	CENTRE			313 592.672	6 242 274.533
	TRS	9.426 707	CL 4FT - DOWN MAIN	312 957.788	6 242 592.652
	TP	9.487 293	CL 4FT - DOWN MAIN	312 932.203	6 242 537.739
	TP*	9.612 599	CL 4FT - DOWN MAIN	312 880.907	6 242 423.413

Figure 42 - Horizontal alignment schedule

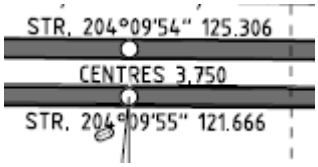


Figure 43 - Straight details

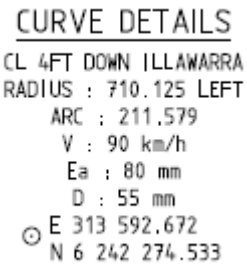


Figure 44 - Curve details

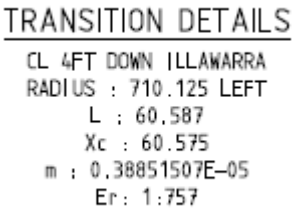


Figure 45 - Transition details

© State of NSW through Transport for NSW 2021

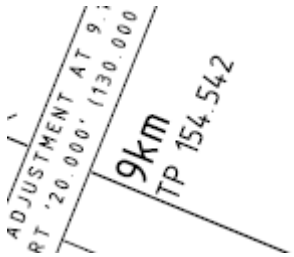


Figure 46 - Kilometrage value

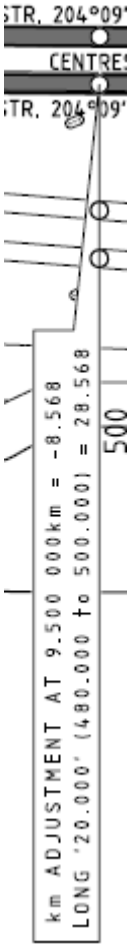


Figure 47 - Kilometrage adjustments

Figure 48 - Survey control marks

© State of NSW through Transport for NSW 2021

SCHEDULE OF CO-ORDINATED SURVEY CONTROL MARKS

POINT	CO-ORDINATES EAST	CO-ORDINATES NORTH	R.L.	DESCRIPTION
1	313 116.907	6 242 826.542	8.497	BT 15145 IN MAST BASE OF OHWS 9+152
2	312 989.937	6 242 644.053	9.693	BT 15146 IN MAST BASE OF OHWS 9+368
3	312 878.325	6 242 405.244	11.611	BT 1600 IN MAST BASE OF OHWS 9+400
4	312 950.000	6 242 550.200	11.550	PM 54796 IN FOOTBRIDGE
5	312 900.325	6 242 590.245	11.711	BT 1650 IN MAST BASE OF OHWS 9+500
6*	312 990.000	6 242 700.350	11.311	PM 54796 IN BANKSIA PLATFORM 1

Figure 49 - Survey control marks - schedule

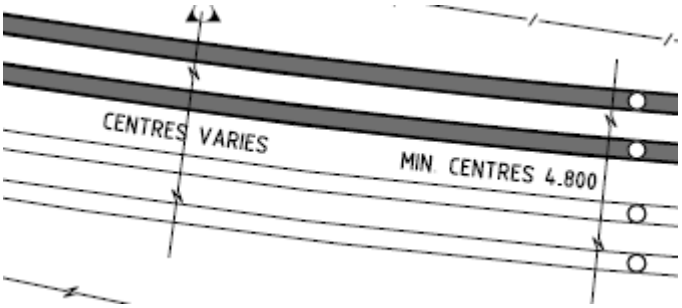


Figure 50 - Design track centres

Track setting out details

Table 20 provides the minimum drawing content requirements that should be displayed on the track setting out drawings. It also provides the reference to respective figures in a track setting out sample drawing.

Figure 51 shows a sample track setting out drawing and Figure 52 to Figure 64 show elements of the drawing that depicts these requirements.

Table 20 - Track setting out details drawing content

Requirement	Comment	Figure reference
Detail survey	Detail survey information should be shown in background in greyscale. Surveyed features should have annotations for all relevant or significant items.	Figure 51
Tracks	Track subject to design should be shaded and shown in the legend.	Figure 51
Horizontal alignment schedule	Horizontal alignment schedule should include point description, kilometrage, centreline name (based on line name), Easting and Northing coordinates. UP and DOWN track frame points should be included in separate schedules.	Figure 51 A2-1 Figure 52

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Design centreline	Each drawing sheet should be self-contained. Reference to other sheets to source relevant data need not be made.	Figure 51
Curve details	Curve details should include track name, radius and direction, arc length, design speed, applied superelevation, superelevation deficiency, centre point Easting and Northing coordinates.	Figure 51 A2-2 Figure 53
Transition details	Transition details should include track name, radius, length, Xc, m and ramp rate. Annotate irregular ramps by dimension, with start and finish km and superelevation values.	Figure 51 A2-3 Figure 54
Straight details	Straights should have bearing and distance information annotated.	Figure 51 A2-4 Figure 55
Design track centres	Where track centres are constant, annotate design value. Where track centres are variable, annotate minimum design value.	Figure 51 A2-5 Figure 56
Turnouts	Turnout details should be comprehensively documented, as required for setting out.	Figure 51
Turnout details	Turnout details should be annotated in schedule form. Tangential and conventional turnout details should be annotated as separate schedules.	Figure 51 A2-6 Figure 57
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction return requirements should be indicated in the notes.	Figure 51 A2-7 Figure 58 A2-10 Figure 60
Clearance points	Clearance point location should be indicated with an asterisk symbol (*) and an arrow in kilometrage label.	Figure 51 A2-8 Figure 59
Design speed	Design speeds should be included in the notes.	NA
Kilometrage values	Kilometrage values should be placed perpendicular to the track. Align the drawing in such a way that the kilometrage values can be read in the direction of increasing kilometrage, from top to bottom when the drawing is rotated 90° clockwise.	Figure 51 A2-9
Kilometrage adjustments	Kilometrage adjustments should be placed perpendicular to the track.	Figure 51

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Survey control marks	Survey control marks should be shown in schedule form. The schedule should include the mark identification number if any, type of mark (State Survey Mark or Brass Triangle) and location. Mark location should also be shown on the drawing, using the appropriate symbol, and labelled from left to right.	Figure 51 A2-11 Figure 62 A2-12 Figure 61
Coordinate system	Horizontal coordinate system (such as MGA, ISG, plane rectangular) and vertical datum origin should be shown in the notes.	Figure 51
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 51
Multiple sheets	Design information in the area of the drawing sheet beyond the join lines should be deleted.	Figure 51
Track pulls	Track pulls that are required should be shown to reposition existing track location onto design alignment.	Figure 51 A2-13 Figure 63
Track shifts	Shifts required to reposition the existing track location onto a new or revised track alignment.	Figure 51 A2-14 Figure 64
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 51
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 51
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 51
North point & grid	North point and grid related to the azimuth of the survey should be annotated, with the grid shown over the whole sheet where appropriate.	Figure 51
Railway boundaries / fence line	Railway boundaries or fence line should be indicated as required.	Figure 51

© State of NSW through Transport for NSW 2021

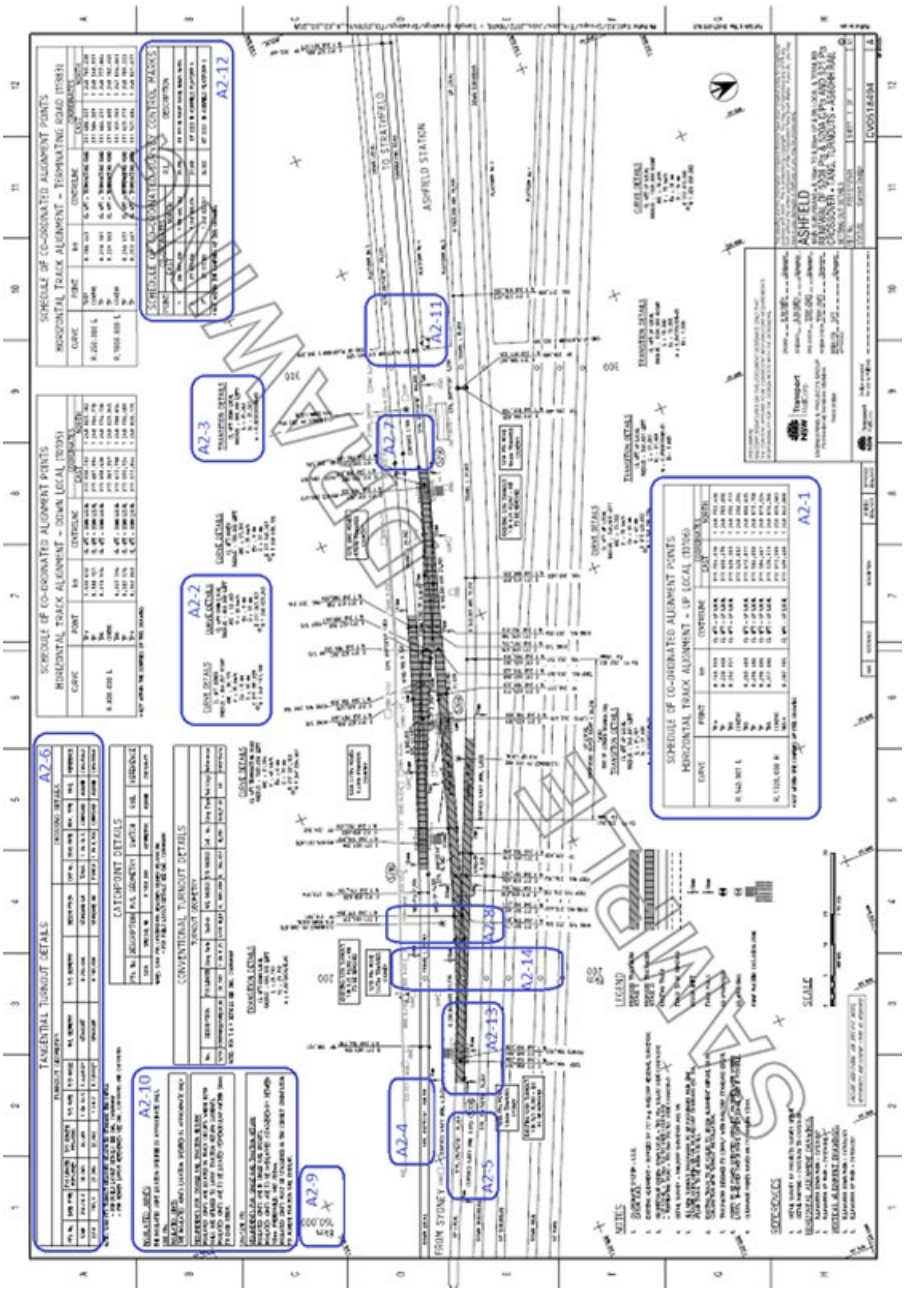


Figure 51 - Track setting out sample drawing

SCHEDULE OF CO-ORDINATED ALIGNMENT POINTS
HORIZONTAL TRACK ALIGNMENT – UP LOCAL (10106)

CURVE	POINT	km	CENTRELINE	COORDINATES	
				EAST	NORTH
	TP *	8.145 193	CL 4FT – UP LOCAL	311 724.010	1 248 752.436
	TP	8.220 450	CL 4FT – UP LOCAL	311 655.279	1 248 783.090
	TRS	8.252 151	CL 4FT – UP LOCAL	311 626.203	1 248 795.717
R. 540.001 L	CENTRE			311 420.832	1 248 296.294
	TRS	8.265 483	CL 4FT – UP LOCAL	311 613.811	1 248 800.635
	TP	8.296 486	CL 4FT – UP LOCAL	311 584.650	1 248 811.158
	TP	8.296 686	CL 4FT – UP LOCAL	311 584.461	1 248 811.224
	TRS	8.311 686	CL 4FT – UP LOCAL	311 570.313	1 248 816.206
R. 1320.000 R	CENTRE			312 013.500	1 250 059.583
	TRS *	8.387 785	CL 4FT – UP LOCAL	311 499.408	1 248 843.808

Figure 52 - Horizontal alignment schedule

© State of NSW through Transport for NSW 2021

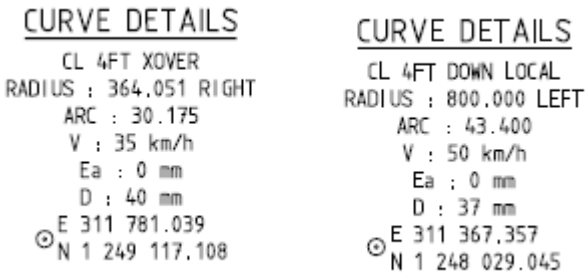


Figure 53 - Curve details

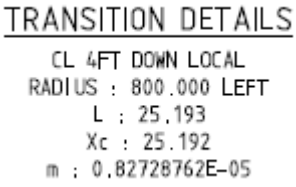


Figure 54 - Transition details

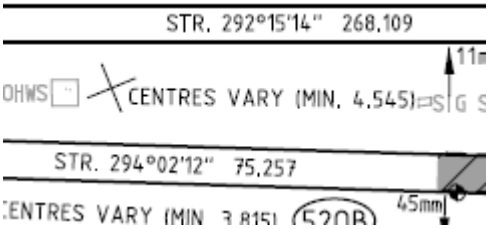


Figure 55 - Straight details

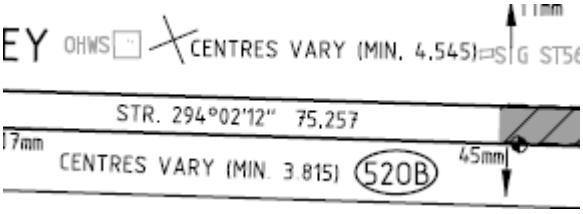


Figure 56 - Design track centres

TANGENTIAL TURNOUT DETAILS													
TURNOUT GEOMETRY									CROSSING DETAILS				
Pts No.	BASE TYPE	T/O LENGTH TOTP-TOEP	T/O LENGTH PTS-XING	T/O RATE	T/O ANGLE	M/L GEOMETRY	T/O GEOMETRY	DESCRIPTION	CAT No.	XING RATE	MIN. TYPE	RAIL	REFERENCE
520B	250:10.5	30.309	26.489	1 IN 10.5	5.440332°	STRAIGHT	R 250.000	STANDARD LH	T250S	1 IN 10.5	COMPOUND	AS60HH	CV0479043
521A	190:7	27.006	22.862	1 IN 7	8.130102°	STRAIGHT	R 190.000	STANDARD RH	T190CR	1 IN 8.106	COMPOUND	AS60HH	CV0479040

Figure 57 - Turnout details

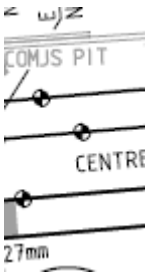


Figure 58 - Insulated joints

© State of NSW through Transport for NSW 2021

Figure 59 - Clearance points

INSULATED JOINTS

THE INSULATED JOINT LOCATION SPECIFIED IS APPROXIMATE ONLY.

520B Pts

INSULATED JOINTS
THE INSULATED JOINTS LOCATION SPECIFIED IS APPROXIMATE ONLY

REQUIREMENTS FOR 'DOUBLE RAIL TRACTION RETURN'
INSULATED JOINTS ARE LOCATED IN TRACK CIRCUITS WHERE BOTH RAILS ARE UTILISED TO CARRY TRACTION RETURN CURRENTS.
INSULATED JOINTS ARE TO BE LOCATED PERPENDICULAR (WITHIN 50mm) TO EACH OTHER.

521A/521B Pts

REQUIREMENTS FOR 'SINGLE RAIL TRACTION RETURN'
INSULATED JOINTS ARE IN SINGLE RAIL CIRCUITS.
INSULATED JOINTS ARE TO BE OVERLAPPED (STAGGERED) BY BETWEEN 100mm (PREFERABLE), AND 2000mm.
INSULATED JOINTS MUST BE STAGGERED IN THE CORRECT ORIENTATION TO ACHIEVE TRACTION RAIL OVERLAP.

Figure 60 - Insulated joints notes

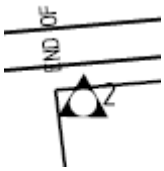


Figure 61 - Survey control marks

SCHEDULE OF CO-ORDINATED SURVEY CONTROL MARKS

POINT	CO-ORDINATES EAST	CO-ORDINATES NORTH	R.L.	DESCRIPTION
1	286 997.206	1 188 460.362	29.290	BT 1111 IN MAST BASE OHWS 8+195
2	311 603.956	1 248 800.014	27.508	BT 2222 IN ASHFIELD PLATORM 4
3*	311 517.185	1 248 822.141	26.502	BT 3333 IN ASHFIELD PLATFORM 3

Figure 62 - Survey control schedule

© State of NSW through Transport for NSW 2021

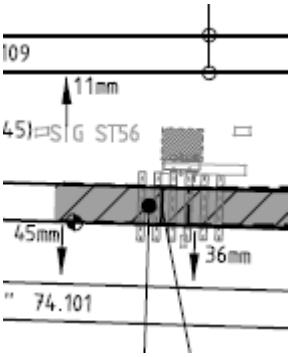


Figure 63 - Track pulls

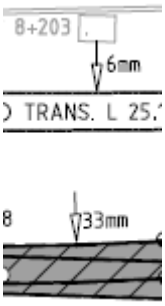


Figure 64 - Track shifts

9.6.2. Vertical alignment drawings

Vertical alignment drawings (long sections) are used to document vertical track alignment.

Vertical alignment drawings should preferably be drawn on a standard A1 sheet, but can be acceptable as a roll plan to A1 sheet width.

> *Note: All numerical values expressed in metres shall be annotated to three decimal places, unless otherwise indicated. Grading information shall also be shown to three decimal places.*

Vertical alignment drawing content

Table 21 provides the minimum drawing content requirements that should be displayed on the vertical alignment drawings. It also provides the reference to respective figures in a sample vertical alignment drawing.

Figure 65 shows a sample vertical alignment drawing and Figure 66 to Figure 73 show elements of the drawing that depicts these requirements.

© State of NSW through Transport for NSW 2021

Table 21- Vertical alignment drawing content

Requirement	Comment	Figure reference
Track name	Track name should be shown as a heading on the top left corner of the profile.	Figure 65 A3-1 Figure 66
Kilometrage location	The running kilometrage should include labels for the horizontal alignment and vertical alignment frame points. It should include kilometrage adjustments.	Figure 65
Diagrammatic representation of the horizontal alignment	The diagrammatic representation of the horizontal alignment should have the straight and transition frame points, curve radius and design superelevation noted.	Figure 65 A3-2 Figure 67
Existing rail levels	The existing rail levels should be interpolated at 20 m intervals.	Figure 65
Track lifts and falls	From existing rail level to proposed vertical design level (in m).	Figure 65
Grade and intersection points	Intersection Point (IP), metrage and Reduced Level (RL) information should be annotated.	Figure 65 A3-3 Figure 68
Design rail levels	Design rail levels should be annotated.	Figure 65
Grade values	Grade values should be annotated with adjoining grade information shown adjacently.	Figure 65 A3-4 Figure 69
Proposed vertical design	Indicates grade length and value (shown as %), vertical curve length and radius.	Figure 65
Vertical curve details	Vertical curve length, approach and departure length, and vertical curve radius to be shown.	Figure 65 A3-5 Figure 70
Construction or interim grades	Tie in-grades to existing design alignment to be included at design stage. This helps to define the scope for survey.	Figure 65 A3-6 Figure 71
Existing and design track profiles	Indicative information only to indicate magnitude of track lifts or falls.	Figure 65
Formation profile	Plotted as required.	Figure 65
Track layout diagram	The track layout diagram should show crossovers and turnouts where necessary, and aligned to profile details if possible.	Figure 65 A3-7 Figure 72

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Existing and proposed design structures	The existing and proposed design structures should include overbridges, underbridges, tunnels, pipes, culverts, turnouts, platforms (level or standard) access and topographic features. The profile of these structures and features should be described at their longitudinally plotted location. Underside of girder levels (overbridges). Deck levels (underbridges).	Figure 65 A3-8 Figure 73 A3-8 Figure 73 Figure 65
Ballast depth	For information purposes only, when required.	Figure 65
Contact and catenary wire levels	Contact and catenary wire levels are shown when required for overhead wire design.	Figure 65
Notes & references	All notes and references related to the drawing should be listed under their respective heading.	Figure 65
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 65
Scale	Preferred scales are 1:1000 horizontal and 1:100 vertical. Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 65

© State of NSW through Transport for NSW 2021

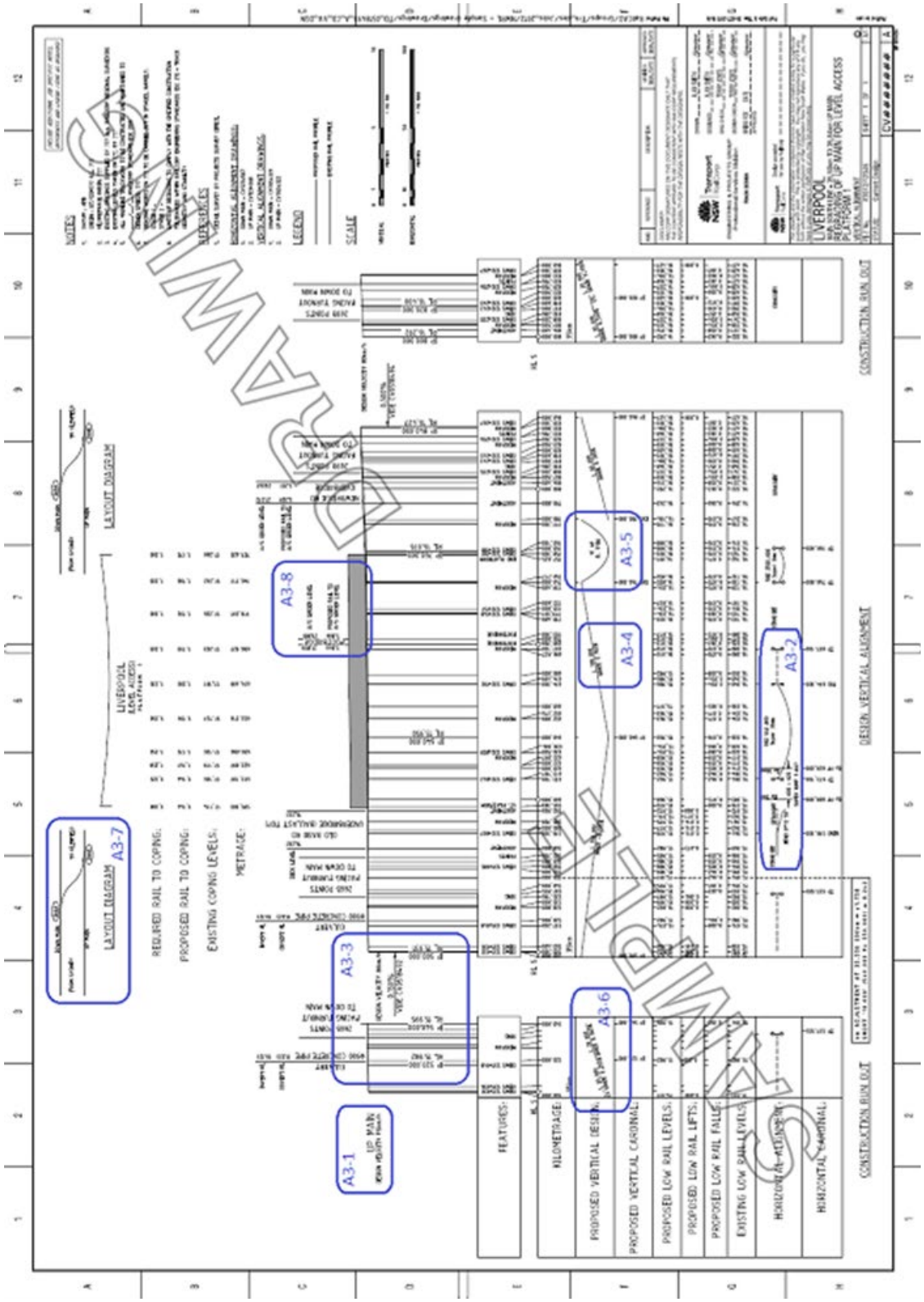


Figure 65 - Vertical alignment sample drawing

© State of NSW through Transport for NSW 2021

Figure 66 - Track name

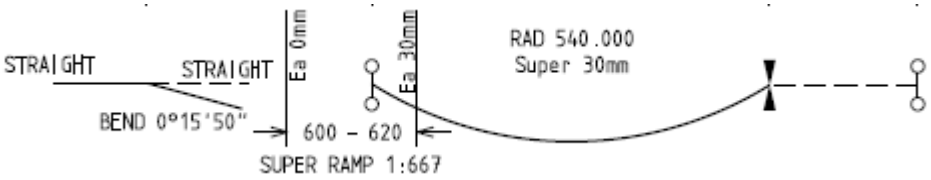


Figure 67 - Diagrammatic representation of the horizontal alignment

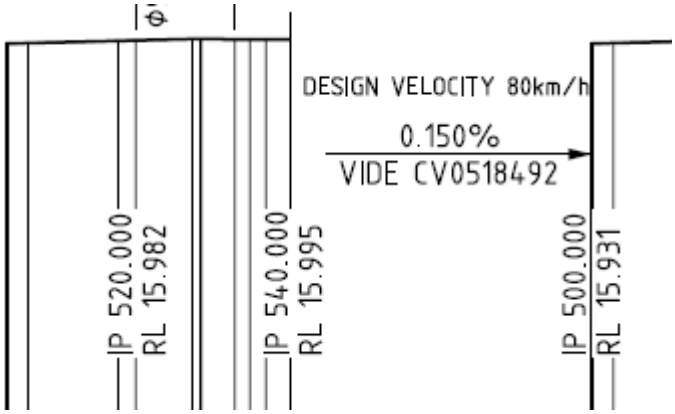


Figure 68 - Grade and intersection points

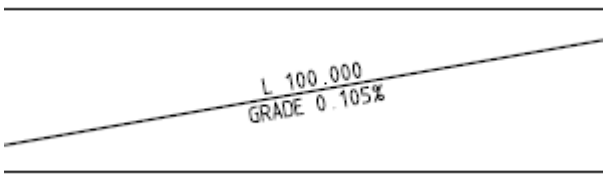


Figure 69 - Grade values

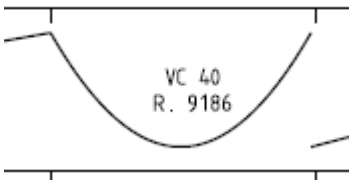


Figure 70 - Vertical curve details

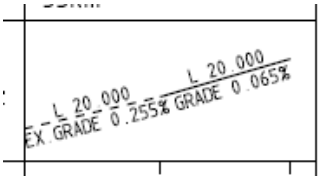


Figure 71 - Construction or interim grades

© State of NSW through Transport for NSW 2021

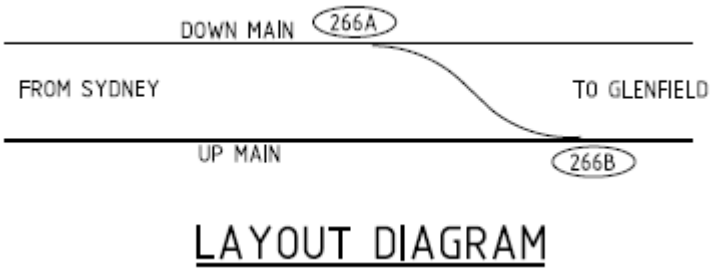


Figure 72 - Track layout diagram

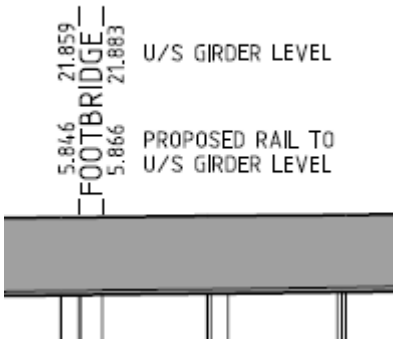


Figure 73 - Existing and proposed design structure

9.6.3. Turnout detail drawings

Turnout detail drawings are used to document the design geometry and various components used to make up a turnout, crossover, diamond, catch point or slip.

Turnout component drawings are used to detail the various track components for manufacturing purposes.

Field layout for tangential turnouts

A field layout drawing for tangential turnouts is intended to provide a plan, laid out in correct orientation, for the constructor. The position and type of insulated joints, and cant plate set requirements should be shown on this drawing. The initial layout of the bearers allows the 'rough' layout to be as close as possible to the final layout. This minimises inaccuracies and reduces rework.

Table 22 provides the minimum drawing content requirements that should be displayed on field layout drawings for tangential turnouts. It also provides the reference to respective figures in a sample tangential turnout drawing.

Figure 74 shows a sample tangential turnout drawing and Figure 75 to Figure 84 show elements of the drawing that depict these requirements.

© State of NSW through Transport for NSW 2021

Table 22 - Field layout for tangential turnouts

Requirement	Comment	Figure reference
Turnout type configuration	Turnout type configuration information should be provided. Turnout details should include the location, points numbers, type and length.	Figure 74
Bearer layout information	To assist in the layout of turnout bearers and end infill ties. Specific circumstances may require more detailed bearer layout information.	Figure 74 A6-1 Figure 75 A6-2 Figure 76
Setting out dimensions	To assist in laying out turnout and end infill steelwork. This information is also used as a final check of the turnout layout.	Figure 74 A6-3 Figure 77
In-bearers	Indicated in the correct orientation if used.	NA
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction-return requirements to be indicated in the notes. Standard GIJ units or special units fabricated into closures should also be annotated.	Figure 74 A6-4 Figure 78 A6-5 Figure 79
Closure details	Closure information should include details of special closures with built-in GIJs, and with specific closure requirements annotated.	Figure 74 A6-6 Figure 80
Closure and checkrail carrier details	Closure and checkrail carrier details should be labelled in the traditional sequence that is, A, B, C, D, E, F, G, H, K …	Figure 74 A6-7 Figure 81 Figure 84
Additional plating requirements (from standard supply)	Additional plating requirements for special infills should be annotated adjacent to GIJs, and tabulated in a schedule.	Figure 74 Figure 83
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 74
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 74 A6-8 Figure 82
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 74
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 74

© State of NSW through Transport for NSW 2021

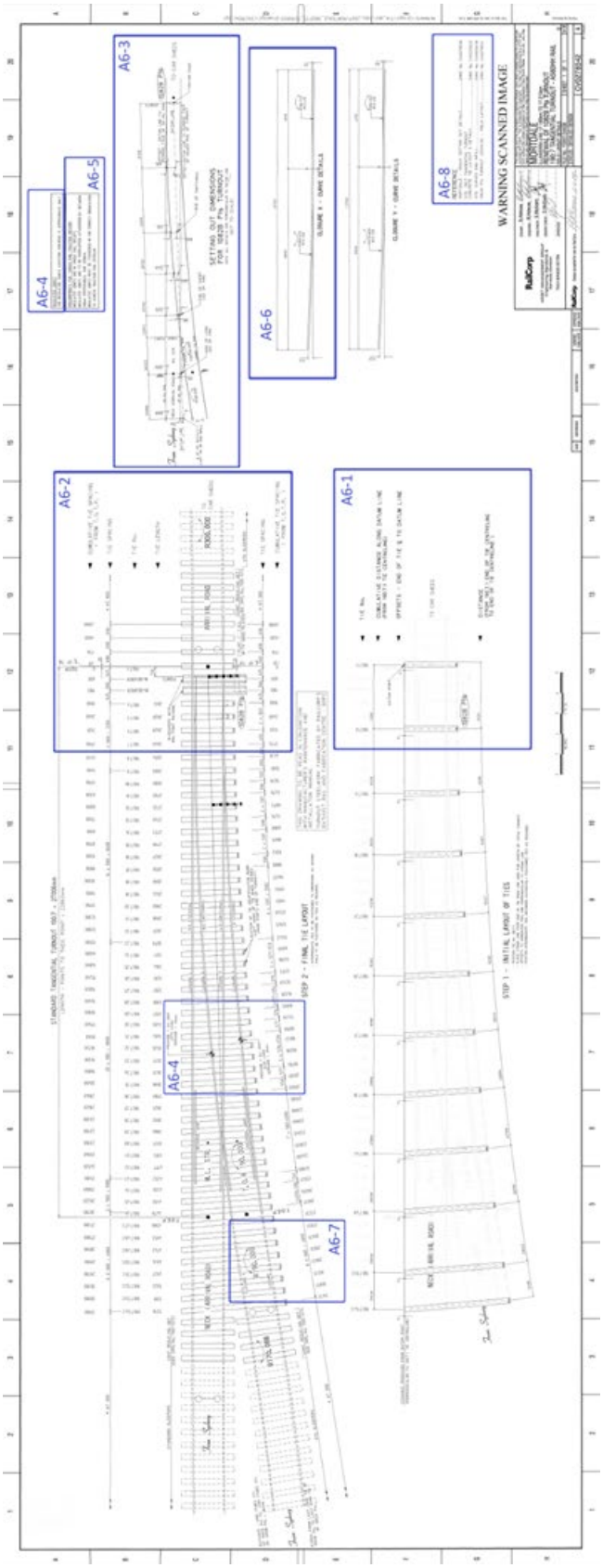


Figure 74 - Sample tangential turnout drawing

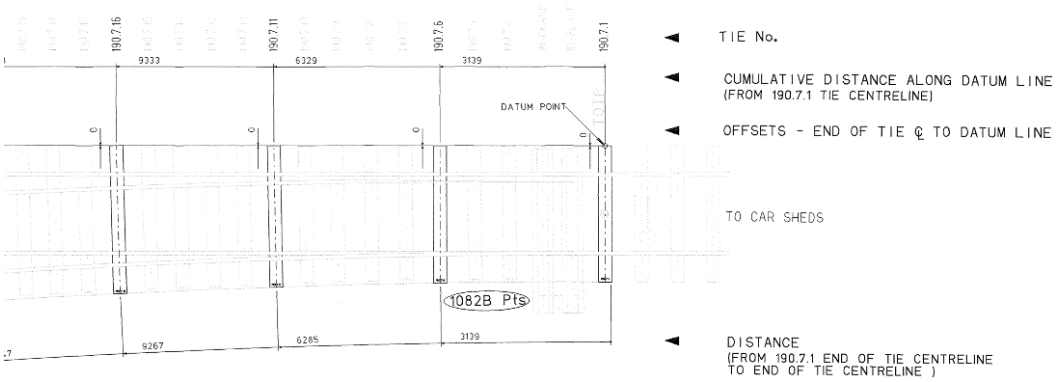


Figure 75 - Initial bearer layout

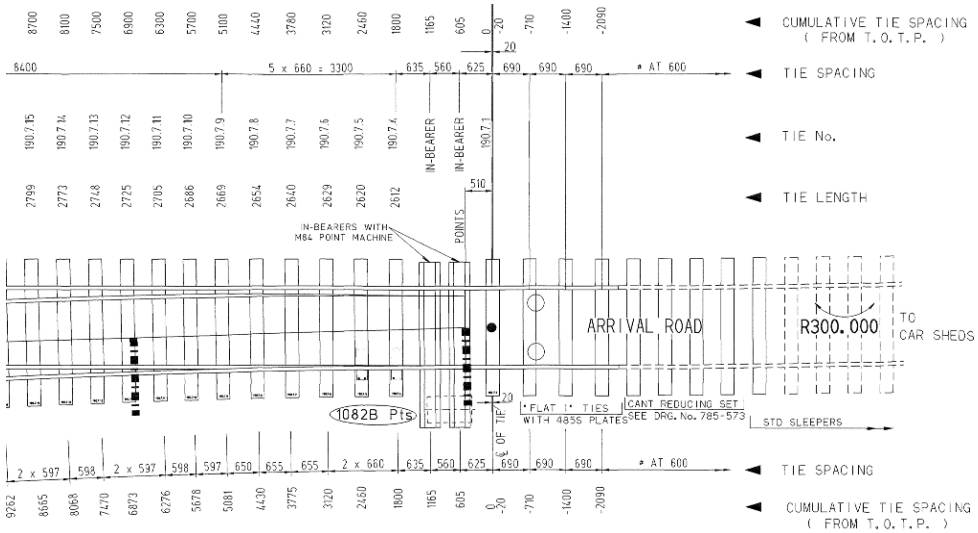


Figure 76 - Final bearer layout

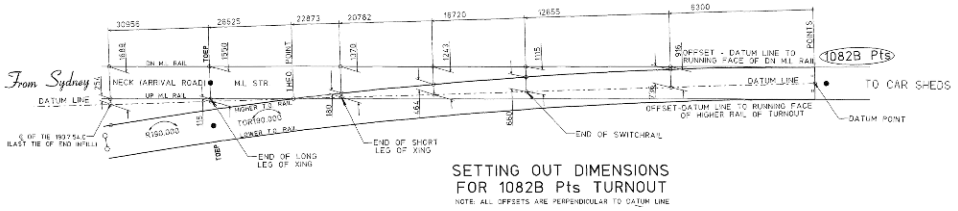


Figure 77 - Setting out dimensions

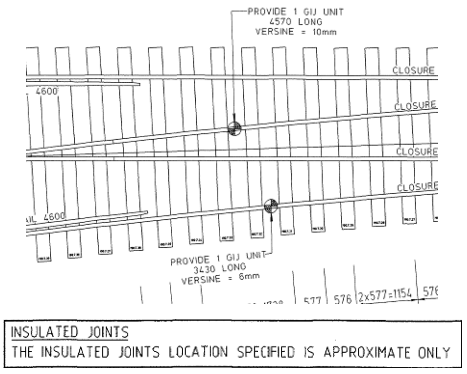


Figure 78 - Insulated joint locations

© State of NSW through Transport for NSW 2021

REQUIREMENTS FOR 'SINGLE RAIL TRACTION RETURN'
INSULATED JOINTS ARE IN SINGLE RAIL CIRCUITS.
INSULATED JOINTS ARE TO BE OVERLAPPED (STAGGERED) BY BETWEEN 100mm (PREFERABLE), AND 2000mm.
INSULATED JOINTS MUST BE STAGGERED IN THE CORRECT ORIENTATION TO ACHIEVE TRACTION RAIL OVERLAP.

Figure 79 - Traction rail information

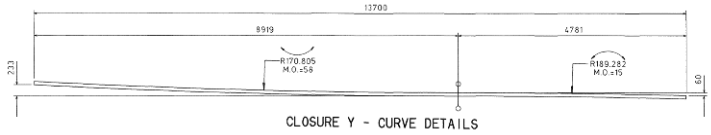


Figure 80 - Closure detail

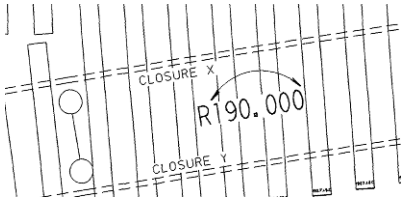


Figure 81 - Closure and check rail carrier labels

REFERENCE
MORTDALE - TRACK SETTING OUT DETAILS_____DWG No CV0278538
STD. 190:7 TANGENTIAL TURNOUT
CONCRETE TIE LAYOUT & DETAILS_____DWG No CV0225622
STD. CURVED END INFILL_____DWG No CV0020230
1082A Pts TURNOUT (250:8.25) - FIELD LAYOUT_____DWG No CV0278541

Figure 82 - References

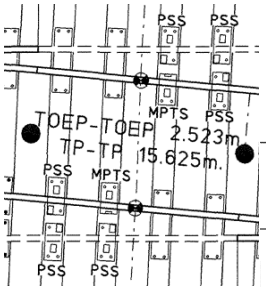


PLATE	REFERENCE	COMMENTS	REQ'D
PSS	CV0142613	REQUIRED FOR 250:10.5.3734.12.R 250:10.5.3734.13.R	6
MPTS	CV0142615	REQUIRED FOR 250:10.5.3734.13.R	2

Figure 83 - Additional plating information

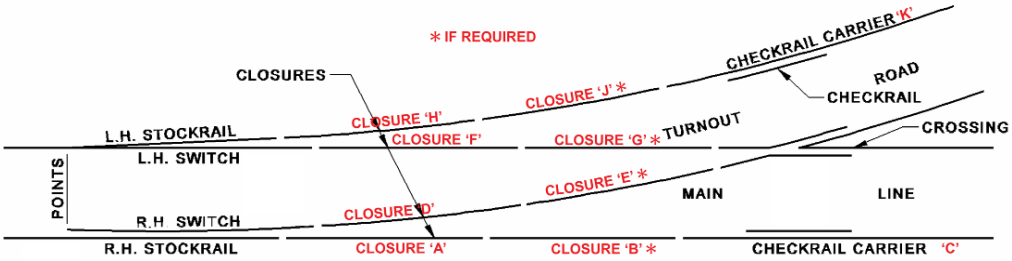


Figure 84 - Closure naming conventions

© State of NSW through Transport for NSW 2021

Tangential turnout – Bearer layout and details

Bearer layout and detail drawings are prepared for special crossover infill areas, where the use of standard bearers is not achievable. The information required includes bearer details, bearer layout configuration, and details regarding resilient pads.

Table 23 provides the minimum drawing content requirements that should be displayed on the tangential turnout drawings. It also provides the reference to respective figures in a sample tangential turnout drawing.

Figure 85 shows a sample tangential turnout – bearer layout and details drawing and Figure 86 to Figure 92 show elements of the drawing that depict these requirements.

Table 23 - Tangential turnout - bearer layout and details

Requirement	Comment	Figure reference
Turnout type configuration	Turnout type configuration information should be provided. Turnout details should include the location, points numbers, type and length.	Figure 85
Bearer layout information	Sufficient dimensioning (between bearers and cumulative on both sides) should be provided to allow for accurate layout for bearers. Specific circumstances may require more detailed bearer layout information.	Figure 85 A7-1 Figure 86
Bearer details	Bearer details should include the length of each bearer. It should include the identification number of each bearer.	Figure 85 A7-1, A7-7 Figure 86, Figure 92 Figure 85 A7-1 Figure 86
In-bearers	Indicated in the correct orientation if used.	Figure 85
Resilient pad details	Resilient pad details should include the pad dimensions for all turnout base plates, with specific pad details if required.	Figure 85 A7-2 Figure 87
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction-return requirements to be indicated in the notes. Standard GIJ units or special units fabricated into closures should also be annotated.	Figure 85 A7-5, A7-6 Figure 90 Figure 91

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Closure details	Closure information should include details of special closures with built- in GIJs, and with specific closure requirements annotated.	Figure 85 A7-3 Figure 88
Closure and checkrail carrier details	Closure and checkrail carrier details should be labelled in the traditional sequence that is, A, B, C, D, E, F, G, H, K …	Figure 85 A7-4 Figure 89
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 85
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 85
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 85
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 85

© State of NSW through Transport for NSW 2021

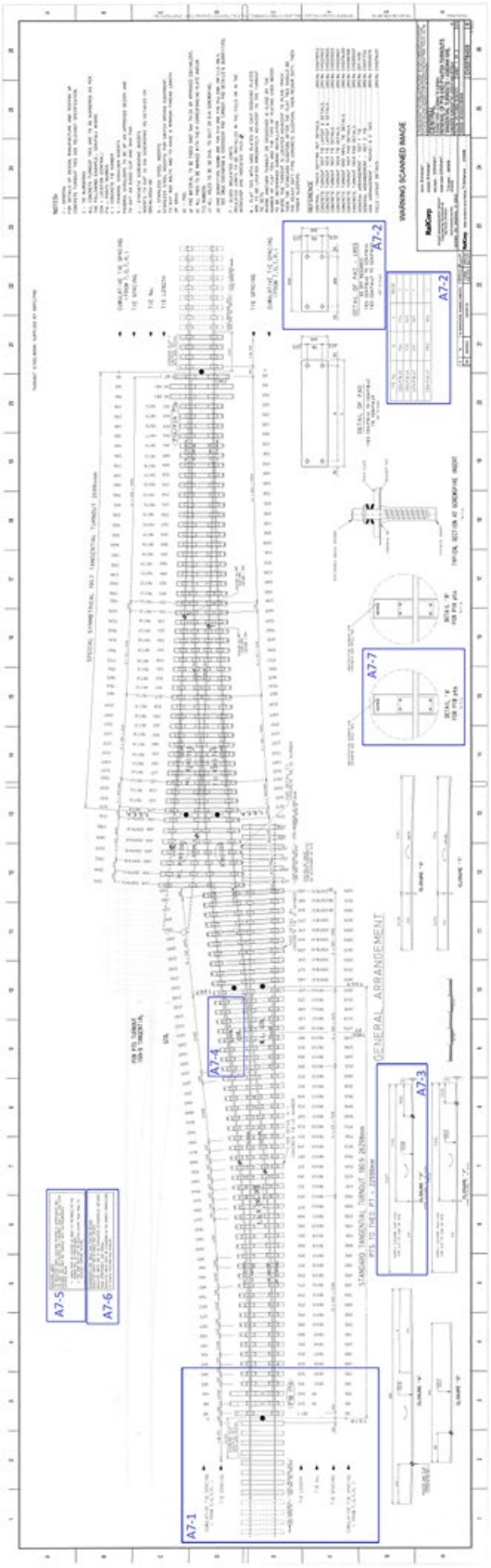


Figure 85 - Sample tangential turnout - tie layout and details

© State of NSW through Transport for NSW 2021

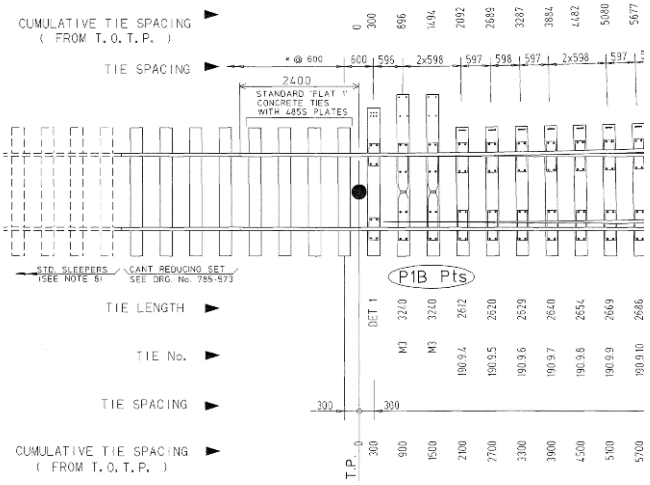
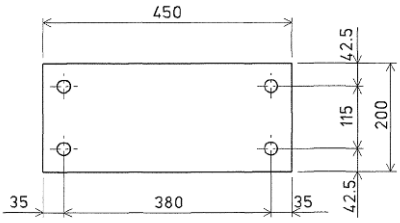


Figure 86 - Concrete turnout and bearer details



DETAIL OF PAD - 485S
60 OFF REQUIRED
TIES CEN.P1B.45 TO CEN.P1B.54
TIES CEN.P1A.47 TO CEN.P1A.53

TIE No.	A	L	REQD
CEN.P1B.45	704	774	1
CEN.P1B.46	770	840	1
CEN.P1B.47	837	907	1
CEN.P1A.47	882	952	1

Figure 87 - Resilient pad details

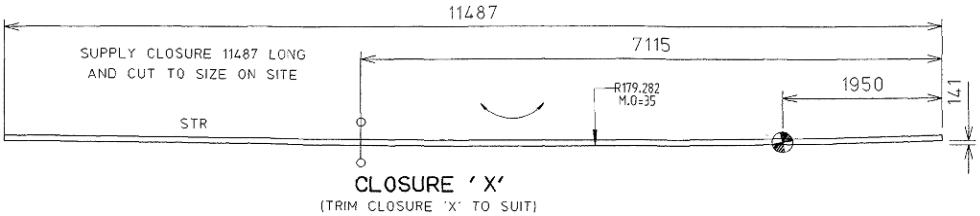


Figure 88 - Closure details

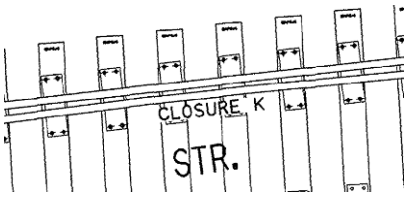


Figure 89 - Closure and check rail carrier labels

INSULATED JOINTS

THE INSULATED JOINTS LOCATION SPECIFIED IS APPROXIMATE ONLY. THE JOINT MAY BE LOCATED 1 OR 2 BEARERS AWAY BY CIVIL STAFF, PROVIDED THIS DOES NOT CONFLICT WITH THE REQUIREMENTS SPECIFIED BELOW :

- JOINTS MUST BE LOCATED AS NEAR TO THE MIDDLE OF THE BEARER BAY AS PRACTICABLE.
- THE JOINT MUST NOT BE LOCATED CLOSER THAN 75mm TO ADJACENT SUPPORT PLATING.

Figure 90 - Insulated joints - notes

© State of NSW through Transport for NSW 2021

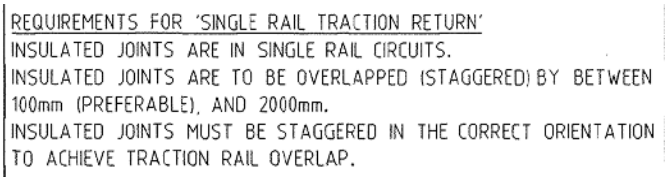


Figure 91 - Traction return - notes

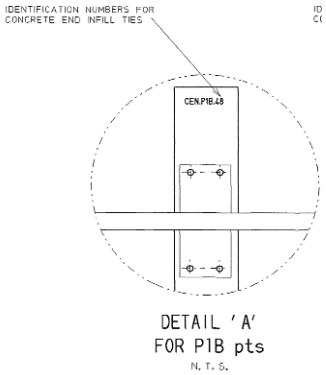


Figure 92 - Bearer details

Conventional turnout – Timbering and plating

Timbering and plating details drawings are prepared for conventional geometry turnouts and other special trackwork configurations. The details provided are used for the manufacture and fabrication of the constituent components, and for layout and component identification required for pre-installation assembly.

Table 24 provides the minimum drawing content requirements that should be displayed on the conventional turnout drawings. It also provides the reference to respective figures in a sample conventional turnout drawing.

Figure 93 shows a sample conventional turnout drawing and Figure 94 to Figure 103 show elements of the drawing that depict these requirements.

Table 24 - Conventional turnout - Timbering and plating

Requirement	Comment	Figure reference
Timbering and plating details	Timbering and plating details should contain the length, spacing and location of required bearers, from commencement of the cant reducing plates at either end. It should also include the identification number of each plate.	Figure 93 A4-1 Figure 94
Tables of materials	Tables of materials should include tables of pandrol base plates, timber bearers, closures, heelblock dimensions and standard plate information. Item numbers should be referenced to components on the drawing.	Figure 93 A4-2 Figure 95

© State of NSW through Transport for NSW 2021

Requirement	Comment	Figure reference
Tables of materials (continued)	Table of pandrol base plates Table of timber bearers Table of closures Table of heelblock dimensions Table of standard plates	Figure 93 A4-3 Figure 96 Figure 93 A4-4 Figure 97 Figure 93 A4-5 Figure 98 Figure 93 A4-6 Figure 99 Figure 93 A4-7 Figure 100
Setting out dimensions for turnout steelwork	Setting out dimensions for turnout steelwork should include offsets to the mainline and turnout for field layout and check purposes.	Figure 93 A4-8 Figure 101
Switch, stockrail and checkrail details	Switch, stockrail and checkrail details should include the offsets, mid-ordinates, radii and curvature direction of these components.	Figure 93 A4-9 Figure 102
Crossing details	Crossing details should include the crossing rate and XL catalogue number shown in the material list, with reference to the detail drawing.	Figure 93
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction-return requirements to be indicated in the notes. Standard GIJ units or special units fabricated into closures should also be annotated.	Figure 93
Closure details	Closure information should include details of special closures with built in GIJs, with specific closure requirements annotated.	Figure 93
Closure and checkrail carrier details	Closure and checkrail carrier details should be labelled in the traditional sequence, that is, A, B, C, D, E, F, G, H, K …	Figure 93 A4-11 Figure 103
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 93
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 93
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 93

© State of NSW through Transport for NSW 2021

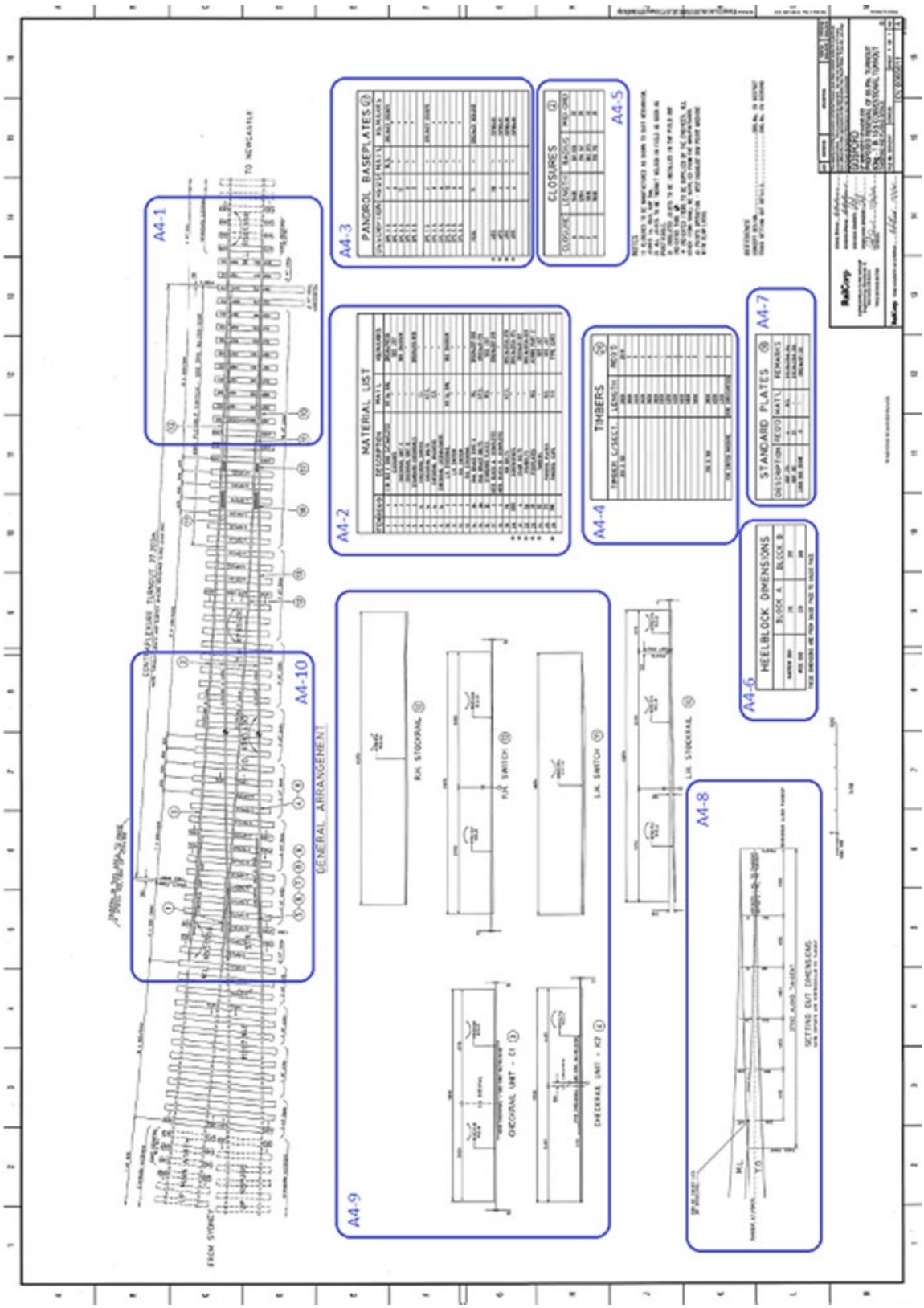


Figure 93 - Sample conventional turnout - timbering and plating drawing

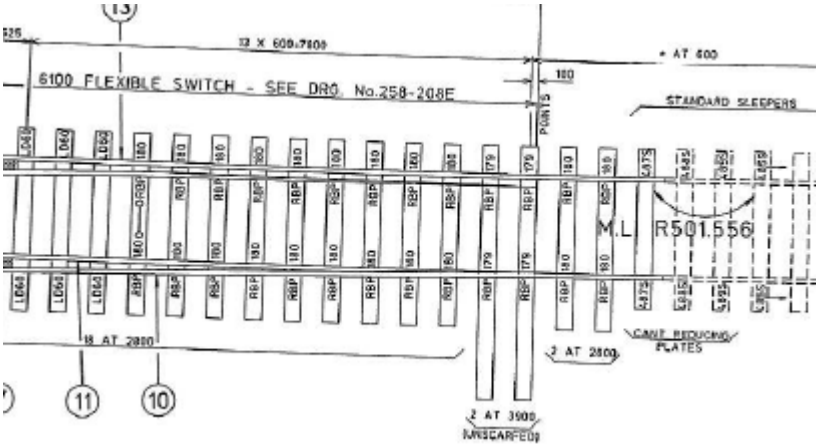


Figure 94 - Timbering and plating details

MATERIAL LIST

	ITEM	REQ'D	DESCRIPTION	MAT'L	REMARKS
	1	1	1 IN 10.5 V XING CAT.No.XL2723	60 kg RAIL	DRG.No.PW298
	2	4	CLOSURES	"	SEE LIST
	3	1	CHECKRAIL UNIT C	"	SEE DIAGRAM
	4	1	CHECKRAIL UNIT K	"	"
	5	2	STANDARD CHECKRAILS	"	DRG.No.310-1019
	6	14	CHECKRAIL CHOCKS	C.I.	"
	7	14	CHECKRAIL BOLTS	H.T.S.	"
	8	14	CHECKRAIL WASHERS	C.S.	"
	9	14	CHECKRAIL LOCKWASHERS	"	"
	10	1	L.H. STOCKRAIL	60 kg RAIL	SEE DIAGRAM
	11	1	L.H. SWITCH	"	"
	12	1	R.H. SWITCH	"	"
	13	1	R.H. STOCKRAIL	"	"
	14	26	RAIL BRACE TYPE 5	M.I.	DRG.No.207-569
	15	26	RAIL BRACE BOLTS	H.T.S.	DRG.No.91-170
	16	32	STANDARD PLATES	M.S.	SEE LIST
	17	2	HEEL BLOCK A (COMPLETE)	"	DRG.No.207-519
	18	2	HEEL BLOCK B (COMPLETE)	"	"
	19	78	MB BOLTS	H.T.S.	DRG.No.205A-370
*	20	840	SCREWSPIKES	"	DRG.No.205A-374
*	21	6	CHAIR BOLTS	"	DRG.No.91-187
*	22	56	FISHBOLTS	"	DRG.No.205A-323
*	23	28	FISHPLATES	M.S.	AS1085 PART 2
*	24	65	TIMBERS	-	SEE LIST
	25	212	PANDROL PLATES	M.S.	SEE LIST
*	26	396	PANDROL CLIPS	S.S.	TYPE E2003

Figure 95 - Material list

PANDROL BASEPLATES (27)

	DESCRIPTION	REQ'D	MAT'L	REMARKS
	SPC 3 S	2	M. S.	DRG.No.CV 0133871
	SPC 4 S	6	"	"
	SPC 6 S	12	"	"
	SPC 7 S	6	"	"
	SPC 9 S	2	"	"
	DPC 1 S	2	"	DRG.No.CV 0133870
	DPC 2 S	8	"	"
	DPC 3 S	6	"	"
	DPC 4 S	12	"	"
	DPC 5 S	6	"	"
	DPC 6 S	6	"	"
	PCRS	14	"	DRG.No.CV 0064935
*	4855	118	"	ISP96485
*	4875	4	"	ISP96487
*	4885	4	"	ISP96488
*	4895	4	"	ISP96489

Figure 96 - Pandrol base plates

© State of NSW through Transport for NSW 2021

TIMBERS (26)		
TIMBER C/SECT.	LENGTH	REQ'D
250 X 150	2800	20 *
	3000	7
	3200	5
	3400	4
	3600	4
	3800	1
	4000	-
	4200	2
	4400	3
	4600	3
	4800	4
	5000	3
250 X 180	3800	3
	4000	4
	4200	1
FOR SWITCH MACHINE	3900 (UNSCARFED)	2

Figure 97 - Timber bearer details

CLOSURES (2)			
CLOSURE	LENGTH	RADIUS	MID-ORD
A	11400	501 838	32
D	12804	784 147	26
F	12810	592 273	41
H	11600	783 712	21

Figure 98 - Closure details

HEELBLOCK DIMENSIONS		
	BLOCK A	BLOCK B
NARROW END	216	261
WIDE END	228	289

THESE DIMENSIONS ARE FROM GAUGE FACE TO GAUGE FACE.

Figure 99 - Heelblock dimensions

STANDARD PLATES (16)			
DESCRIPTION	REQ'D	MAT'L	REMARKS
RBP 178	4	M.S.	DRG.No205A-354
RBP 180	22	"	DRG.No205A-355
LONG D60 CHAIR	6	"	DRG.No197-312

Figure 100 - Standard plate dimensions

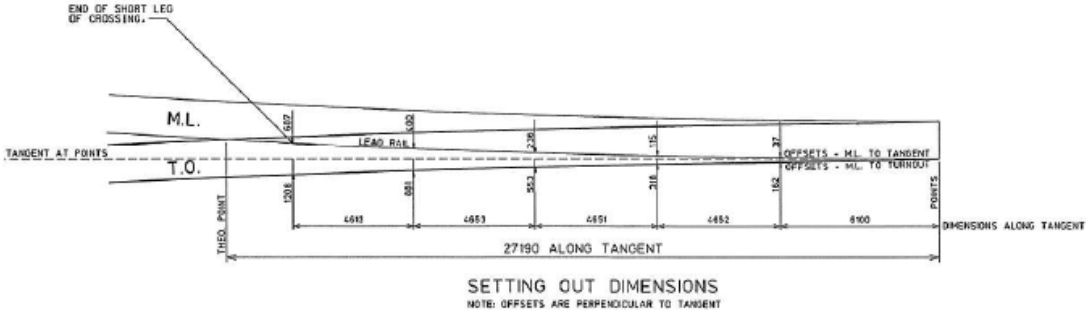


Figure 101 - Setting out dimensions for turnout steelwork

© State of NSW through Transport for NSW 2021

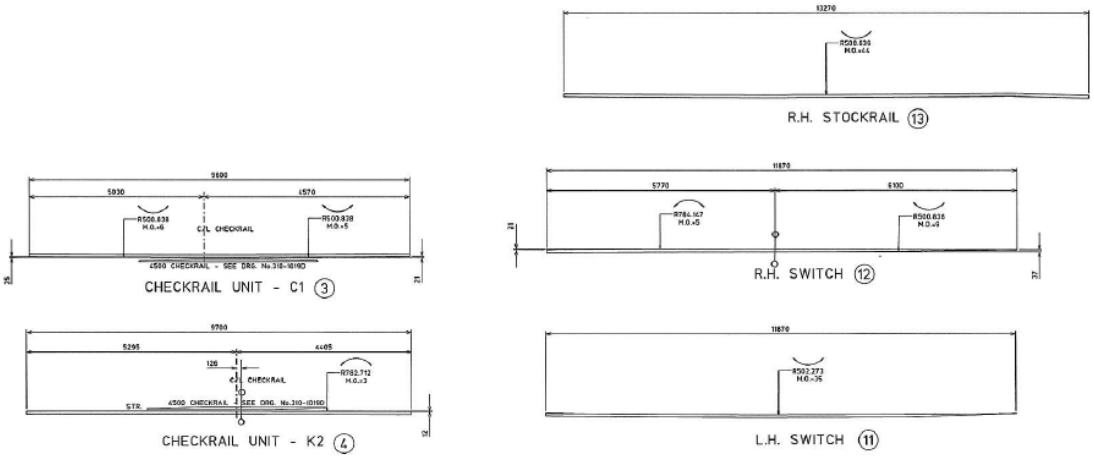


Figure 102 - Switch, stockrail and checkrail details

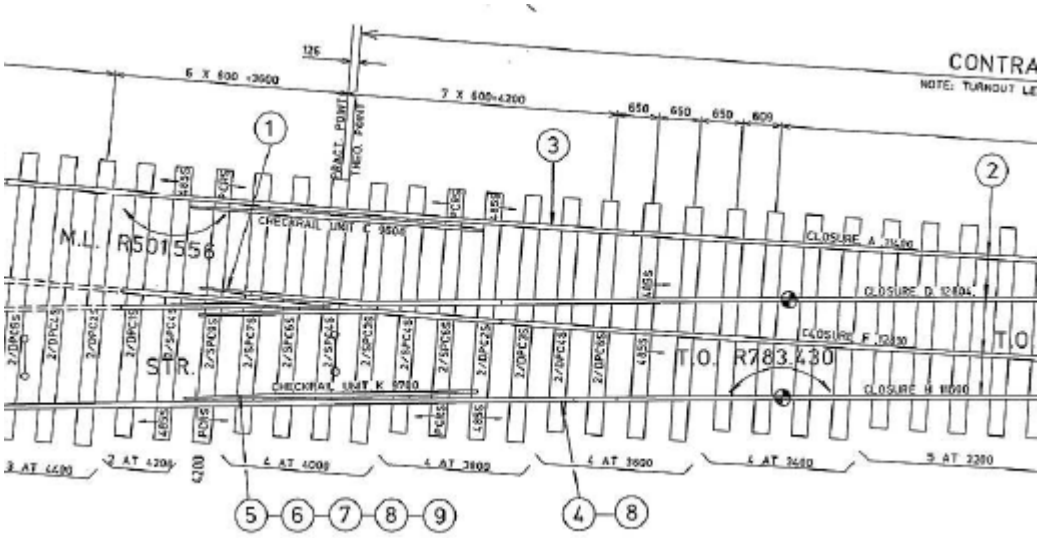


Figure 103 - Closure and checkrail carrier details

Component drawings general requirements

The following are the minimum general requirements for component drawings:

- components should be preferably drawn on A3 sheets
- the scale of the component drawing should be appropriate for the amount of detail being shown
- the component drawing dimensions shall be expressed in mm

Component drawing content

The following drawing content should be included in component drawings, as required:

- general arrangement showing plan, elevation, end elevation and sections as required to fully detail the component
- assembly drawings and procedures

© State of NSW through Transport for NSW 2021

- material specifications and finishes
- welding procedures
- general shape and orientation, and a full listing of coordinates for concrete bearer inserts
- relevant notes and references

9.6.4. Cross-section drawings

Cross-sections are generally drawn perpendicular to the track centreline, and are viewed in the direction of increasing metrage, or in the direction of flow in the case of waterway cross-sections.

Cross-section drawings general requirements

The following should be considered for cross-section drawings:

- cross-section drawings should be drawn on standard A1 sheets
- the preferable scale for cross-section drawings is 1:100; however 1:200 can be used

Cross-sections shall commence at the bottom left side of the drawing sheet, then be drawn upwards in increasing metrage order, keeping the offset origin of each section vertically above each other (where possible).

Drawing content for cross-section drawings

The following are the minimum drawing content requirements for cross-section drawings:

- each cross-section shall have a kilometrage label placed beneath the offset origin
- datum level should be shown on each cross-section
- offset origin should be zero, being either the proposed design centreline or the existing track centreline
- offset distances to the left and right of the offset origin shall have negative and positive values respectively
- features shall be indicated and labelled
- the approximate railway boundary or fence line should be shown
- railway tracks should be labelled
- existing rail or sleeper profiles should be shown

Cross-sections showing the design proposals should include the following details:

- proposed rail or sleeper profile
- proposed track design centreline labelled

© State of NSW through Transport for NSW 2021

- proposed design rail level and superelevation
- proposed design formation
- areas and volumes calculated to earthworks level, if required
- cross-section showing batter slopes, ballast profile, capping layer and all associated dimensions
- cross-section should be referenced facing away from Sydney, with DOWN on the left

10. Civil CAD requirements

The civil CAD requirements are applicable to the civil and structural drawings produced for TfNSW rail projects. These requirements shall be read in conjunction with the general requirements in Section 6 of this standard.

Where conflict exists between the two sections, then the civil and structural drawing requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

10.1. Title block for civil drawings

Civil design drawings shall use the drawing title block as explained in Section 7.1 of this standard. Figure 104 shows an example of a completed title block for civil design drawings.

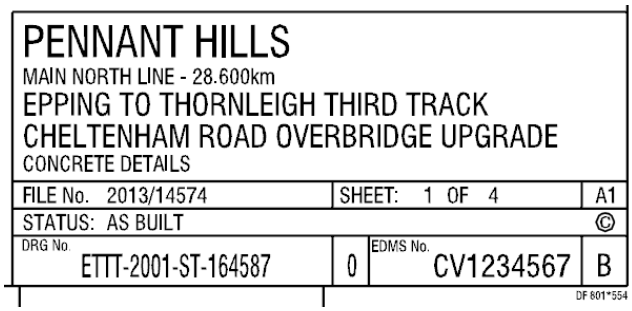


Figure 104 - Sample completed drawing detail box for civil drawings

10.2. Cell library for civil and structural drawings

For geotechnical patterns, the geotechnical.cel cell library should be used on civil and structural drawings.

This cell can be obtained by downloading the resource file and opening the cell library. This file is available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R3 *Civil CAD Resources*.

© State of NSW through Transport for NSW 2021

10.3. Types of civil and structural design drawings

Based on the design content, the civil and structural design drawings are classified into the following drawing types:

- abutments
- alignment
- architectural detail
- bar shape diagrams
- civil works
- concept design
- concrete details
- cross-sections
- cover sheet
- details
- details and sections
- foundation
- general arrangement
- layout
- marking plan
- miscellaneous details
- notes
- options
- precast concrete details
- precast reinforced concrete details
- precast reinforcement details
- reinforced concrete details
- reinforcement details
- sections
- setting out details
- steelwork details

© State of NSW through Transport for NSW 2021

- steelwork fabrication
- structure diagrams
- suggested construction sequence
- drainage
- earthworks
- bearings
- piles
- piers
- girders
- deck

The list of types of drawings is based on the drawing contents.

The drawing type name should be populated in tag 'tbDetail3' of the detail box in the title block.

10.4. Structural steelwork drawings

Section 10.4.1 through to Section 10.4.9 provide the structural steelwork design requirements and fabrication drawing requirements along with the reference letters used in structural steelwork.

10.4.1. Designation of steel sections

For the designation of rolled steel sections, reference letters should be used in conjunction with critical dimensions of the section to identify the product and refer to the required length in millimetres, which is given at the end. The reference letters and examples of steel sections are provided in Table 25 and Table 26.

Table 25 - Steel section reference letters

Section	Reference letters
Universal beam	UB
Universal column	UC
Welded beam	WB
Welded column	WC
Angle (equal, unequal)	EA, UA
Channel (parallel flange)	PFC
Square hollow section	SHS
Rectangular hollow section	RHS
Circular hollow section	CHS

© State of NSW through Transport for NSW 2021

Section	Reference letters
Taper flange beam	TFB
Plate	PL
Flat	FL
T section cut from universal beam	TB
T section cut from universal column	TC

Table 26 - Steel section examples

Section	Notation
Universal beam	Nominal depth x mass per metre x length (530 UB 92x3000)
Universal column Welded beam Welded column	Nominal depth x mass per metre x length (310 UC 158x3000) Nominal depth x mass per metre x length (1200 WB 455x15000) Nominal depth x mass per metre x length (350 WC 197x6000)
Equal angle	Size of legs x thickness x length (75x75x10 EAx3000)
Unequal angle	Size of long leg x short leg x thickness x length (150x100x10 UAx3000)
Channel	Depth x length (380 PFCx3000)
Square hollow section	Size of sides x thickness x length (75x75x4.0 SHSx3000)
Rectangular hollow section	Size of long side x short side x thickness x length (125x50x4.0xRHSx3000)
Circular hollow section	Outside diameter x thickness x length (76 ODx3.2 CHSx3000)
Taper flange beam	Depth x length (125 TFBx3000)
Plate	Width x thickness x length (100x12 PLx300)
Flat	Width x thickness x length (100x12 FLx300)
Pipe	Nominal bore (40 NB)

10.4.2. Welding symbols

The type, size and position details of basic welds shall be represented as symbols on the drawings. These symbols shall be in accordance with AS 1101.3 *Graphical symbols for general engineering - Welding and non-destructive examination* and are available in the civil design cell library published on the AMB website.

10.4.3. Steelwork marking plans

A marking plan shows the arrangement of structural members in diagrammatical form and is also used as the starting point from which detail drawings are developed. It should show the overall form and dimensions of a structure, member sizes, levels, existing or adjacent members

© State of NSW through Transport for NSW 2021

and any future extensions. The marking plans should be drawn to scale without minute details. A single line for each member is sufficient. For smaller structures, the marking plan may be included with the detail drawings.

Design particulars of columns in a building should be shown on a column schedule. The schedule shall include sizes of members, base plate sizes, portions of splices and levels. Any future extension details should be shown in dotted line.

10.4.4. Marking of members

The marking plans serve as key diagrams to the structure and they record the identification marks of the members. As a rule, the identification marks shall use the prefixes that are shown in Table 27.

Table 27 - Steelwork marking prefixes

Member	Prefix	Member	Prefix
Beams	B	Roof bracing	RB
Columns	C	Stringers	S
Crane beam	CB	Ties	T
Girts	G	Trusses	TR
Purlins	P	Vertical (wall) bracing	VB
Rafter	R	Walkways (platform) channels	PC

The numbering of identification marks shall start from the top left corner of the marking plan. Alternatively, in larger buildings, the floor beam marks may be prefixed with different letters for each floor, starting from the lowest floor that is A, then B, C, and so on.

The steelwork sections shall be shown in a table on the marking plan, comprising three columns, such as item, mark and section. If the marking plan has to be shown on several sheets, this table should appear on only one sheet.

Orientation of members made of angle or channel sections shall be clearly shown on the marking plan.

10.4.5. Detail set outs

Before starting the detail drawings, the set outs should be prepared for connections, panel points, and so on.

The set outs shall be set to large scale to enable the scaling of dimensions to the required accuracy. The set outs shall be used to determine the shape and size of gusset plates, the location of bolts and the clearance between members. For simple rectangular joints, which can be computed easily and accurately, the preparation of set outs is not necessary.

© State of NSW through Transport for NSW 2021

10.4.6. Steelwork details

Unless special conditions require otherwise, multiple columns shall be drawn lengthwise with the lower end to the left.

The angles and channels should be drawn with the flanges down, and the thickness shown by short dashed line.

The views of beam endplates shall be shown only when the information cannot be conveyed with notes.

If a frame or member is symmetrical or nearly so about its centre line, only one-half of the frame or member with a note ‘symmetrical about centre line’ or ‘symmetrical about centre line except where noted’ may be shown. In such cases, the left half of the frame or member is usually shown and shall be extended slightly beyond the centre line to show that the frame or member does not end at the centre line.

In a view of one side of a heavy truss member or latticed column, only the bracing or lacing on the face depicted shall be shown. All other bracing and lacing is omitted and such omission should be covered by an appropriate note. Tubular members should be shown as outline only and the tube thickness should be indicated by a note.

Filled holes in a steelwork assembly indicate bolt locations. Similarly, filled holes in a member indicate holes for bolts. Unfilled holes indicate holes for purposes other than bolting; for example, drain holes for galvanising.

10.4.7. Marking of steelwork details

The instructions for marking of members to facilitate erection shall be shown preferably on the flanges. Unless the member is symmetrical, it shall be fully orientated. For example,

MARK – 'NORTH'

MARK – 'TOP'

The identification mark of each member should be positioned on the drawing below the member. Examples of identification marks are as follows:

MARK A1 – 1 REQ’D – AS DRAWN

MARK A2 – 1 REQ’D – OPP HAND AS NOTED

Opposite hand noting should be used with caution unless the component is opposite hand in all aspects.

Monorail beams shall be marked on the web in capital letters at least 75 mm high. For example,

MARK – 'MAXIMUM LOAD NOT TO EXCEED TWO (2) TONNE –
CLASS No. 2 – MONORAIL No. MR1'

© State of NSW through Transport for NSW 2021

10.4.8. Steelwork connections

For welded connections, the category of weld such as SP or GP, and the extent of examination shall be included in the drawing notes; for example, all welds to be category SP, extent of visual inspection 100%, non-destructive testing 10%. The weld preparation for any site welds shall be shown where necessary.

For bolted connections, care shall be taken to indicate the type of bolt to be used and to distinguish between different types of bolts and tensioning methods appearing on one drawing, that is, commercial bolts 4.6/S, and high strength bolts 8.8/S, 8.8/TF and 8.8/TB. The holes shall be located on standard gauge lines for structural steel sections. Standard edge distances and pitches shall be used wherever possible.

10.4.9. Allowance for erection clearances

The diagonal length (in plan view) of a beam is usually shorter than the face-to-face distance between supporting members, sufficient to avoid forcing the beam into position.

However, because the beam is relatively short or wide connection details are required, the diagonal length may exceed the face-to-face distance in such a way that the connection at one end should be shipped loose, or the length of the beam should be shortened.

A study shall be conducted to determine the clearance available for erecting beams of this type. The maximum diagonal length of the beam shall be about 3 mm less than the face-to-face distance between column or girder web. It should also clear any obstructions, such as cleats or stiffeners; otherwise, the obstructing detail shall be shipped loose.

10.5. Reinforcement drawings

The reinforcement drawings show the location, grade, diameter and the number of reinforcement bars in the structure. They shall also show sufficient additional information to enable the bars to be cut, bent and placed in the positions required by the design. The aim shall be to produce a drawing, which clearly indicates the exact intentions of the designer, bearing in mind the problems, which may be encountered during bending and placing of the bars and placing of concrete. The drawings shall also show locations and types of all embedded items such as lifting hooks, ferrules, conduits and HD bolts.

10.5.1. Layout of drawing

Each group of bars (except for straight bars) shall be shown in at least two views. The bars shall be drawn to scale lengthways and in their correct position (except where some displacement is required to separate adjacent bars for clarity). An exploded view can be used to detail heavily reinforced structures. All bars, both near face and far face, shall be drawn as solid line and not as dashed line.

© State of NSW through Transport for NSW 2021

Concrete outlines and other outlines used on a reinforcement drawing shall be drawn to scale. Concrete dimensions and other concrete details are not required if already shown elsewhere. When pipes or other embedded items are cut in section on a reinforcement drawing, they should be drawn to scale, but without dimensions. All joints in the concrete shall be shown on the reinforcement drawing.

10.5.2. Bar detailing

Leaders accompanying bar notations shall be drawn as shown in Figure 105.

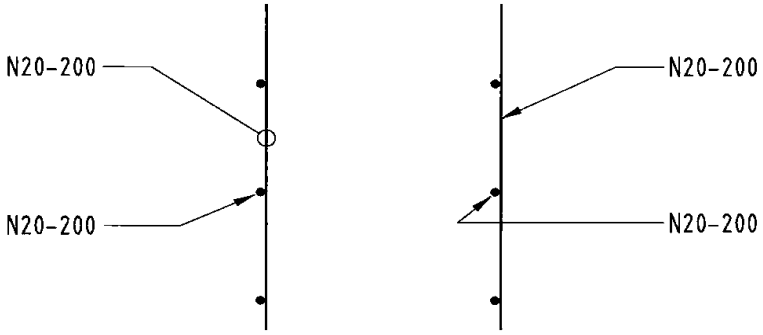


Figure 105 - Leaders for bar notations

10.5.3. Bar notation

Every bar or group of bars shall be identified by means of a notation in the following order:

- number of bars in the group
- bar mark
- bar grade and diameter
- centre to centre spacing

Either the number or spacing information may be omitted if necessary, but not both.

Some examples of the notation are as follows:

- 4/S1 N24-150
- 4/S1 N24
- S1 N24-150

Alternatively, when the reinforcement drawing is not complex, the bar mark may be omitted. The notation would be as follows:

- 4/N24-150
- 4/N24
- N24-150

© State of NSW through Transport for NSW 2021

The full bar notation, using any of the types mentioned in the examples, shall be shown once only and this shall occur on the view in which the extent lines are shown. On all other views only the bar mark, for example 'S1', or (if there is no bar mark) the bar diameter, for example 'N24', shall be used to identify bars. If there are no extent lines, the full bar notation shall be shown on the view in which the shape and location of the bar is most clearly shown.

10.5.4. Reinforcement laps and cogs

The laps and cogs shall be noted or dimensioned on the reinforcement drawing. Where all laps or cogs are the same, a description provided in the notes would be sufficient.

For example, 'All laps to be 500 mm unless noted otherwise. Cogs are similar.'

If laps or cogs vary across the drawing, then they shall either be all dimensioned or alternatively all covered in the bar notation. Examples of bar notation for laps or cogs are as follows:

S1 N24-200 tied to T1 N12-400 LAP 500

L1 N24-200 COG 300

10.5.5. Steel location abbreviations

Table 28 shows the abbreviations that are used to show the location of reinforcement. These abbreviations should be included at the end of the bar notation, separated by a dash or in parentheses; for example, 4/N24-150 T&B.

Table 28 - Abbreviations for reinforcement location

Description	Abbreviation
Bottom	B
Centrally placed	CP
Each face	EF
Each way	EW
Far face	FF
Near face	NF
Top	T

10.5.6. Steel mesh

Where welded wire mesh is used, the extent of the mesh should be shown and the type of mesh identified with a note such as 'SL62'. Each wire should be shown as a heavy line with sufficient details to indicate the direction in which the main longitudinal wires shall lie. Examples of steel fabric details are given in Figure 106. The mesh in the section may be shown as a dashed line (small scale) or solid lines with filled circles representing main wires.

© State of NSW through Transport for NSW 2021

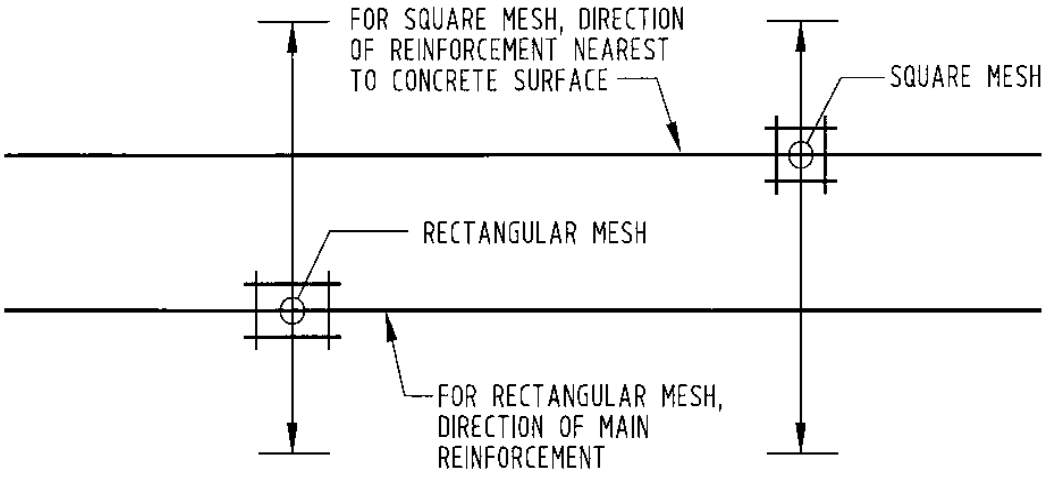


Figure 106 - Steel mesh

10.6. Precast concrete drawings

Precast concrete units shall be clearly identified, particularly when shown on the same drawing as cast in-situ concrete elements. The mass for each unit shall be mentioned.

For heavily loaded structures, the reinforcement pattern shall provide for all openings or blockouts as designed by the engineer. For walls and lightly loaded slabs in which openings are common, the adjacent main reinforcement need not be specially detailed. A note indicating that reinforcement should be moved or cut on site should be provided. For larger openings, additional steel trimmers shall be provided around the opening irrespective of whether the main reinforcement pattern has been altered to suit.

10.7. Order of sheets in a set

The order of the sheets in a set of drawings shall follow the logical order of the construction procedure of the structure.

10.7.1. Bridge drawings

A set of bridge drawings should be in the following sequence:

- cover sheet
- general arrangement
- general notes (where required)
- construction details (where required)
- setting out and piles

© State of NSW through Transport for NSW 2021

- abutments (new abutment, new abutment headstocks, or strengthening)
- abutment concrete
- abutment reinforcement
- piers (new pier, new pier headstocks, or strengthening)
- pier concrete
- pier reinforcement
- girders (steel / pre-stressed concrete (PSC) / reinforced concrete (RC))
- girder reinforcement (PSC / RC)
- bearings
- approach slabs
- traffic barriers
- pedestrian barriers
- walkways
- miscellaneous (for example, fabrication, miscellaneous items and so on)
- associated drawings
- protection screens
- electrical safety screens
- survey cross-sections
- detail site survey

10.7.2. Station platform drawings

A set of station platform drawings should be in the following sequence:

- cover sheet
- general arrangement
- general notes (where required)
- setting out details
- concrete details
- precast concrete details (if using precast elements)
- miscellaneous details
- services

© State of NSW through Transport for NSW 2021

10.7.3. Overhead wiring structure drawings

A set of overhead wiring structure drawings should be in the following sequence:

- structure diagram footing details
- steelwork details
- miscellaneous details

11. Detailed Site Survey CAD requirements

The Detailed Site Survey (DSS) CAD requirements define the standard codes and equivalent CAD layer numbers, which represent services and their installation type within the rail corridor. These codes and layer numbers should be used as the basis for classification of services and their construction method in CAD file format. The data is collected via field survey, transformed into a DSS compliant CAD file to produce DSS plans that are managed by the Underground Services Unit (USU) and also for use in the Sydney Trains' Geographic Information System (GIS).

Survey CAD drawings for areas outside Sydney Trains heavy rail area shall comply with the general requirements in Section 6 and AS 5488 *Classification of Subsurface Utility Information (SUI)*.

The DSS CAD requirements shall be read in conjunction with the general requirements in Section 6 of this standard. Where conflict exists between the two sections, then the DSS CAD requirements take precedence over the general requirements unless the general requirements expressly states otherwise.

The services data surveyed relates to the underground and above ground utility services and is defined as 3D vector data with coordinated xyz locations obtained by survey methods.

The services data is required to be compatible with the AutoCAD or MicroStation applications and the Corporate GIS (small world platform). Refer to the following documents for more information:

- AS 4799 *Installation of underground utility services and pipelines within railway boundaries*
- AS 5488 *Classification of Subsurface Utility Information (SUI)*
- GL A 00512 *Guide to interpretation of Detailed Site Survey (DSS) – Plan Symbols and Numeric Route Codes*
- PR A 00498 *Detailed Site Survey DSS Survey and Drafting*
- TMG 1310 *Locating of Underground Services*
- TMG 1440 *Requirements for the Locating of Underground Services in the Rail Corridor*
- T HR CI 12190 ST *Service Installations Within the Rail Corridor*

© State of NSW through Transport for NSW 2021

- T HR EL 20008 ST *Underground Cables and Cable Enclosures – Location Data Recording*
- SMS-06-GD-3066 *Guide to Managing Construction Hazards*
- SafeWork NSW – *Excavation work code of practice*
- SafeWork NSW – *Work near underground assets guide* 2007

11.1. Application of DSS CAD requirements

DSS CAD requirements apply to services and infrastructure in Sydney Trains heavy rail area only. In DSS, the Sydney Trains heavy rail area is divided into two categories:

- DSS controlled area
- non-DSS controlled area

A DSS controlled area is an area classified as controlled with respect to services information where a DSS has been completed.

Non-DSS controlled area is an area classified as uncontrolled with respect to services information where a DSS has not yet been completed.

The drawings for both areas shall be drawn in accordance with the requirements stated in this section and PR A 00498 *Detailed Site Survey DSS Survey and Drafting*.

11.2. Data Capture

All positional data shall be recorded electronically.

The attribute data shall be recorded electronically (that is, depth and class).

The use of Global Positioning Systems (GPS) or Global Navigation Satellite Systems (GNSS) and remote sensing methods are allowed, provided the required precisions are obtained.

Ground truth points for each base station dataset shall be used to verify GPS or GNSS positions.

11.2.1. Above ground survey feature data

The coordinated 3D location of major above ground features located within the railway corridor including, but not limited to, OHWS, buildings, poles, fences, anchors, major changes in topography (such as ballast, banks and drainage features) and features useful for positioning of users in the field shall be collected and included in the dataset.

11.2.2. Underground service feature data

The coordinated 3D location of all underground services and associated features located within the rail corridor including, but not limited to, empty ducts, gas lines, signal cables, electrical cables and telecommunications, shall be captured.

© State of NSW through Transport for NSW 2021

Service attribute information shall be shown on the plans for underground services.

The service attribute information is to be shown as two tags:

- DEPTH, shown in metres to one decimal place
- CLASS, which is an indicator of both vertical and positional accuracy of location

Positive values indicate the distance down from ground surface to the top of service. Negative or 'zero' values indicate a service is on ground or above and shall not be used.

The tags will be created in the drawing models as either an attributed block containing both tags (in dwg files) or as tags (in dgn files), and each tag shall be attached to the xyz location (at ground surface Reduced Level to which the attribute information refers. The attributed block or tags shall be placed in the same layer as the service identified in accordance with Section 11.5.

The Class Tag is a single letter relating the associated accuracies of the method used to determine the depth and position of the service.

The accuracies listed below are based on AS5488 *Classification of Subsurface Utility Information (SUI)* and have been categorised and summarised for use on DSS drawings into the following classes:

- Class A - validated position by direct survey measurement of both a potholed or exposed service and the corresponding ground surface (for depth calculation).
- Class B - using appropriate surface location techniques (such as electronic detection) and other evidence to determine the approximate position of subsurface services in three dimensions to better than 0.5 metres horizontally and vertically.
- Class C - correlation of aboveground features and approximate position of subsurface services in two dimensions where depth is unknown or not determined.
- Class D - Unknown depth / unknown location

Class C and class D are not to be used for depth tags as this has been replaced by the use of the ‘U’ designator in service labelling; refer to Section 11.5.5 Unlocated or unsurveyed service routes for further information.

The service routes shall be located at angles of horizontal and vertical deviation, significant changes in the ground surface, termination points and at least every 20 m where the service follows a nominal straight path.

11.3. DSS drawing files

The DSS drawing files shall be created as detailed in Section 6.3.1 of this standard.

The DSS plans should be of A3 size at a scale of 1:250, longitudinally orientated with track direction from Sydney on the left. Where the corridor is too wide to fit on A3 sheets, then A2

© State of NSW through Transport for NSW 2021

sheets or A1 sheets may be used, with templates available in landscape and portrait orientations. See Section 6.11 for drawing sheet size.

The sheet layout shown on cover sheet(s) shall be plotted at a scale of 1:2000 on A3 sheets.

Areas of special interest containing condensed services information require plots at a scale of 1:100. Diagrams are to be placed on the sheet for which it is enlarging; if there is insufficient space to place the enlargement on that sheet then it is to be shown on a designated diagram sheet at the end of the plan set. Where diagrams are not placed on the sheet for which they are enlarging, then the cover sheet is to be annotated with the diagram outline and reference to the sheet which the diagram is placed.

11.3.1. DSS model files

The model file shall contain the surveyed feature data represented in a 3D vector graphical format. The model file shall contain the surveyed feature data placed on layers, as defined in Section 6.3.2 and Section 11.5 of this standard.

Data should either be string lines (defined as a connected line-string with 3D coordinates at all vertices) or points (defined by cells/blocks) or polygons.

11.4. Title block for DSS drawings

The DSS drawings shall use the drawing title block as shown in Figure 107.

Section 7 of this standard explains all the smart tags in the title block that are common to all disciplines. The smart tags that are specific to DSS are explained in this section.

The preferred size for DSS drawings is A3.

© State of NSW through Transport for NSW 2021

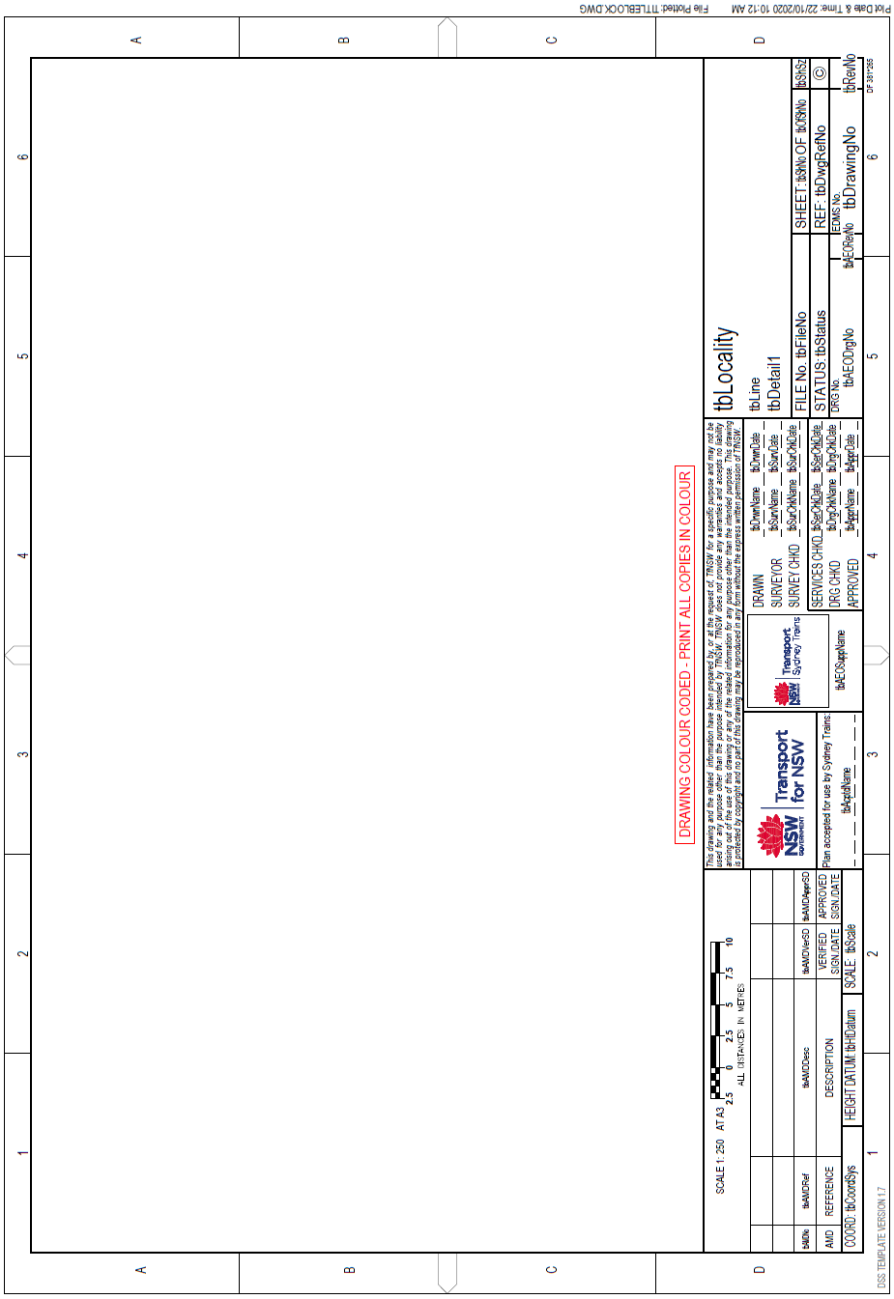


Figure 107 - DSS drawing sheet template

11.4.1. Drawing details box for DSS drawings

The fields present in the drawing details box are explained in Section 7.1.1 of this standard. Where conflicts exist between Section 7.1.1 and this section then this section is to take priority.

Field positions are shown in Figure 108 with a completed example shown in Figure 109. Requirements and standards specific for fields in DSS Drawing Detail Boxes are listed in Table 29.

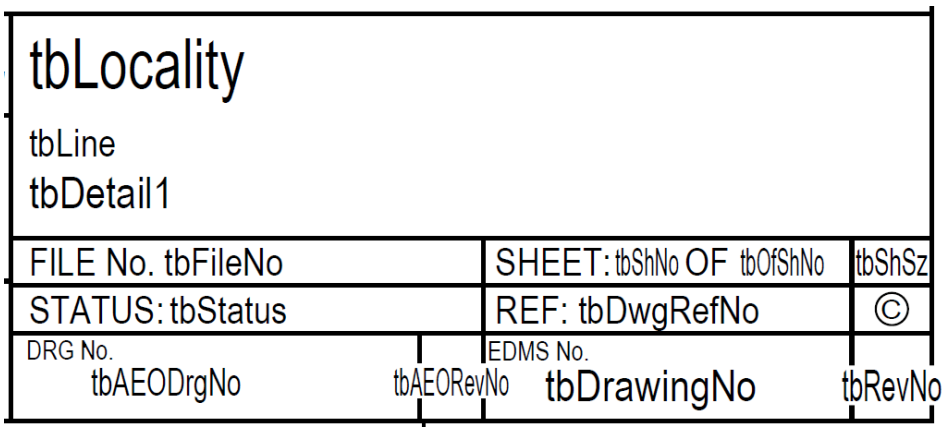


Figure 108 - Drawing detail box on a DSS Drawing

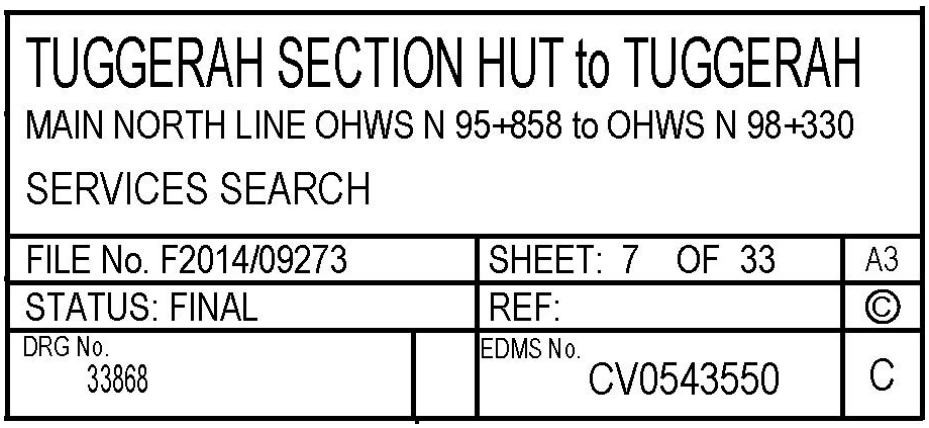


Figure 109 - Example Completed Drawing detail box for DSS Drawing

Table 29 - DSS Drawing Drawing detail box – smart tags description

No.	Field name	Tag	Requirements
1	Locality	tbLocality	Include the main location of the drawing. Refer to T MU AM 01007 TI *Asset Reference Codes Register* for a list of location names.
2	Corridor and Extents	tbLine	Include the formal rail corridor name followed by defining features of coverage extents
3	Drawing Type	tbDetail1	Current State of Plan (i.e. 'SERVICES SEARCH' or 'WORK AS EXECUTED')
4	File number	tbFileNo	Field for DSS TRIM Plan Set Reference Number
5	Sheet Number	tbShNo	Sheet number of a drawing in that set of drawings.
6	Total number of sheets	tbOfShNo	Total number of sheets in a set in which this drawing forms part of, including cover sheets.
7	Sheet size	tbShSz	Indicate the size of the drawing.

© State of NSW through Transport for NSW 2021

No.	Field name	Tag	Requirements
8	Status	tbStatus	Current State of Plan (i.e. 'FINAL', 'WAX' or 'DRAFT')
9	Drawing File Reference	tbDwgRefNo	To use the standard drawing file name convention
10	AEO Drawing File Name	tbAEODrgNo	For AEO Internal use for drawing name
11	AEO Drawing Reference Number	tbAEORefNo	For AEO Internal use for revision number
12	EDMS number	tbDrawingNo	Include the EDMS number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom), and is unique for each drawing. There should be no gap character between letters and numbers. See Section 8.1 for details.
13	EDMS amendment level (revision associated with EDMS number)	tbRevNo	Indicate the EDMS amendment level, which is related to the EDMS number and shall be changed only when the drawings are submitted to VPR. See Section 7.4 for details.

11.4.2. Sign-off box for DSS drawings

The sign-off box for the DSS drawing shall contain signatures, full name and date of signature of the person who performed the tasks including drawn, surveyor, survey checked, services checked, drawing checked and approval of the drawing for release. Figure 110 shows the sample sign-off box for DSS drawings.

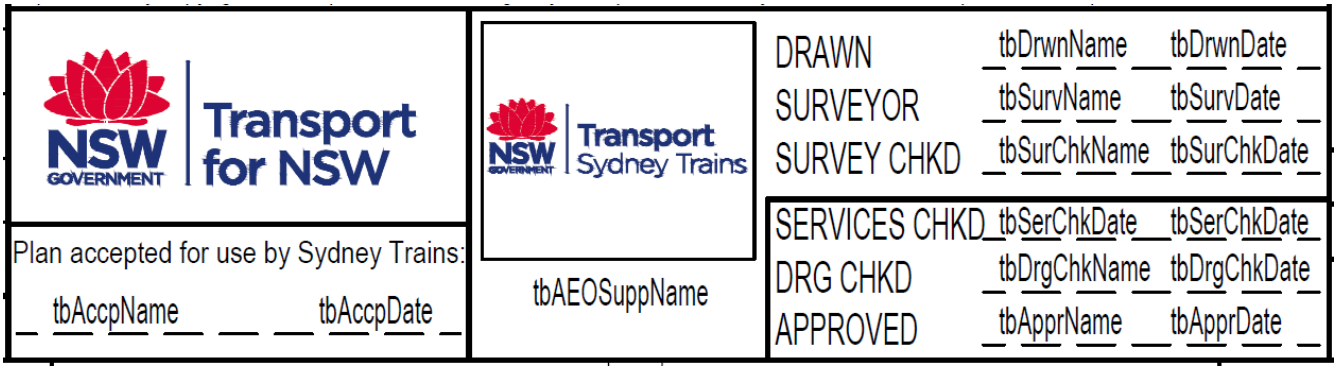


Figure 110 - Sign-off box on a DSS drawing

Table 30 provides a list of the field names in the sign-off box of the DSS drawing and their requirements.

Note: Where the first name of the person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.

© State of NSW through Transport for NSW 2021

Table 30 - DSS Drawing Sign-off box – smart tags description

No.	Field name	Tag	Requirements
1	Drawn by (Name)	tbDrwnName	Include the full name of the draftsperson.
2	Drawn date	tbDrwnDate	Include the date of sign-off by the draftsperson.
3	Surveyor (Name)	tbSurvName	Include the full name of the surveyor who surveyed the area.
4	Surveyed date	tbSurvDate	Include the date of sign-off by the surveyor.
5	Survey checked by (Name)	tbSurChkName	Include the full name of the person who checked the survey information.
6	Survey checked date	tbSurChkDate	Include the date of sign-off by the survey checker.
7	Services checked by (Name)	tbSerChkName	Include the full name of the person representing the operator and maintainer who checked the services shown on the drawing.
8	Services checked date	tbSerChkDate	Include the date of sign-off by the services checker.
9	Drawing checked by (Name)	tbDrgChkName	Include the full name of the person representing the operator and maintainer who checked the drawing.
10	Drawing checked date	tbDrgChkDate	Include the date of sign-off by the drawing checker.
11	Approver (Name)	tbApprName	Include the full name of the person representing the operator and maintainer who approved the plan to be released.
12	Approved date	tbApprDate	Include the date of sign-off by the plan approver.
13	Surveyor company name	tbAEOSuppName	Include the name of the survey company.
14	Plan accepted for use by Sydney Trains	tbAccpName	Include the full name of the person who accepted the plan for use by Sydney Trains.
15	Plan accepted for use by Sydney Trains	tbAccpDate	Date when plan accepted for use by Sydney Trains.

11.4.3. Amendment box for DSS drawings

The fields present in the amendment box are explained in Section 7.1.3 of this standard. Additional fields specific to DSS are shown in Figure 110. Requirements specific to DSS Drawings shown in Figure 111 are listed in Table 31.

© State of NSW through Transport for NSW 2021

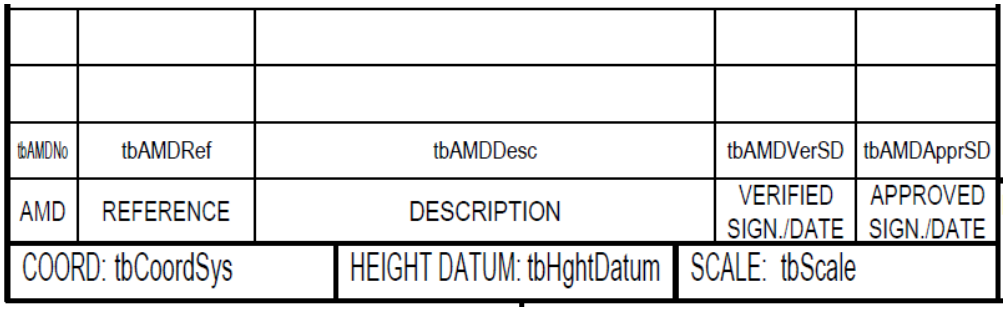


Figure 111 - Amendment box on a DSS drawing

Table 31 - DSS Drawing Amendment box – smart tags description

No.	Field name	Tag	Requirements
1	Amendment level	tbAMDNo	Indicate the amendment level of current revision.
2	Amendment reference	tbAMDRef	To include District Reference Number (DRN) for which control of the DSS plans was granted and if available Configuration Change Request Number (CCR) is also to be listed.
3	Amendment description	tbAMDDesc	Include a brief description of the reason that the amendment to the plan was required.
4	Amendment verifier sign	tbAMDVerSD	Include the first initial and surname of the person who verified the amendment and the date of signature.
5	Amendment approver sign	tbAMDApprSD	Include the first initial and surname of the person who approved the amendment and the date of signature.
6	Co-ordinate system	tbCoordSys	Required for drawings containing survey coordinates, generally Integrated Survey Grid (ISG), Map Grid of Australia 1994 (MGA) or Map Grid of Australia 2020 (MGA2020)
7	Height datum	tbHghtDatum	Required for drawings containing surveyed levels, typically Australian Height Datum (AHD)
8	Scale	tbScale	The major scale of a drawing.

11.5. Route code and layer definitions for services identification

Section 11.5.1 provides standard codes and equivalent CAD layer numbers, which represent services and their installation type. This shall be used as the basis for classification of services and their construction method in the CAD file format.

11.5.1. Route codes and definitions

DSS services data shall be segregated into layers as shown in Figure 112 and Figure 113.

Table 32 to Table 35 list the acronyms used in Figure 112 and Figure 113.

© State of NSW through Transport for NSW 2021

The information in Figure 112 and Figure 113 represents layer structure for AutoCAD. The layer names and the number descriptors for MicroStation shall be similar to AutoCAD.

Layer 0 is reserved for the Control Area Boundary (CAB); represented by a closed 2D polyline.

Layers 1 to 196 are reserved for Sydney Trains services; represented by a 3D line with vertices at ground level.

Layer 197 is reserved for large pits; represented as a closed 3D polyline.

Layer 198 is reserved for small pit centroids; represented as a 3D point.

Layer 199 is reserved for unknown services or undefined service mixes; represented by a 3D line.

Layers 200 to 299 are reserved for external agency services; represented by a 3D line.

Prefixes and suffixes are not permitted, that is, 4, not 04 or cable4.

If a service is unable to be located accurately, then the service shall be clearly marked as unlocated and unsurveyed on the drawing; see Section 11.5.5 for more information.

Accuracy of locate for buried services shall be shown in accordance with Section 11.2.2.

Table 32 - Sydney Trains services descriptor

Descriptor	Meaning
S	Signal cable
C	Copper communications cable
OF	Optic fibre cable (for any Sydney Trains branch)
LV	Low voltage power - Voltages less than or equal to 1000 V AC or 1500 V DC
HV	High voltage - Voltages greater than 1000 V AC or 1500 V DC
EB	Electrolysis bond cable
CCTV	Closed circuit television
SD	Station data (Smartcard and miscellaneous data cabling)
DC	1500 V direct current system cable
CUL	Culvert
TD	Drainage Pipe
CA	Compressed air
AR	Abandoned route
USM	Un-coded service mix

Table 33 - External agency services descriptor

Descriptor	Meaning
PL33	Electric power cable less than 33 kV
EXT	External agency service (consult asset owner)

© State of NSW through Transport for NSW 2021

PG33	Electric power cable equal to or greater than 33 kV
GLP	Low pressure gas main
GHP	High pressure gas main - secondary main or greater
TLS	Telstra
OPT	Optus
PWL	Powertel
UE	UEComm
VS	Vision Stream
WTR	Water
SWR	Sewer
OS	Other service(s) – *(includes ARTC services)*
DRE	Drainage service
RMS	Roads and Maritime Services
NBN	National Broadband Network

Table 34 - Route descriptors

Descriptor	Meaning
AG	Above ground
DB	Direct buried
GST	Galvanised steel troughing
GLT	Ground level troughing
P	Ducted pipe
UB	Directional under bore
ARL	Aerial
NS	Not specified (consult Asset Owner)

Table 35 - Other descriptors

Descriptor	Meaning
CAB	Under control area boundary
PIT	Service pit
E	Earth conductor (Sydney Trains or external agency)
F	Liquid Fuel Line (Sydney Trains or external agency)
U	Unlocated unsurveyed service (approximate position only)
R	Redundant cable (type known, left in situ)

© State of NSW through Transport for NSW 2021

Layer No.	Description	Route Type	Layer No.	Description	Route Type	Layer No.	Description	Route Type
0	CAB	-	50	S, C, LV	GST	100	S, OF	UB
1	S	DB	51	S, C, LV	GLT	101	LV, HV	UB
2	S	GST	52	S, C, LV	P	102	S, C, OF, LV	UB
3	S	GLT	53	S, C, HV	DB	103	S, C, OF, HV	UB
4	S	P	54	S, C, HV	GST	104	S, C, OF, LV, HV	UB
5	C	DB	55	S, C, HV	GLT	105	LV	ARL
6	C	GST	56	S, C, HV	P	106	HV	ARL
7	C	GLT	57	S, OF	DB	107	DC	DB
8	C	P	58	S, OF	GST	108	DC	GST
9	S, C	DB	59	S, OF	GLT	109	DC	GLT
10	S, C	GST	60	S, OF	P	110	DC	P
11	S, C	GLT	61	LV, HV	DB	111	E	NS
12	S, C	P	62	LV, HV	GST	112	EB	NS
13	OF	DB	63	LV, HV	GLT	113	CCTV	P
14	OF	GST	64	LV, HV	P	114	CCTV	GST
15	OF	GLT	65	S, C, OF, LV	DB	115	CCTV	GLT
16	OF	P	66	S, C, OF, LV	GST	116	CCTV, C	P
17	LV	DB	67	S, C, OF, LV	GLT	117	CCTV, C	GST
18	LV	GST	68	S, C, OF, LV	P	118	CCTV, C	GLT
19	LV	GLT	69	S, C, OF, HV	DB	119	CCTV, LV	P
20	LV	P	70	S, C, OF, HV	GST	120	CCTV, LV	GST
21	HV	DB	71	S, C, OF, HV	GLT	121	CCTV, LV	GLT
22	HV	GST	72	S, C, OF, HV	P	122	CCTV, C, LV	P
23	HV	GLT	73	S, C, OF, LV, HV	DB	123	CCTV, C, LV	GST
24	HV	P	74	S, C, OF, LV, HV	GST	124	CCTV, C, LV	GLT
25	S, C, OF	DB	75	S, C, OF, LV, HV	GLT	125	SD	P
26	S, C, OF	GST	76	S, C, OF, LV, HV	P	126	SD	GST
27	S, C, OF	GLT	77	*DO NOT USE*	-	127	SD	GLT
28	S, C, OF	P	78	*DO NOT USE*	-	128	S	ARL
29	C, OF	DB	79	CUL	NS	129	C	ARL
30	C, OF	GST	80	TD	NS	130	OF	ARL
31	C, OF	GLT	81	*DO NOT USE*	-	131	F	NS
32	C, OF	P	82	*DO NOT USE*	-	132	VACANT	P
33	OF, LV	DB	83	CA	DB	133	VACANT	GST
34	OF, LV	GST	84	CA	AG	134	VACANT	GLT
35	OF, LV	GLT	85	AR	NS	135	VACANT	UB
36	OF, LV	P	86	S	UB			
37	OF, HV	DB	87	C	UB	136	*DO NOT USE*	-
38	OF, HV	GST	88	S, C	UB	to		
39	OF, HV	GLT	89	OF	UB	196	*DO NOT USE*	-
40	OF, HV	P	90	LV	UB			
41	S, LV	DB	91	HV	UB	197	PIT (polygon)	n/a
42	S, LV	GST	92	S, C, OF	UB	198	PIT (point)	n/a
43	S, LV	GLT	93	C, OF	UB	199	USM	NS
44	S, LV	P	94	OF, LV	UB			
45	S, HV	DB	95	OF, HV	UB			
46	S, HV	GST	96	S, LV	UB			
47	S, HV	GLT	97	S, HV	UB			
48	S, HV	P	98	S, C, LV	UB			
49	S, C, LV	DB	99	S, C, HV	UB			

Figure 112 - Layer structure for Sydney Trains services

© State of NSW through Transport for NSW 2021

Layer No.	Description	Route Type	Layer No.	Description	Route Type
200	PL33	EXT	228	OS	NS
201	PG33	EXT	229	TLS	UB
202	GLP	EXT	230	OPT	UB
203	GHP	EXT	231	PWL	UB
204	TLS	DB	232	VS	UB
205	TLS	GST	233	PL33	ARL
206	TLS	GLT	234	PG33	ARL
207	TLS	P	235	DRE	P
208	OPT	DB	236	TLS	ARL
209	OPT	GST	237	OPT	ARL
210	OPT	GLT	238	PWL	ARL
211	OPT	P	239	VS	ARL
212	PWL	DB	240	OS	ARL
213	PWL	GST	241	OF	ARL
214	PWL	GLT	242	E	NS
215	PWL	P	243	F	NS
216	VS	DB	244	RMS	P
217	VS	GST	245	RMS	GST
218	VS	GLT	246	RMS	GLT
219	VS	P	247	RMS	ARL
220	WTR	NS	248	NBN	DB
221	SWR	NS	249	NBN	GST
222	OS	DB	250	NBN	GLT
223	UE	DB	251	NBN	P
224	OS	GST	252	NBN	ARL
225	OS	GLT			
226	OS	P			
227	OS	UB			

Figure 113 - Layer structure for external agencies services

11.5.2. Multiple and combined service routes

Where multiple services share a common route, the route shall be located and categorised uniquely in accordance with Section 11.5.1 and according to the trench and trough methodology.

The trench and trough methodology is used to determine whether multiple services should be combined from their individual descriptors to a combined descriptor based on whether the services are located in the same galvanised steel or ground level “trough” or have been laid combined in a single “trench” in the case of direct buried, pipes and underbores.

For example, where signal cables and comms cables have been placed in separate galvanised steel troughs on the same posts then this would be shown as both a -2- and -6- route respectively on top of each other where if they were both located together in one single trough then they would be shown as a single -10- in accordance with Section 11.5.1.

Another example is if signal cables and LV cables in ducted pipes were not laid in the same trench at the same depth they would be shown in as -4- & -20- respectively however if they are

© State of NSW through Transport for NSW 2021

laid together in a combined services route where ducted pipes are laid bundled together than this would be shown as a -44- route.

Where multiple pipes containing the same service are laid together at the same depth in the same trench then this is to be shown as a single service, for example, 3 pipes in the same trench with signal cables in each pipe would be shown as a single -4- route.

The reduction of multiple services also applies to the trench and trough methodology. For example, where 5 signal cables and 2 comms cable in separate ducted pipes are in the same trench it would be represented by a single -12- route.

11.5.3. Vacant service routes

Vacant descriptors are to be used only where the vacant route is not in the same trench as other services or if reserved for installation of a specific future service. Where spare vacant pipes are in the same trench as services then they are not to be included in the displayed routes. For example, 5 pipes laid in a trench where 3 contain communications cable and two are vacant would be represented by a single -8- route.

Vacant routes reserved for future services are to be identified by the use of a note on the face of the plan stating the reservation for the specified service, that is, “NOTE: -132- IS RESERVED FOR COMMUNICATIONS”.

Where all services have been removed from an existing route then the plan shall be updated to reflect that the route is now vacant.

11.5.4. Redundant service routes

Redundant services are identified by the suffix ‘R’ after the route number and should be placed on the layer of origin. For example, a redundant signals cable –4R– should be placed on layer 4 (with linetype as -4R- applied to line).

If the origin of a redundant route is unknown, then it is to be shown as -199R-. If the unidentified services cannot be verified as redundant then they are to be treated as live and shown as -199-.

11.5.5. Unlocated or unsurveyed service routes

Services that are known to be in an area, but are not able to be accurately located or surveyed, are given a ‘U’ suffix and should be placed on their respective layer. For example, unlocatable optic fibre cable should be shown as –16U– (using -16U- linetype) and should be placed on layer 16.

The ‘U’ signifies that the position of that particular service is approximate only, and should be verified by potholing prior to carrying out any design or excavation works.

Where an unsurveyed service is also redundant then it shall be shown using the ‘U’ designator in the linetype and if space and clarity permits then a “REDUNDANT” text label is to be placed

© State of NSW through Transport for NSW 2021

parallel and adjacent to the route. If insufficient space to add the text then it is to be annotated with a leader and text stating “U” routes is also redundant, i.e. “-9U- IS REDUNDANT”.

'U' routes should only be used when absolutely necessary and are not accepted as part of work-as-executed for new installations and shall only be used when there is no other way of locating the route.

‘U’ routes shall be placed at RL-99.

11.5.6. Service route annotations

Where routes exit ground or terminate at a feature that is not representable by available DSS symbols, structure lines or standards then a note should be annotated to the end point through use of a leader (for example, “-132- CAPPED” or “UP AWNING”).

Where routes that are typically buried are on ground level or above they should be annotated with textbox to denote their position with either a leader with text denoting service and position (for example, “-4- ON GROUND”) or text denoting position immediately adjacent and parallel to the service if space permits (for example, “ABOVE GROUND”).

Where multiple routes overlap and are illegible then a leader with text identifying the routes shall be used to clarify the services in an area.

Where routes are too short to display the route linetype (that is, route displays as a solid line) then a text will be placed adjacent and parallel to the service displaying only the route number. The colour of the text shall match the colour of the service. If insufficient space exists to show place the text then a leader with text box shall be used to identify the route with the route number prefixed and suffixed with “-“,for example, shown as “-20-“.

11.6. Symbols for DSS drawings

Figure 114 shows the symbols that shall be used in the DSS drawings and DSS field drawings. The symbols for DSS drawings are defined in the DSS CAD template file available in AutoCAD dwg format from the USU.

DSS-1 Air Equipment	**DSS-6** Antenna	**DSS-8** Telephone	**DSS-12** Drainage Pit	**DSS-13** Drainage Inspection Pit (Flush Point)	**DSS-16** Junction Box

© State of NSW through Transport for NSW 2021

DSS-17 Negative Bus Bar	**DSS-28** Bollard	**DSS-32** High Pressure Oil Marker	**DSS-36** High Pressure Gas Marker	**DSS-39** Gas Equipment	**DSS-40** RMS Traffic Light
DSS-54 Cable Marker	**DSS-57** Sign	**DSS-58** Km – ½ Km Post	**DSS-59** Column	**DSS-61** Anchor Block	**DSS-63** OHW Structure
DSS-72 Small Pit (<0.5m)	**DSS-73** Optic Fibre Marker	**DSS-77** Light	**DSS-79** Power Pole	**DSS-80** Electric Light Pole	**DSS-81** Power & Light Pole
DSS-82 Power & Transformer Pole	**DSS-86** Sewer Pit	**DSS-88** Sewer Vent Pipe	**DSS-89** Small Location	**DSS-92** Impedance Bond	**DSS-94** Railway Tuning Unit
DSS-96 Railway Warning Light	**DSS-97** Points Equipment	**DSS-98** Train Stop	**DSS-99** Mechanical Points Lever	**DSS-100** Surface Feeder Cable	**DSS-101** Railway Signal
DSS-102 Railway Level Crossing	**DSS-103** Buffer Stop	**DSS-112** Survey Mark	**DSS-116** Transponder	**DSS-117** Telstra Cable Marker	**DSS-118** Telstra Distribution Pillar

© State of NSW through Transport for NSW 2021

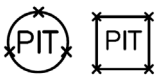
DSS-132 Earth Terminal	**DSS-133** Water Hydrant	**DSS-134** Water Meter	**DSS-135** Water Tap	**DSS-137** Stop Valve	**DSS-138** Points Indicator
DSS-139 Guards Indicator	**DSS-140** Transformer	**DSS-145** Gas Pipeline Marker	**DSS-146** Boot Leg Riser	**DSS-154** Stay Pole	**DSS-157** Ticketing Machine
DSS-159 CCTV Camera	**DSS-160** Track Side Equipment	**DSS-161** Headwall (< 1.0m)	**DSS-162** P.A. System Speaker	**DSS-163** Power Pole & Junction Box	**DSS-164** Light & Guard Indicator
DSS-165 Light & CCTV	**DSS-166** Light & P.A. System Speaker	**DSS-167** Light & CCTV & P.A. System Speaker	**DSS-175** Balise (Control)	**DSS-176** Balise (Fixed)	
DSS-Billboard Billboard (with Posts)	**DSS-Billboard** Billboard (on Wall)	**DSS-GATE** Gate	Drainage Pit (>1m)	Junction Box (with side >1m)	Location (with side >1m)
					
Large Pits (Diameter / Side >1m with Routes)	Sewer Pits (Side / Diameter >1m)	**DSS-X** Survey Shot Cross	Transformer (>1m)	Large Pits (Side / Diameter >1m with No Routes)	

Figure 114 - DSS drawing symbols

11.6.1. Point features and symbol library for DSS drawings

All points along a service route that are captured by survey shall be represented by a cross on layer F-SURV-SYMB. This excludes end points of strings where symbology is available for the feature; for example, small pits, gate ends and signals.

Only one block or cell shall be used to represent a surveyed point.

The DSS CAD template file, available from USU, contains the CAD block definitions for all symbols. The symbol definitions found in the template file are required to be used for all symbols in producing DSS drawings. Blocks for all point features shall be drawn using this library.

11.6.2. Symbols and large structures

Large pits

Circular pits with a diameter greater than 1 metre and rectangular pits with any side length greater than 1 metre are classified as large pits, and shall be represented by 'closed' polygons to true scale and shape of the pit. These pits shall be placed in layer 197.

For large pits, the service routes shall extend at least to the interior of the polygon outlining the pit extremities. The services can connect to the centroid point of the polygon if it exists; however, this is not essential. This applies for all pits including drainage, sewer and services pits.

Where there are no services entering a pit and it doesn’t contain either the sewer or drainage designator then a “PIT” text is to be placed inside the Pit to identify it as a pit.

Small pits

Pits with a diameter or all side lengths less than 1 metre are classified as small pits, and shall be represented by the appropriate symbol and also a point on layer 198.

For small pits, the service routes should connect to the insertion point of the point feature.

Headwalls

Headwalls with all face lengths of less than 1 metre are classified as small headwalls, and shall be represented by a symbol at the pipe invert. Larger headwalls shall be plotted to scale.

Headwalls shall be placed on layer F-DRAN.

Locations, transformers and junction boxes

Locations, transformers and junction boxes with any face length of greater than 1 metre are to be represented as a closed 3D polyline showing their true scale and shape their respective

© State of NSW through Transport for NSW 2021

symbols and/or annotations added to represent the symbol. Services feeding into the structure shall extend inside of the closing 3D polyline.

Where all sides are less than 1 metre then the appropriate point feature symbol is to be used and any services feeding into the structure shall join to the insertion point of the symbol.

Other symbols

Other features represented by a symbol from the library shall have any connecting services connect at the insertion point of the symbol. At the insertion point of a symbol there shall not be any other symbol shown. The only exception of where two symbols can be shown at the same point is the showing of both the “DSS-X” and “DSS-DEPTH-ROUTE” blocks at the same point, but the showing of either of those symbols with any other symbol at the same point is not allowed.

11.7. Colours for DSS plans

Table 36 provides a list of colours that shall be used on all DSS plans.

Table 36 - Colours for DSS plans

Colour	Sample colour	Description
Black / Grey		Existing infrastructure such as fences, buildings, platforms and tracks
Blue		Existing internal (Sydney Trains) services such as signals, communications, electrical, and civil
Green		Existing external agency services such as Telstra, Optus, AGL
Red		Proposed works such as service routes, signals, buildings, level crossings
Pink		Work as executed data identifying infrastructure or services installed or modified
Orange		Work as executed data identifying infrastructure or services removed
Yellow		Control area boundary

11.8. Text for DSS drawings

Font types have been defined in the DSS CAD Template file. Where textstyles use Shapefile font definitions, the definition file is available from USU.

Any text and associated linework (that is, leaders and text box outlines) related to routes shall be located on layer F-MISC-TEXT, separate to route layers. Other text shall be placed on layers as defined in Section 6.9 of this standard. For example, stanchion labels for OHWS shall be placed on layer F- OHWS-TEXT.

The height and line weight of the text shall be in accordance with Section 6.6.3 of this standard.

© State of NSW through Transport for NSW 2021

11.9. Work as executed

Work as executed (WAsEx) plans shall be prepared for all new Sydney Trains and external agency services and infrastructure and for any changes to existing services and infrastructure. The data shall be collected in a coherent way to enable the creation of a new plan, or update to an existing registered plan in VPR.

For new services, sufficient measurements shall be taken to locate bends, curves and terminals of the services, to enable updating of the DSS CAD models and plans.

Any existing services found, but not shown on the existing DSS plans, shall be located and included in the update as 'WAsEx by others'. Every effort shall be made to determine the origin of these services.

In DSS controlled areas, the data will be used to update the existing DSS plan(s) and to update the Corporate GIS.

In non DSS controlled areas, the data will be used to produce a ‘services only plan’ that complies with the general CAD requirements of a DSS, but with limited features surveyed. This is to allow for easy integration of the data when the area is converted to a DSS controlled area, and to allow the data to be immediately entered into the Corporate GIS. These plans shall be registered in the VPR.

11.9.1. New DSS drawing required

A decision as to whether a new DSS drawing is required shall be made after consultation between the project manager, survey consultant and DSS survey coordinator.

If required, a new DSS drawing shall be created and reviewed in accordance with the requirements outlined in Section 11.2.

11.9.2. Existing drawings updated

Work to amend DSS CAD drawings shall only be undertaken by suitably qualified CAD operators.

Attribute information shall be added to the drawings at this stage in accordance with the requirements outlined in this document.

The image renditions and CAD files shall be forwarded to the USU unit for compliance checking.

11.9.3. DSS - Drawing approval

The AEO delegated officer (project engineer / project manager) shall verify and sign off the drawings as being a true and accurate record of the works carried out. The relevant CCR

© State of NSW through Transport for NSW 2021

number or district reference number (DRN) shall be included on these drawings amendment box; see Section 11.4.3.

The TfNSW or Sydney Trains project interface manager or Sydney Trains project engineer / manager shall also sign off these drawings as approved and ensure that the configuration change procedures are followed.

WAsEx data and final DSS drawings shall be submitted to the USU team in CAD and PDF format including signed verified and approved PDFs for acceptance.

Upon receiving all of the above documentation the Sydney Trains' Configuration Change Representative from USU will accept the completed WAsEx drawings and is only then able to approve any forms or documentation related to the associated CCR number and/or Final Completion Certificate.

11.9.4. Drawing layers colour change

When the updated DSS files are accepted as a compliant representation of the works completed, the WAsEx data shown shall be converted to the standard DSS colour coding to represent the installed services. Final image renditions shall be produced, with a new amendment together with a final CAD file.

11.9.5. DSS VPR submission

Compliant CAD and image rendition files containing WAsEx details shall be forwarded to Sydney Trains' GIS unit by the USU team for updating of the Corporate GIS.

The USU team shall provide completion advice and submit FINAL drawings to the VPR, and arrange for superseded drawings to be archived.

12. Architectural CAD requirements

The architectural CAD requirements are applicable to architectural drawings produced for TfNSW rail projects. These requirements should be read in conjunction with Section 6 of this standard.

Where conflict exists between the two sections, then the architectural CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

12.1. Title block for architectural drawings

The architectural drawings shall use the drawing title block as explained in Section 7 of this standard. Figure 115 shows an example of a completed title block for architectural drawings.

© State of NSW through Transport for NSW 2021

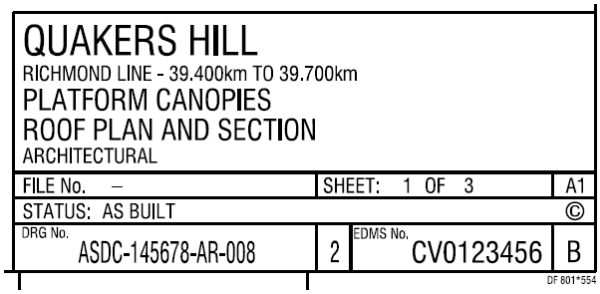


Figure 115 - Completed drawing title block for architectural drawings

12.2. Seed files for architectural drawings

Refer to Section 6.10 of this standard for architectural drawings' seed files.

12.3. Level symbology for architectural drawings

Different drawing elements should be drawn on different layers as explained in Section 6.9 of this standard.

Download file T MU MD 00006 R5 *Architecture CAD Resources.*

12.4. Railway drawing convention

The preparation of architectural drawings for TfNSW shall comply with the following drawing conventions:

- Sydney is always drawn on the left-hand side of the drawing sheet.
- If the work area is adjacent to the running tracks, the tracks should be indicated on the plan. Tracks may be shown as a single thin line, a centreline symbol, or as two thin lines representing the individual rails, depending upon scale and proximity to the work site.
- Other items that can be shown include the following:
    - railway boundary
    - road access and adjacent public roads including kerbs, gutters and pavements
    - railway infrastructure such as overhead wiring masts, signals, power poles, lighting poles, and so on
    - fences and gates
    - embankments, cuttings, slopes, and so on
    - drainage – surface, subsurface, and track related
    - structure gauge clearances to walls, roofs, and other proposed structures
    - adjacent property ownership and boundaries

© State of NSW through Transport for NSW 2021

13. Electrical CAD requirements

The electrical CAD requirements apply to electrical drawings that are produced for TfNSW rail projects. These requirements should be read in conjunction with the general requirements in Section 6 of this standard.

Where conflict exists between the two sections, then the electrical CAD requirements take precedence over the general requirements unless the general requirements expressly states otherwise.

13.1. Title block for electrical drawings

Electrical drawings shall use the drawing title block as explained in Section 7.1 of this standard. Figure 116 shows an example of a completed title block for electrical drawings.

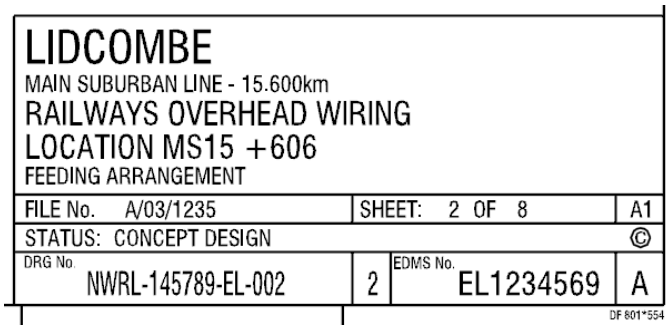


Figure 116 - Sample completed drawing title block for electrical drawings

The following are different electrical job description or categories for electrical drawings:

- railways overhead wiring
- HV aerial lines and cables
- substations
- distribution power supply
- low voltage electrical services
- sectioning huts
- earthing and bonding

The following are some examples of electrical drawing types:

- layout
- general arrangement
- fitting details
- connection diagram

© State of NSW through Transport for NSW 2021

- site plan
- switching arrangement
- cross-section
- schematic diagram
- assembly
- feeding arrangement
- profile
- single line diagram

13.2. Seed files for electrical drawings

The following seed files should be used for creating electrical drawing files (2D drawings with title block):

- EL_model3Dsheet2D_m.dgn (contains 3D model space and 2D drawing sheet with units of measure set to metres and decimals of metres)
- EL_model3Dsheet2D_mm.dgn (contains 3D model space and 2D drawing sheet with units of measure set to millimetres and decimals of millimetres)

These files are available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R6 *Electrical CAD Resources*.

13.3. Cell libraries for electrical drawings

The following cell libraries should be used for producing electrical drawings:

- EL_SCHM_AS1102_25M.cel
- EL_OHWiring_V8.cel
- EL_OHWLayout_V8.cel
- EL_Transmission_Line.cel

A complete list of cells can be obtained by downloading the resource files from the AMB section of the TfNSW website.

Download file T MU MD 00006 R6.

© State of NSW through Transport for NSW 2021

13.4. Types of electrical drawings

The electrical design drawings are broadly classified into two types as follows:

- general drawings
- site-specific design drawings, such as substation drawings, overhead wiring (OHW) layout drawings and high voltage (HV) aerial line and cable drawings

13.5. General drawings

General drawings are detail drawings of type approved electrical equipment, standard designs, fittings or assemblies, which are not site-specific. They can be used on any part of the rail electrical network. These drawings act as a template for creating designs for those repeated features. These drawings shall be accepted by the Director Energy Networks & Systems, AMB.

Amendments to general drawings shall also be accepted by the Director Energy Networks & Systems, AMB.

General drawings are similar to AMB standard drawings, but they may not be published and may not be referenced in AMB standards.

13.5.1. Drawing title block

The drawing title block shall be filled in as for AMB standard drawings described in Section 6.1.2, except for the following:

- the ‘Location’ field in the drawing details box shall contain the word “GENERAL”, and the acceptance box for the signature by the Director Energy Networks & Systems, AMB shall be located above the drawing details box
- EDMS numbers are not assigned by the AMB
- In the amendment box, ‘APPROVED’ shall be replaced by ‘ACCEPTED’

13.6. Site-specific design drawings

A site-specific electrical drawing shows the layout and location of electrical equipment for a particular site. It shows the basic civil and structural infrastructure along with the electrical equipment. These drawings should be drawn on an appropriate drawing sheet to display the information clearly. See Table 7 for more information.

© State of NSW through Transport for NSW 2021

13.6.1. Substation drawings

The purpose of the substation drawing set is to show the layout, location and detail drawings for a substation. The following is the typical drawing types required for a substation:

- drawing index
- site plan
- ground plan
- single line diagram
- lighting layout
- building requirements
- arrangement (indoor and outdoor)
- schematics
- line differential scheme
- earth potential rise (EPR) drawing
- cable schedule
- allocation of conduits
- interconnection block diagram
- fire system
- lightning protection system
- SCADA I/O schedule
- SCADA and communication block diagram
- crane and float access diagram
- power cable installation procedure

These drawings are in addition to those produced by the manufacturer of equipment as required by the relevant TfNSW equipment standards. Table 37 provides a list of the electrical drawing types and the content description for a substation design. The list of drawing types are applicable to locations such as sectioning huts, switching station, substations, low voltage (LV) switchrooms, padmount locations, and 1500 V isolating and rail connection (IRCS) switch yards

© State of NSW through Transport for NSW 2021

Table 37 - Substation drawings standard - drawing contents

Drawing type	Views	Content description and notes
Covering sheet/drawing index (for a location)	NA	The covering sheet should have a document list as an index showing: • All the electrical substation design drawings created for the project. • The installed electrical equipment with the cross-reference to all the manufacturer's equipment drawings. • List of design reports and associated reference number. The drawing numbers listed shall be both EDMS number and the corresponding design AEO drawing number.
Site plan	Plan view	The purpose of the site plan is to depict accurately the location and site requirements of the substation in relation to its geographical location, geographical details and relationship with surrounding infrastructure and services. The proposed location and extents should be shown and suitably dimensioned to facilitate set out by survey on site and preparation of detailed building requirements. Interfaces with both current and proposed electrical infrastructure should be shown on the drawing. The following contents should be included in the survey information of the site where the substation is proposed to be located: • ground contours • relevant property boundaries and easements • all existing services, both buried (water, gas, sewer) and above ground (HV aerial lines and aerial telephone or communication cables) • major geographical features (trees, creeks, natural drainage) • existing roads and associated gutters or driveways, boundary fences • railway tracks and orientation to Sydney • proposed location of facility and site requirements • OHW structures, signals, gantry structures • route of underground cables to supply points • route of 1500 V positive and negative cables • cross-sections relating to the above cables • relevant notes, if required, detailing easement and property boundary peculiarities
Ground plan	Plan view	The purpose of the ground plan is to accurately display and detail civil infrastructure elements such as equipment footings, concrete hobs and drainage requirements in the substation yard. The following contents should be shown: • perimeter fence • substation building • access roadways • railway tracks and orientation to Sydney • existing infrastructure elements • major geographical features such as embankments • outdoor equipment foundations including construction centrelines

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Building requirements	Plan view and Sections	The purpose of building requirements drawing is to show the base parameters. The base parameters enable the production of detailed civil designs for the substation building. The contents should include the requirements of the *National Construction Code (NCC), volume one* for the following items: • building dimensions and outline, including height of ceilings, doorway heights and widths • pits, conduits, cable access requirements • equipment footprints and associated weight • noise requirements • access requirements (such as concrete landing area at main access doors) • heat loading and associated ventilation requirements • floor tolerances (level and hardness for DCCBs and ac switchgear) • special requirements for ceiling areas above DCCBs
Lighting	Layout, Sections and Elevations	The purpose of the lighting design drawings is to detail the installation requirements of the light fittings to ensure compliance with the modelling for illumination levels and requirements of AMB standard T HR SS 80001 ST. The typical content of the lighting drawings are as follows: • Separate drawings for internal and external lighting. There should be a separate drawing for each internal level of the substation. • Location of fittings superimposed over the plan view of the internal and external equipment layout. • Relevant sections and elevations to detail the height and location of fittings and installation method. • Identification of fittings and circuits. Circuits to be identified to reflect the normal/emergency lighting circuit and the 125V dc lighting circuit. • Critical distances from exposed equipment and restricted installation zones to be shown. • Location of light switches, daylight sensors. • Notes and reference to related drawings. • Legend and notes. This is usually a separate drawing associated with 415/240V power drawings.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
240/415V AC General Power Outlets	Layouts, Sections and Elevations	The purpose of the AC auxiliary supply drawing is to detail the location type and associated connectivity of the 415/240V equipment such as the auxiliary transformer, ac distribution boards, ac power outlets within and external to the substation. • Separate drawings for internal and external GPOs. There should be a separate drawing for each internal level of the substation. • Location of GPOs superimposed over the plan view of the internal and external equipment layout. • Relevant sections and elevations to detail the height and location of GPOs and installation method if required. • Identification of the type of GPO and associated power circuit. • Notes and reference to related drawings (e.g. Cable schedule, 240/415V ac distribution board schematic). • Legend and notes. This is usually a separate drawing associated with 415/240V power drawings.
Crane and float access diagram	Plan and section	The purpose of crane and float access drawing is to show the position of the crane and associated float for lifting major items of equipment (typically rectifier transformers, system transformers and reactors). The content should include the following: • plan view of the substation building including the outdoor area, transformer bays, with access roads, fences and access gates detailed • cross-sections detailing critical pinch points in relation to the lift of the equipment • view of the crane in position with outriggers extended and the required transport float in position • detail of buried infrastructure which is relevant to the access roads and positioning of the crane, its outriggers and transport float. Infrastructure that cannot support additional loads other than traversing vehicles shall be clearly identified • table of required crane size with associated equipment that it has been sized on • where required, multiple positioning of the crane and float shall be identified in stages with appropriate diagrammatic representation for each stage • if the transformer requires winching into position after the initial crane lift, this detail is required to be included on the drawing
Cable schedule	Tabulation	The purpose of the cable schedule is to provide an accurate record of all cables to be installed within the substation and between the substation and the equipment located externally. This document is used to purchase the cables. It is used in conjunction with the block diagram and the allocation of conduit drawings. The contents of this document are derived from a spreadsheet that consists of the following: • cable identification numbers, core number • name of equipment that cable originates from, terminal number • name of equipment that cable terminates at, terminal number • function • conductor size, insulation type and grade • comments

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Cable installation procedure drawings	Plan and section	The purpose of the cable installation procedure drawing is to document the designer's concept for the procedures for installing large power cables. This is in particular where power winching is required or where a particular sequence or approach is required to ensure that the minimum cable-bending radius is not infringed. The content should include the following: • appropriate plan view and cross-sections of the substation and outdoor yard, transformer bays • illustrative detail of the methodology showing location of pits, required position of cable drums and sequence of events for correct installation
Interconnection block diagram (electrical)	Schematic diagram	The purpose of the interconnection block diagram is to provide a visual representation of the electrical interconnections between items of equipment within the substation and externally located equipment. The diagram is used by the electrical contractor when installing the cables in conjunction with the cable schedule and the allocation of conduit drawings. The following contents should be shown on the drawing: • equipment represented as squares or rectangles with associated labels • interconnections between equipment • cable identification numbers adjacent to each interconnection • blocks depicting equipment with labels
Allocation of conduits	Plan view /elevations and cross-sections	The purpose of the allocation of conduit drawing is to provide detailing of all aspects of the installation of conduits required in the substation. The drawing is critical for the correct positioning of conduits. It is used in conjunction with the cable schedule and interconnection block diagram. The contents of this drawing show the detailed location of all conduits and should include the following: • dimensions for locating conduits • conduit size, class, radius of bends • conduit spacing • particular requirements for conduits such as bellmouths • elevations and sections to show depth of installation and positioning within pits • conduit identification number • corresponding cable identification numbers • building and features equipment and foundations

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Internal arrangement	NA	The purpose of the internal arrangement drawing is to show the interconnectivity between equipment that is installed within the substation building; for example, 1500 V dc cabling, HV cabling, LV cabling and control wiring. The drawing should include the physical outline of the equipment and the associated electrical relationship to other equipment within the substation and the equipment located externally. This drawing should be drawn to scale with all dimensions shown to enable installation of equipment. Critical dimensions shall be shown as specified to demonstrate compliance with the minimum egress accessway, clearances as prescribed in AS/NZS 3000 *Electrical Installations*, AS 2067 *Substation and high voltage installation exceeding 1 kV a.c.* and the *National Construction Code (NCC)*
Internal arrangement (continued)	Plan view	Several plan views are required on separate drawings to detail different aspects of the design as follows: 1. EQUIPMENT LAYOUT - The internal arrangement drawing contents in the plan view shows all the internal equipment for the substation. The drawing should show the position of the equipment within the substation with relevant dimensions shown for mounting of equipment, access and clearance requirements. The interconnection between the equipment should be shown, such as cable trays, cable ladders, and conduits. The detailed part listing contains notes detailing particular requirements such as clearances, torques and tensions. 2. BASEMENT CABLE ARRANGEMENT – One of the internal arrangement drawings required is for the basement, which details the cable ladder/support system. This drawing shall show the complete cable support system and the associated allocation of cables (HV, 1500 V dc, LV control, and so on) to ensure segregation is maintained. It shall include cross-sections, detailed parts list, method of fixing, dimensions, notes as required, the method of securing the cables, any additional requirements for mechanical and fire protection, cable bending radius, and so on. 3. EGRESS PATHWAY - The emergency egress pathway(s) is shown shaded in a colour. Dimensions should be shown to demonstrate compliance to AS/NZS 3000, AS 2067 and NCC. Equipment with doors should have the opening area of the door shown with the critical dimensions to demonstrate compliance. Both internal and external detail can be included on the one drawing where appropriate. Egress pathways for basements shall be shown.
Internal arrangement (continued)	Detailed sections	The internal arrangement drawing contents in the detailed sections view shows detailed sections as required for the internal equipment for the substation. The cross-sections show in detail, the methods of connection of cables, arrangements of equipment, any particular mounting details for equipment and details of how cables and busbar are installed. The detailed parts listing contain notes detailing particular requirements such as clearances, torques and tensions.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Outdoor arrangement	NA	The purpose of the outdoor arrangement drawing is to show the interconnectivity between the equipment that is installed outside the substation building such as transformer bays, outdoor HV yard, and 1500 V IRCS yard. This drawing should include the physical outline of equipment and associated electrical relationships to other equipment within the substation and equipment located externally. It should also show the identification of high voltage phases. Safety dimensions as specified in AS 2067 are required to be shown. These critical dimensions are required to be identified as such. Any associated restrictions such as maximum vehicle height should be shown. The emergency egress pathway(s) are shown, shaded in a colour. Dimensions should be shown to demonstrate compliance to AS/NZS 3000, AS 2067 and NCC. This drawing shall be drawn to scale with all dimensions shown to enable installation of the equipment.
Outdoor arrangement (continued)	Plan view	The drawing contents of the outdoor arrangement in the plan view should contain the substation outline including the following (shown in half tone): • intruder fence • substation building - plot using full tone, all other features to be displayed in half tone • access roadways • railway tracks and orientation to Sydney • major internal equipment (for interconnection purposes)
Outdoor arrangement (continued)	Cross-sections and details	The drawing contents of the outdoor arrangement in cross-sections and details should contain detailed cross-sections looking at the entire outdoor area, associated equipment and interconnections. It should show the individual detailed sections as required and the complex arrangements. It should also show an elevation of feeder termination structures for the busbars showing arrangement and phasing including connection to first pole of substation feeders. The drawing should show the dimensions for the following: • major centreline distances between equipment • clearance dimensions such as heights of busbars, distances from yard fences and distances between phases, shown using a shaded envelope • minimum distances to meet standards in brackets should be shown adjacently • swing of handles (ABSW) The detailed parts listing include details of signage to be installed and notes detailing torques and tensions, preparation requirements and references to standard designs.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Fire system	Plan view and cross-sections.	The drawing content of the fire system should be overlayed over the plan view of the indoor and outdoor substation arrangement with relevant cross-sections as required. There shall be separate drawings for each level of the location. The drawings shall be to scale with dimensions and shall show all the components of the fire system such as: • fire indication panel, fire detection panel, SCADA interface panel, and so on • all sensors • air sampling pipework • air sampling filters • fire system test points • emergency activation pushbuttons • strobes • portable fire extinguishers There shall be a legend for the graphical representation of the equipment and also a detailed equipment list which identifies the manufacture, model and part number of all parts of the fire system. Appropriate installation notes as required shall be included.
Fire system	Schematic / interface	Schematic and interface diagrams which details the interface to other systems within the substation such as 415/240 V distribution boards, SCADA panels, connection between fire related panels, connection to strobes, pushbuttons, and so on. These drawings should include details on wiring, the enclosure requirements, and so on.
Lightning Protection System		Drawings documenting the assessment of the lightning protection system (LPS) using the rolling sphere method (RSM). Drawings shall be to scale with the substation building outline, outdoor yard and other substation equipment locations (for example, transformer bays) shown with the proposed LPS. All major equipment located outdoors, fences, lighting poles and aerial line structures, and so on, shall be shown. The spheres (or portion of) with relevant dimensions shall be shown to demonstrate compliance. There shall also be drawings to enable the construction and installation of the LPS. These drawings shall include detailed parts list and comprehensive construction notes.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Oil Containment System		An additional drawing is required for the oil containment system. The purpose of this drawing is to provide the design details of the oil containment system. It should include: • plan view of the substation bays showing the drains, interconnection pipes, containment tanks and so on • cross-sections detailing the system and all components • detailed part listing • table of the design parameters and assumptions that determined the size of pipes, size of containment tanks and so on • notes on requirements for removing oil, maintenance and so on
Earthing arrangement and details	Plan view	The purpose of the earthing arrangement and details drawing is to provide details of the earthing systems associated with the substation. The earthing arrangement details should include the substation outline, earthing details, dimensions and detailed parts listing. Earthing details drawings should include the following: • location of numbered earth electrodes, depth and diameter of hole, type of electrode and material • earth grid location and depth • basic design parameters • earth grid conductor and grid tails for connection to equipment and structures • differentiation between earthing system for earth fault path and bonding for step and touch potential • details of tee and cross connections between earth wires • fence and structure earthing details • location of earthing points for portable earths, and so on • details of high voltage cable screen connections • details of attachment to concrete slab reinforcing • location of earth bars • cable screens • details of blue metal requirements, including grade and depth • location of commissioning test points • water pipe bonds and insulated joint location details Dimensions include the following: • major centreline distances between equipment • clearance dimensions such as heights of busbars, distances from yard fences and distances between phases Minimum distances to meet the standards in brackets should be shown adjacently.
Earthing arrangement and details (continued)	Detail	Detailed parts listing should include the following: • electrodes • clamps • earth cable • earth lugs (no of holes) • notes detailing particular requirements such as clearances, torques and tensions

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Underground electrical services	Plan and section	The purpose of the underground electrical services drawing is to provide details of buried electrical services and the method of installation. The contents of the underground electrical services drawing in the plan view should include the substation outline, three themes of underground electrical cables and their common details. Underground electrical cables should be shown according to the following three themes: • high voltage cables • 1500 V positive and negative cables, 600 V rectifier cables • low voltage cables, control cables Each theme should contain the following common details: • de-commissioned cables should be shown • equipment foundations should be shown for reference (half tone) • internal equipment should be shown for interconnection purposes (half tone) • key dimensions from the edge of the cable route to equipment foundations and slabs • notes detailing particular requirements such as clearances between HV cables and LV cables • AUSTEL requirements
Underground electrical services (continued)	Cross-sections and details	This drawing should show cross-sections with the following details: • cable depth below ground • PVC marker tape or methods of protection for the cables • concrete troughing and conduits • details of cables (material, screen type, diameter, and so on) • cable separation • any other relevant details • cable ID number as per the cable schedule • key dimensions • notes detailing particular references to standard drawings and documents • installation type
Underground services	Plan view	The purpose of the underground services drawing is to provide details of buried services (excluding electrical) and their method of installation. The contents should include substation outline and underground services. The underground services (non-electrical) should include the following: • compressed air pipes • water and sewer pipes • drainage pipes • gas pipes • oil bunding Outdoor equipment footings should be shown for reference only.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
EPR	Plan	The purpose of this drawing is to show the EPR contours in accordance with the earth system modelling and subsequent validation. The drawing is a plan view of the location showing the building outline, key infrastructure such as fences, fence gates, OHW stanchions, outdoor substation equipment. The drawing shall include the results of the CIT test including earth impedance of the earth grid and each electrode. EPR contours based on calibrated earth models are preferred where available. Soil model and fault level used to generate the EPR plot shall also be shown.
Schematic diagrams	NA	The purpose of the schematic diagram is to provide detailed information to enable the installation of control and protection wiring of the equipment. This diagram should be used in conjunction with the wiring diagram. The diagram should include the following details: • control circuit for the specified equipment • control supply fuses or circuit breakers • terminal numbers for relays, control switches, test blocks and so on • termination strips and the associated numbering • cable identification number • specific details about relays, control switches, indication lights and so on The drawing should also have notes detailing particular requirements such as termination blocks, wire size and colour, relay and switch details, references to standard designs and relevant drawings and documents.
Wiring diagram	NA	The purpose of the wiring diagram is to provide detailed information to show the physical layout of the wiring and installation of related equipment for control and protection cubicles. The contents of this drawing should show the cubicle or panel with a physical layout of all the wiring and terminals strips, selection switches, and indication lights. It should also show the details of the terminal strips, selection switches, and indication lights and the cable identification numbers.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Distribution board schematic diagrams	NA	The purpose of the distribution board schematic diagrams is to show the electrical requirements of the low voltage distribution boards. The contents of this drawing should show the electrical details of the distribution board which includes the following: • voltage and fault levels • insulation resistance requirements • details of type of circuit breaker or fuse • colour of board • circuit labels • size of incoming or outgoing cable • number of spares • IP rating and form number • door requirements (hinge side, lock type) • mounting requirements • physical size restrictions The 240 V (415 V) schematic diagram should also show the details of the changeover and its connections if used.
AC Protection concept	NA	The protection concept is produced to document the requirements for high voltage protection schemes. It is accompanied by a Microsoft Word compatible document, which describes in detail the protection requirements. Diagrammatically it shows the HV busbars, ACCBs, VTs, transformers and location of CTs. The interconnection with the interfacing substations is also shown. The HV busbar and the order of associated equipment shall match the approved operating diagram for the location. It includes details on CTs, VTs, protection relays, ratings of the HV switchgear, connection between protection relays and associated CTs and VTs, and connection to the ACCB trip coil. It includes the interconnection to adjacent substations and relevant details of the HV protection scheme at the remote substation. Existing protection equipment and interconnection is shown in blue, new equipment and interconnection in red, and removal in green. The busbar, ACCBs, and VTs are shown in black colour. Electrical ratings of the HV busbar, ACCBs, CTs and VTs are shown.
DC protection concept	NA	This concept (word document) is produced for a traction substation and sectioning hut. It documents the requirements for the dc protection scheme associated with each 1500 V feeders at a location and typically includes the following detail: feeder and rectifier DCCB direct acting overload settings, protection relay settings, intertrip settings and requirements, DCCB frame leakage requirements, analogue requirements, alarms and indications, modifications required at remote ends.

© State of NSW through Transport for NSW 2021

Drawing type	Views	Content description and notes
Line differential scheme	NA	The content of the line differential schematic diagram should typically include the following for both ends of the scheme: • HV busbars, associated ACCBs, air break switches (ABS) and links • CTs (including CTs used for other protection schemes) with secondary circuitry connection to the line differential relay; CTs to be shown in correct position and polarity identified • VTs • line differential relays and associated test blocks, with all connections to the relay detailed and referenced to the equipment schematic drawings • auxiliary supply to the line differential relay and supervisory control and data acquisition system (SCADA) alarms • schematic representation of the communication scheme between line differential relays • relevant notes and an item list
SCADA and communication block diagram	NA	The purpose of the SCADA and communication cabling block diagram is to show the SCADA, phone, ICT, protection relay, PLC and other serial communication cabling. It also shows the incoming and outgoing connections to communications backbone. For an example, refer to EL0435527 *Toongabbie SS Electrical Communication Cabling Block Diagram.*
SCADA I/O schedule	NA	The purpose of the SCADA I/O schedule is to provide an accurate record of the input and output signals to the SCADA system, whether through hardwired or serial connections or internal to the RTU. This document is used to size and purchase the SCADA RTU and program the RTU and the master station, and wire the marshalling cubicle. Refer to T HR EL 11001 PR *Design Technical Reviews for Electrical SCADA Equipment* and T HR EL 11001 F1 *SCADA Sample I/O Schedule* for further details.

13.6.2. Production of overhead wiring, HV aerial lines and cables layout drawings

The electrical layout drawing system comprises a series of primary and secondary CAD model files assembled to enable the production of overhead wiring and HV aerial line and cable drawings.

Each model file should contain the data pertaining to the design, location and graphical representation of features in accordance with the subject theme.

Each model file should display approximately 4 km of rail corridor and provide a base from which A1 size layout drawings are produced at a scale of 1:500.

The primary model files are supported by secondary model files attached as reference files. These secondary files supply additional or ancillary graphic data and are used in the construction of the primary model files.

© State of NSW through Transport for NSW 2021

Primary model files

The following primary model files should be created to support the electrical design:

- overhead wiring model file - this should contain graphic details pertaining to location and design of the overhead wiring system
- HV aerial line and cable model file - this should contain graphic details pertaining to the location and design of the HV aerial line and cable system
- electrical mapping model file - this should contain subset of aerial mapping (where available), and updates from electrical detail surveys
- electrical track model file - this should contain subset of track alignment files (where available)
- grid file - this provides the drawing sheet set out and grid annotation for the layout drawings

Overhead wiring model file

OHW data should be placed in the file in accordance with the following specifications:

- Cells should remain in the model files as cells (not to be dropped).
- Data fields and text nodes should be entered as tags as provided in various cells for annotation purposes. In case the cell contains message text or drawing references as necessary, the cell can be dropped to allow editing of specific text.
- 'As constructed' OHW masts should be placed accurately at locations indicated by survey data (MGA or ISG Coordinates of Ramset Nails placed in masts).
- Cells should be placed at size provided and should not be re-scaled. Cells should be created in cell library at a scale suitable for a production drawing scale of 1:500 and the size should not be altered.
- OHW data should not conflict with HV aerial lines and cable data. The HV aerial line and cable routes should not be broken by OHW data, that is, structure numbers should not be placed across HV aerial lines and cable routes.

Refer to T HR EL 08014 ST *Overhead Wiring Layouts* for more information on overhead wiring layouts.

The following features should be shown in the electrical overhead wiring model file:

- OHW structures
- OHW structure numbers
- bay lengths
- coding and symbology

© State of NSW through Transport for NSW 2021

- anchors systems and details
- overlap details
- section insulators
- termination, pennant and mid-track insulators
- contact wire (in and out of running)
- associated design data, such as, radial load factors, staggers, blowout extents
- mast foundations (existing and as-built)

HV aerial lines and cables model files

The HV aerial lines and cable routes should be placed in the file in accordance with the following file specifications:

- Graphics should not conflict with OHW data; if required, OHW data should be moved to clear off the aerial lines and cable routes.
- Data should be placed in the model in accordance with the file specification.

  Note that some data, particularly cable cross-sections are placed in the layout drawing files.

Data and annotation should be placed into the files in accordance with the following specifications:

- Model files should be attached as reference files (graphic data from model files should not to be copied into drawing file).
- A1 border sheet file should be moved and rotated to coincide with the relevant location as determined by the grid file.
- Model files should be clipped in accordance with the join lines indicated in the grid file.
- Ancillary notes, warnings, construction tables should be added to the drawing file, where required.
- Where cables are concerned, cable cross-sections and dimensions should be added into the layout drawing file.

The following features should be shown in the electrical HV aerial lines and cables model file:

- HV aerial lines and cables routes
- pole top arrangements
- bay lengths
- deflection angles

© State of NSW through Transport for NSW 2021

- pole numbers
- other aerial lines
- cable routes
- joint locations
- pits, manholes, ducts
- cable depths (covers)
- pipes and other services crossing and adjacent
- other existing cable routes

This section should be read in conjunction with T HR EL 10001 ST *HV Aerial Line Standards for Design and Construction* and T HR EL 20004 ST *High Voltage AC and 1500 V DC Traction Power Supply Cable Infrastructure – Standards for Design and Construction*.

Electrical mapping model file

Where aerial mapping exists in CAD format, the electrical mapping file should be created and the aerial mapping copied into the file over the full extent of the model.

The following features should be drawn in electrical mapping model file:

- railway boundaries
- miscellaneous boundaries
- street names
- survey marks
- cadastral details
- roads, streets, lanes
- footpaths, concrete slabs
- buildings, ruins
- fences, gates, cattle grids
- bridges, culverts, overpasses
- pipes, walls, tanks, conveyors
- vegetation text
- embankments, (top, toe, cliffs, rocky outcrops)
- embankment symbols
- vegetation boundaries

© State of NSW through Transport for NSW 2021

- natural drainage, rivers, creeks, lakes
- drainage text
- track names and platform numbers
- general mapping annotation
- track elements, switches, buffers
- kilometre marks and text
- OHW structures, OHW anchors
- general signs, crossings
- posts, guideposts, freestanding posts
- power poles and HV aerial lines
- signals and signal gantry structures
- signal and cable troughing, elevated and ground line
- sumps, manholes, hydrants
- platforms
- any unidentified structures

Electrical track model file

The following features should be drawn in the electrical track model file:

- track centrelines
- track frame points, tangent points, transition points, bends, identification text (kilometrage)
- track centres text
- track radius text
- superelevation text
- kilometrage text and symbols
- structures
- platforms
- track componentry, rails, turnouts
- track componentry identification, such as curves, transitions, straights

© State of NSW through Transport for NSW 2021

Grid file

Where a grid file is available, the grid file should be used for the construction of layout drawings.

Where a grid file is not available, the grid file should be produced in accordance with the following specification and requirements:

- A1 sheet pattern should be placed in centre to track centreline with sufficient coverage to incorporate future HV aerial lines and cable requirements.
- Drawing sheets should be oriented at whole angles to simplify plotting and view rotation. Where possible, runs of sheets should maintain the same orientation to provide maximum coverage.
- Sheet joins should be radial from corners to give maximum coverage when sheets are placed at angles.
- Join lines should be placed at approximately 25 mm from side of sheets (at 1:500 scale).
- Join lines should be placed on multiple levels to facilitate display of alternate sheets.
- Grid marks and crosses shall be placed at 50 m intervals over each drawing sheet area in accordance with level map.
- Grid shall be annotated and placed around the inside edge of each sheet area. Annotation should not conflict or overwrite.

Secondary files

The following secondary model files should be referenced from other disciplines:

- civil design files - provides details of civil design and construction such as bridges, retaining walls, culverts
- services files - provides details of utility services, cables, pipes, drainage
- boundary files - provides details of survey boundaries

13.6.3. OHW tension length diagram

The purpose of the tension length diagram is to identify and show the extent of the proposed wire runs together with details of the termination points and anchors.

The extent of each wire run should be shown by a single coloured line between the termination points. The details of the termination anchors and fixed mid points, out of running wire and overlaps should be indicated.

© State of NSW through Transport for NSW 2021

The diagram should show the following:

- individual wire runs, wire lengths, each identified by an individual colour

  Only eight colours are allowed due to reproduction identification limitations.
- location of anchor points and details, including type/tension, length/wire run names and for fixed mid points, tension loss figures
- bridges and bridge names
- platforms and platform numbers, station names, station extents (show hatching)
- proposed and existing structures
- track names and to and from Sydney indicators
- interaction with existing wiring (show in black colour)
- substations and sectioning huts (show in shaded grey colour)
- tunnels and tunnel names
- out of running wires (show as dashed lines)
- overlaps (O/L) together with km of locations
- section insulator locations
- notes indicating that the diagram is a coloured drawing
- legend depicting symbols and descriptions

The colours shown for the individual wire runs should be carried through to the concept and detailed design and utilised to identify all design data pertaining to that particular wire run (that is, structure loading, blowout values, stagger values, coding and so on).

Diagrams should be produced in A3 size and identified as a colour drawing.

13.6.4. Combined overhead wiring and HV aerial line and cable drawings

A project may require the production of a combined layout where the overhead wiring aspects and the HV aerial line and cable aspects both appear on the same drawing.

The presentation should be such that OHW details such as coding, tables and bay lengths shall be clear of HV aerial line pole numbers, pole-top arrangements, span lengths and so on.

© State of NSW through Transport for NSW 2021

13.6.5. HV aerial line profiles

HV aerial line profiles shall be developed in CAD format and should be drawn to scale as follows:

Horizontal 1:500 or 1:1000 and Vertical 1:50 and 1:100

Refer to T HR EL 10001 ST *HV Aerial Line Standards for Design and Construction* for more details.

13.6.6. Other drawings

Construction drawings shall be provided for the implementation of bonding designs. Plans showing the location of each bond and all isolation points are required for all 1500 V dc bonding designs.

A detailed bonding plan and elevation drawing is required to show the circuit configuration, installation and route details for all bonding circuits which are installed on structures such as on a bridge, in a tunnel or within a building. Refer to T HR EL 12005 ST *Bonding for 1500 V DC Traction Systems* for further details regarding the developments of detailed bonding plans and elevations.

Standard drawings may be referenced for details of bonds to rail where simple bonding circuits are implemented such as in the case of independent OHWS bonds to rail.

Standard drawings may be referenced for details of standard isolation points and insulated sections such as in GST, fencing and buried conductive piping.

Where multiple OHWS require independent bonding, a bonding schedule shall also be provided.

14. Signal CAD requirements

The signal CAD requirements are applicable to signal drawings produced for TfNSW rail projects. These requirements should be read in conjunction with Section 6 of this standard.

Where conflict exists between the two sections, then the signal CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

14.1. Title block for signal drawings

The title block selection for a signal drawing depends upon the drawing type. The signal circuit book and air system drawing shall use a title block that is explained in Section 14.1.1 and Section 14.1.2, respectively. All other signal drawings should use the title block as explained in Section 14.1.3.

© State of NSW through Transport for NSW 2021

14.1.1. Circuit book

A circuit book consists of various sheet types, such as cover sheet, index sheet, correlation sheet, control sheet, amendment sheet and wiring sheets. This standard states the requirements for creating and updating the cover sheet and wiring sheets of circuit book. For other sheets, refer to SPG 0703 *Signalling Documentation and Drawings*.

Each circuit book shall have one EDMS number assigned and all sheets shall be associated with this EDMS number.

Cover sheet of circuit book

The circuit book cover sheet consists of the following four components:

- circuit book title
- circuit book detail box
- circuit book sign-off box
- circuit book revision box

Figure 117 shows a sample circuit book cover sheet with these components marked.

© State of NSW through Transport for NSW 2021

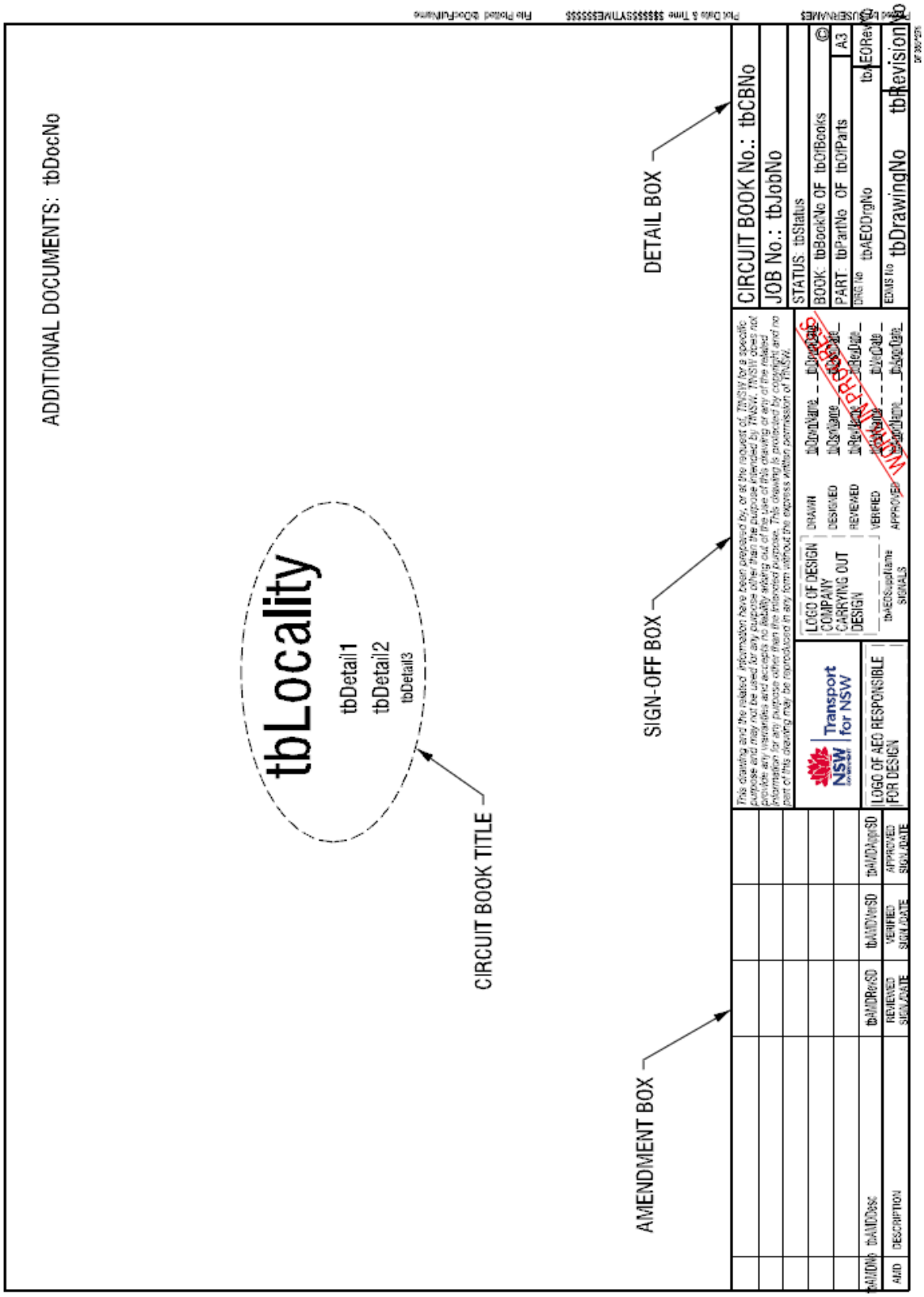


Figure 117 - Typical circuit book cover sheet

Circuit book title

The circuit book title provides details about the circuit book subject matter. Figure 118 shows the different fields within the circuit book title.

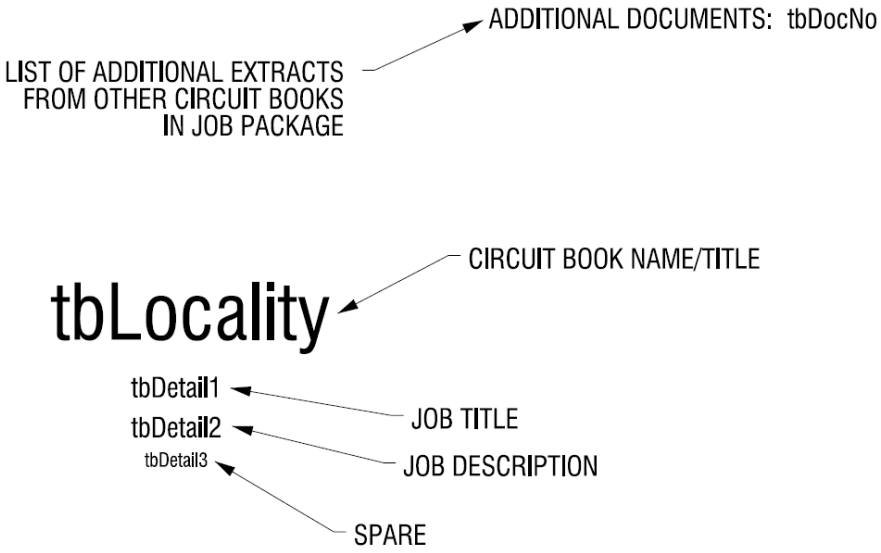


Figure 118 - Circuit book title

Table 38 provides the details of the field names and tags related to the circuit book title.

Table 38 - Circuit book title - smart tags description

No.	Field name	Tag	Requirements
1	Circuit book name/title	tbLocality	Include the name or title of the circuit book.
2	Job title	tbDetail1	Include the job title. This should be removed on as-built circuit book.
3	Job description	tbDetail2	Include the job description. This should be removed on as-built circuit book.
4	Spare	tbDetail3	Additional field and should be used for additional information.
5	Additional documents	tbDocNo	Include a list of extracts from other circuit books that forms the job package. This should be removed on as-built circuit book.

Circuit book detail box

The circuit book detail box provides details about the circuit book numbering system and current revision level.

© State of NSW through Transport for NSW 2021

Figure 119 shows the different fields in a circuit detail box.

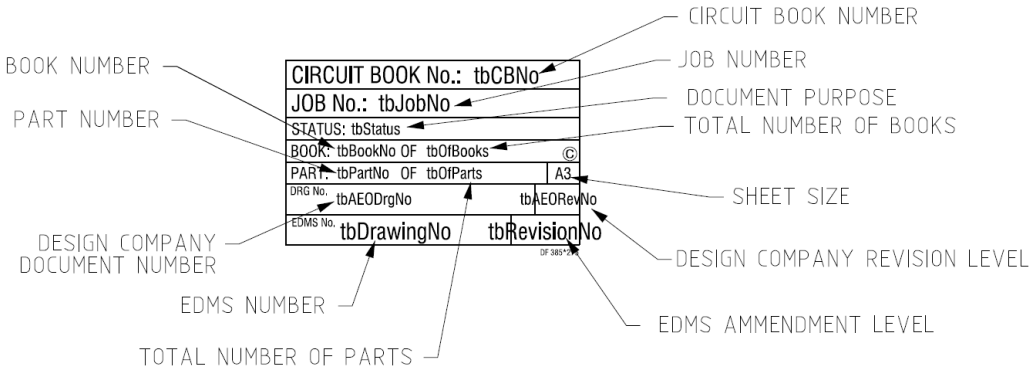


Figure 119 - Circuit book detail box

Table 39 provides the details of the field names and tags of the circuit book detail box.

Table 39 - Circuit book detail box - smart tags description

No.	Field name	Tag	Requirements
1	Circuit book number	tbCBNo	Include the circuit book number.
2	Job number	tbJobNo	Include the project job number.
3	Document purpose	tbStatus	Include the status of the current revision of the circuit book. Allowable values are as follows: • for review • for construction • for testing • for commissioning • as-built
4	Book number	tbBookNo	Include the book number of a circuit book in a set of circuit books. Where there is no other circuit book in the set, the particular book is book 1.
5	Total number of books	tbOfBooks	Include the total number of circuit books in a set of circuit books. Where there is no other circuit book in the set, the particular book set number is 1.
6	Part number	tbPartNo	Include the part number of a circuit book. Where there is no other part of circuit book, the particular part is part 1.
7	Total number of parts	tbOfParts	Include the total number of parts of a circuit book. Where there is no other part of a circuit book, the particular part set number is 1.
7	Sheet size	tbSheetSize	Include the size of the circuit sheet. Allowable values are only A2 or A3.

© State of NSW through Transport for NSW 2021

No.	Field name	Tag	Requirements
8	EDMS number	tbDrawingNo	Include the TfNSW drawing number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom). This is unique for each circuit book. Refer to Section 8.1 for details.
9	EDMS amendment level (revision associated with EDMS number)	tbRevisionNo	Include the TfNSW revision related to EDMS number. This number shall be updated only when drawings are submitted to VPR. The first instance of the circuit book shall always show an 'A' in this box. The timing of this can vary for each circuit book. Refer to Section 7.5 for details.
10	Design company document number	tbAEODrgNo	Include the design company document number. Refer to Section 7.4.4 for details.
11	Design company revision level	tbAEORevNo	Indicate the design company revision level related to the design company document number. Refer to Section 7.5 for details.

Circuit book sign-off box

The circuit book sign-off box shall contain the signature, which includes the full name of the person who performed the tasks including drawn, design, review, verified and approval of the document for release.

> *Note: Where the first name of the person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.*

Figure 120 shows a sample sign-off box for a circuit book.

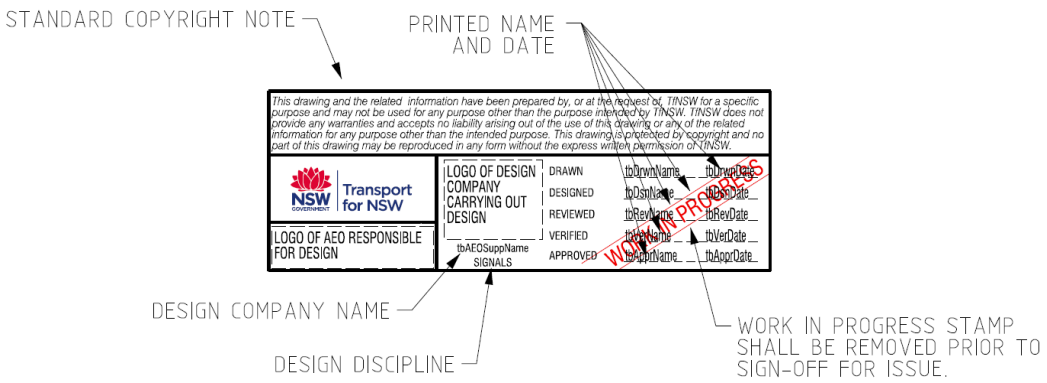


Figure 120 - Circuit book - sign-off box

Table 40 provides the details of the field names and tags of the circuit book sign-off box. Refer to SPG 0703 for definitions for each role type.

© State of NSW through Transport for NSW 2021

Table 40 - Circuit book sign-off box - smart tags description

No.	Field name	Tag	Requirements
1	Drawn by (Name)	tbDrwnName	Include the full name of the person who drafted the circuit book.
2	Drawn date	tbDrwnDate	Include the date of sign-off by the draftsperson.
3	Designed by (Name)	tbDsnName	Include the full name of the person who created the design component of the circuit book.
4	Designed date	tbDsnDate	Include the date of sign-off by the designer.
5	Review by (Name)	tbRevName	Include the full name of the person who reviewed the drafting of the circuit book.
6	Reviewed date	tbRevDate	Include the date of sign-off by the reviewer.
7	Verify by (Name)	tbVerName	Include the full name of the person who verified the circuit book.
8	Verify date	tbVerDate	Include the date of sign-off by the verifier.
9	Approver (Name)	tbApprName	Include the full name of the person who approved the design for release.
10	Approved date	tbApprDate	Include the date of sign-off by the design approver.
11	Design company name	tbAEOSuppName	Include the name of the design company.

Circuit book revision box

The revision box records the revision details of TfNSW amendment letter with or without the modification number along with the initial of the designer, reviewer, independent verifier and approver for the current revision.

Figure 121 shows a revision box for the circuit book.

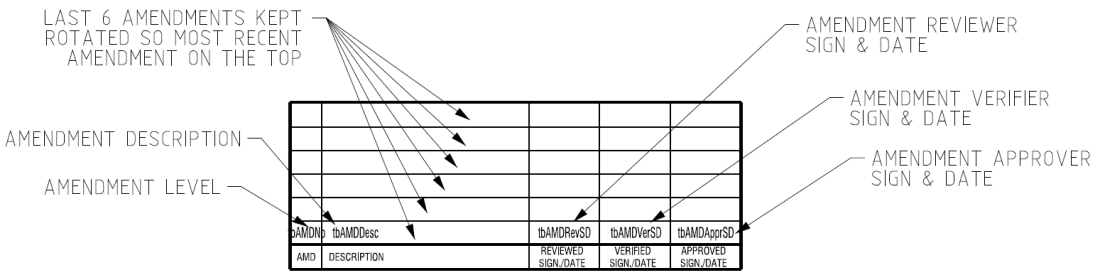


Figure 121 - Circuit book - revision box

Table 41 provides the details of the field names and tags of circuit book revision box.

© State of NSW through Transport for NSW 2021

Table 41 - Circuit book revision box - smart tags description

No.	Field name	Tag	Requirements
1	Amendment level	tbAMDNo	Include the current amendment. Refer to Section 7.5 for details.
2	Amendment description	tbAMDDesc	Include a brief description of the phase of review or approval that the drawing is issued.
3	Amendment reviewer sign and date	tbAMDRevSD	Include the initials of the person who reviewed the revision and sign date.
4	Amendment verifier sign and date	tbAMDVerSD	Include the initials of the person who verified the revision and sign date.
5	Amendment approver sign and date	tbAMDApprSD	Include the initials of the person who approved the revision and sign date.

Circuit book wiring sheet

The circuit book wiring sheet contains smart tags values for the current sheet. These values are populated in line with smart tag values of the circuit book cover sheet.

Figure 122 shows a sample format of the circuit book wiring sheet.

© State of NSW through Transport for NSW 2021

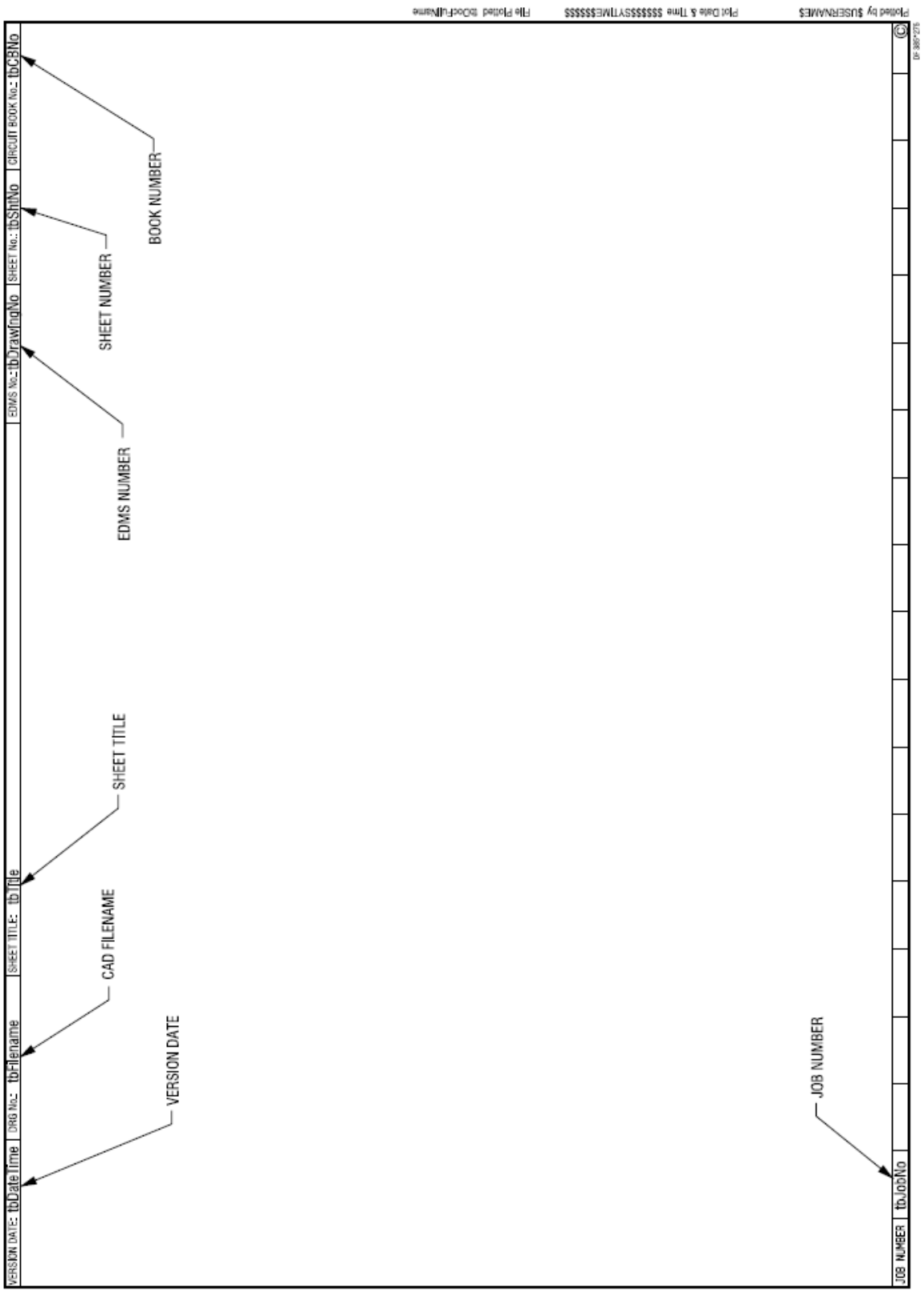


Figure 122 - Typical circuit book wiring sheet

© State of NSW through Transport for NSW 2021

Table 42 provides the details of the fields and tags of the circuit book wiring sheet.

Table 42 - Circuit book wiring sheet - smart tags description

No.	Field name	Tag	Requirements
1	Job number	tbJobNo	Include the project job number.
2	Version date	tbDateTime	Include the date when the design was created or altered.
3	CAD filename	tbFilename	Include the CAD file name for the sheet.
4	Sheet title	tbTitle	Include the title for the sheet.
5	EDMS number	tbDrawingNo	Include the EDMS number of the book.
6	Sheet number	tbShtNo	Include the sheet number for current sheet.
7	Book number	tbCBNo	Include the circuit book number.

14.1.2. Air supply book

The air supply book consists of various sheet types, such as cover sheet, index sheet, correlation sheet, control sheet, amendment sheet and wiring sheets. This standard states the requirements for creating and updating the cover sheet and airline diagram sheets of air supply book. For other sheets, refer to SPG 0703.

Each air supply book shall have one EDMS number assigned and all sheets shall be associated with this EDMS number.

Cover sheet of air supply book

The air supply book cover sheet consists of the following four components:

- air supply book title
- air supply book detail box
- air supply book sign-off box
- air supply book revision box

© State of NSW through Transport for NSW 2021

Figure 123 shows a sample air supply book cover sheet with these components marked.

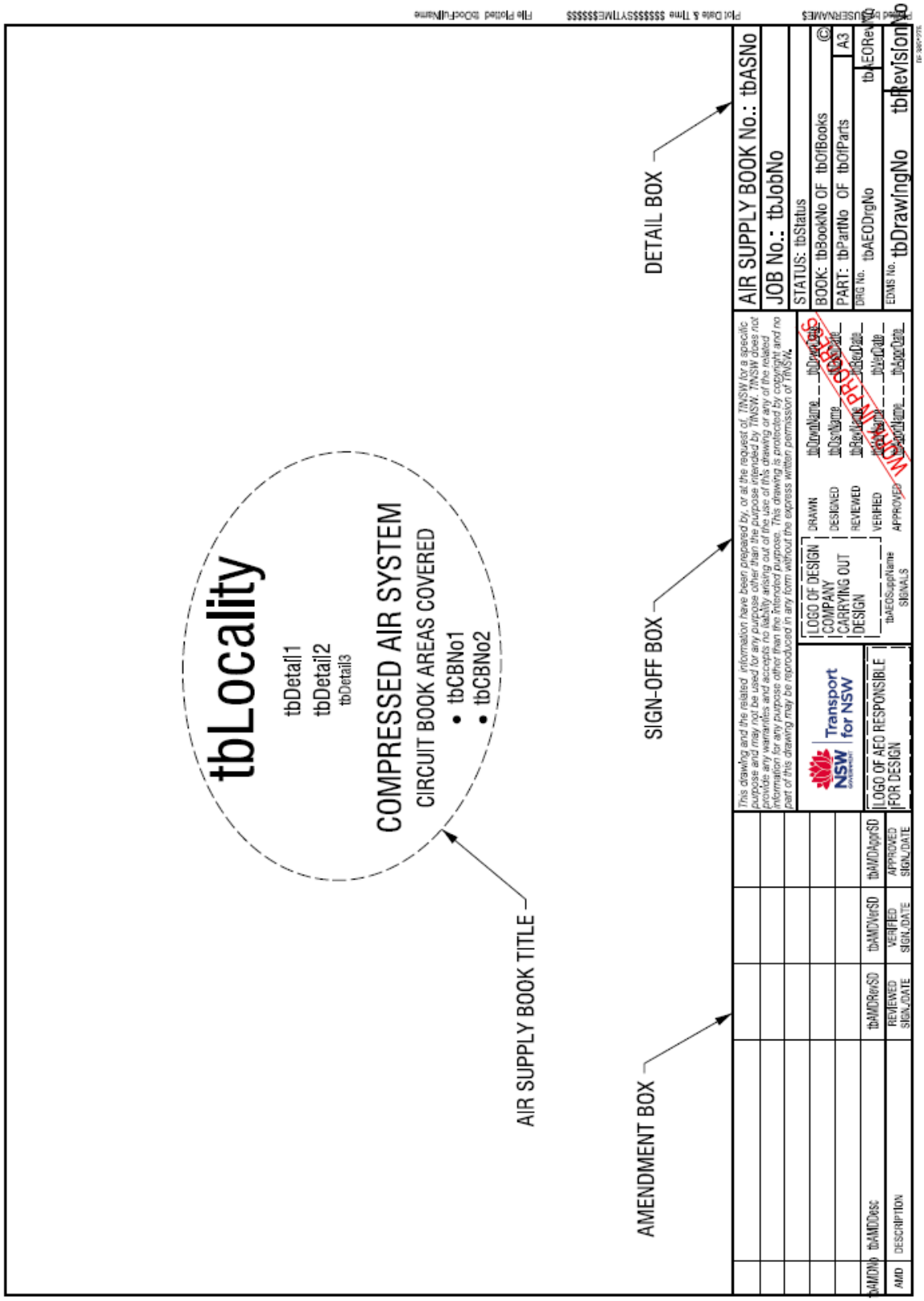


Figure 123 - Typical air supply book cover sheet

Air supply book title

The air supply book title provides details about the air supply book subject matter. Figure 124 shows different fields within the air supply book title.

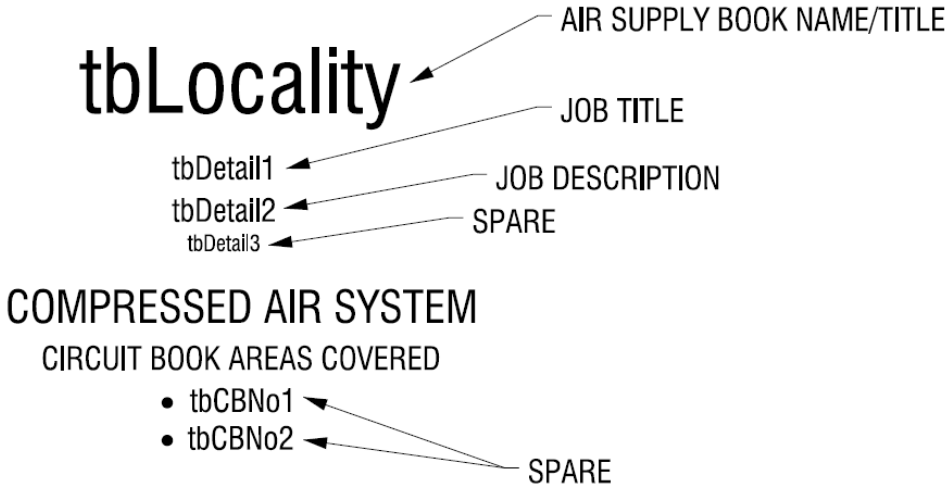


Figure 124 - Air supply book title

Table 43 provides the details of the field names and tags related to the air supply book title.

Table 43 - Air supply book title - smart tags description

No.	Field name	Tag	Requirements
1	Air supply book name/title	tbLocality	Include the name or title of the air supply book.
2	Job title	tbDetail1	Include the job title. This should be removed on as-built air supply book.
3	Job description	tbDetail2	Include the job description. This should be removed on as-built air supply book.
4	Spare	tbDetail3	Additional field and should be used for additional information.
5	Additional documents	tbDocNo	Include a list of extracts from other air supply books that forms the job package. This should be removed on as-built air supply book.

Air supply book detail box

The air supply book detail box provides details about the air supply book numbering system and the current revision level.

© State of NSW through Transport for NSW 2021

Figure 125 shows the different fields in an air supply book detail box.

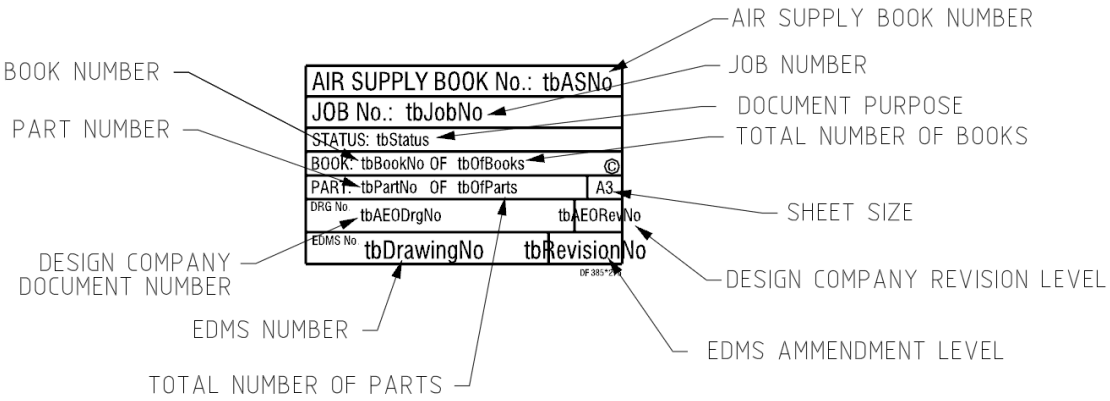


Figure 125 - Air supply book detail box

Table 44 provides the details of the field names and tags of the air supply book detail box.

Table 44 - Air supply book detail box - smart tags description

No.	Field name	Tag	Requirements
1	Air supply book number	tbCBNo	Include the air supply book number.
2	Job number	tbJobNo	Include the project job number.
3	Document purpose	tbStatus	Include the status of the current revision of the air supply book. Allowable values are as follows: • for review • for construction • for testing • for commissioning • as-built
4	Book number	tbBookNo	Include the book number of an air supply book in a set of air supply books. Where there is no other air supply book in the set, the particular book is book 1.
5	Total number of books	tbOfBooks	Include the total number of air supply books in a set of air supply books. Where there is no other air supply book in the set, the particular book set number is 1.
6	Part number	tbPartNo	Include the part number of an air supply book. Where there is no other part of air supply book, the particular part is part 1.
7	Total number of parts	tbOfParts	Include the total number of parts of an air supply book. Where there is no other part of an air supply book, the particular part set number is 1.
7	Sheet size	tbSheetSize	Include the size of the air supply sheet. Allowable values are only A2 or A3.

© State of NSW through Transport for NSW 2021

No.	Field name	Tag	Requirements
8	EDMS number	tbDrawingNo	Include the TfNSW drawing number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom). This is unique for each air supply book. Refer to Section 8.1 for details.
9	EDMS amendment level (Revision associated with EDMS number)	tbRevisionNo	Include the TfNSW revision related to EDMS number. This number shall be updated only when drawings are submitted to VPR. The first instance of the air supply book shall always show an 'A' in this box. The timing of this can vary for each air supply book. Refer to Section 7.5 for details.
10	Design company document number	tbAEODrgNo	Include the design company document number. Refer to Section 7.4.4 for details.
11	Design company revision level	tbAEORevNo	Indicate the design company revision level related to the design company document number. Refer to Section 7.5 for details.

Air supply book sign-off box

The air supply book sign-off box shall contain the signature, last name and initial of the person who performed the tasks including drawn, design, review, verified and approval of the document for release.

> *Note: Where the first name of a person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.*

Figure 126 shows a sample sign-off box for an air supply book.

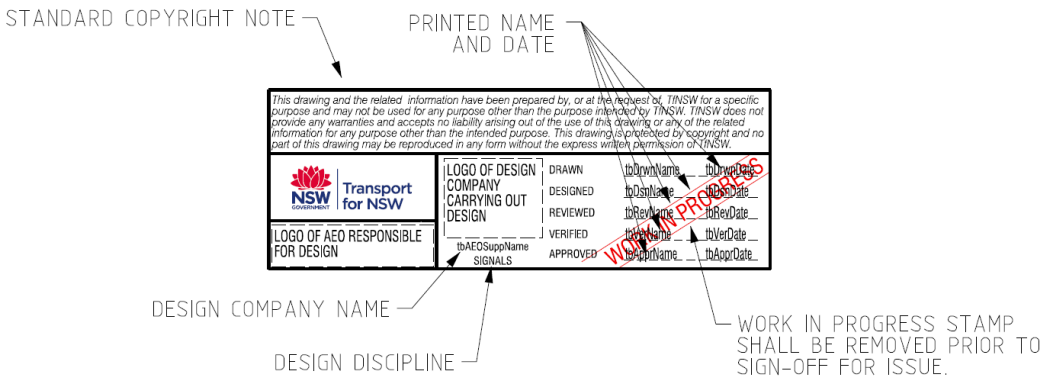


Figure 126 - Air supply book - sign-off box

The fields present in the air supply book sign-off box are same as that of the circuit book sign-off box and are explained in Table 39 of this standard.

© State of NSW through Transport for NSW 2021

Air supply book revision box

The air supply book revision box records the revision details of the TfNSW amendment letter with or without the modification number along with the initial of the designer, reviewer, independent verifier and approver for the current revision.

Figure 127 shows a revision box for the air supply book.

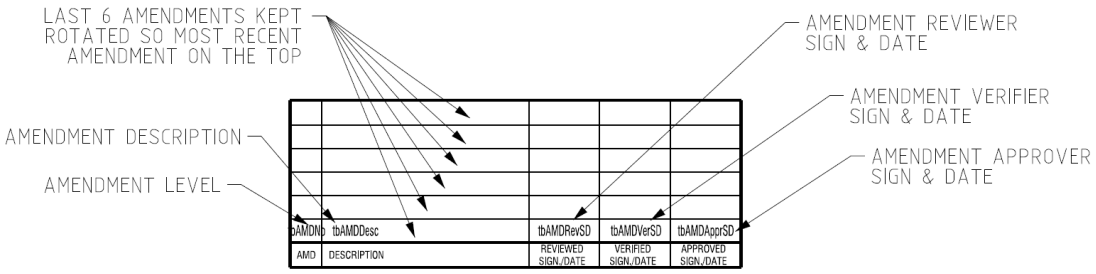


Figure 127 - Air supply book - revision box

The fields present in the air supply book revision box are same as that of the circuit book revision box and are explained in Table 41 of this standard.

Air supply book airline sheet

Figure 128 shows a sample format of the air supply book airline sheet.

Table 45 provides the details of the fields and tags of the air supply book airline sheet.

Table 45 - Air supply book airline sheet - Smart tags description

No.	Field name	Tag	Requirements
1	Job number	tbJobNo	Include the project job number.
2	Version date	tbDateTime	Include the date when the design was created or altered.
3	CAD filename	tbFilename	Include the CAD file name for the sheet.
4	Sheet title	tbTitle	Include the title for the sheet.
5	EDMS number	tbDrawingNo	Include the EDMS number of the book.
6	Sheet number	tbShtNo	Include the sheet number for current sheet.
7	Book number	tbCBNo	Include the air supply book number.

© State of NSW through Transport for NSW 2021

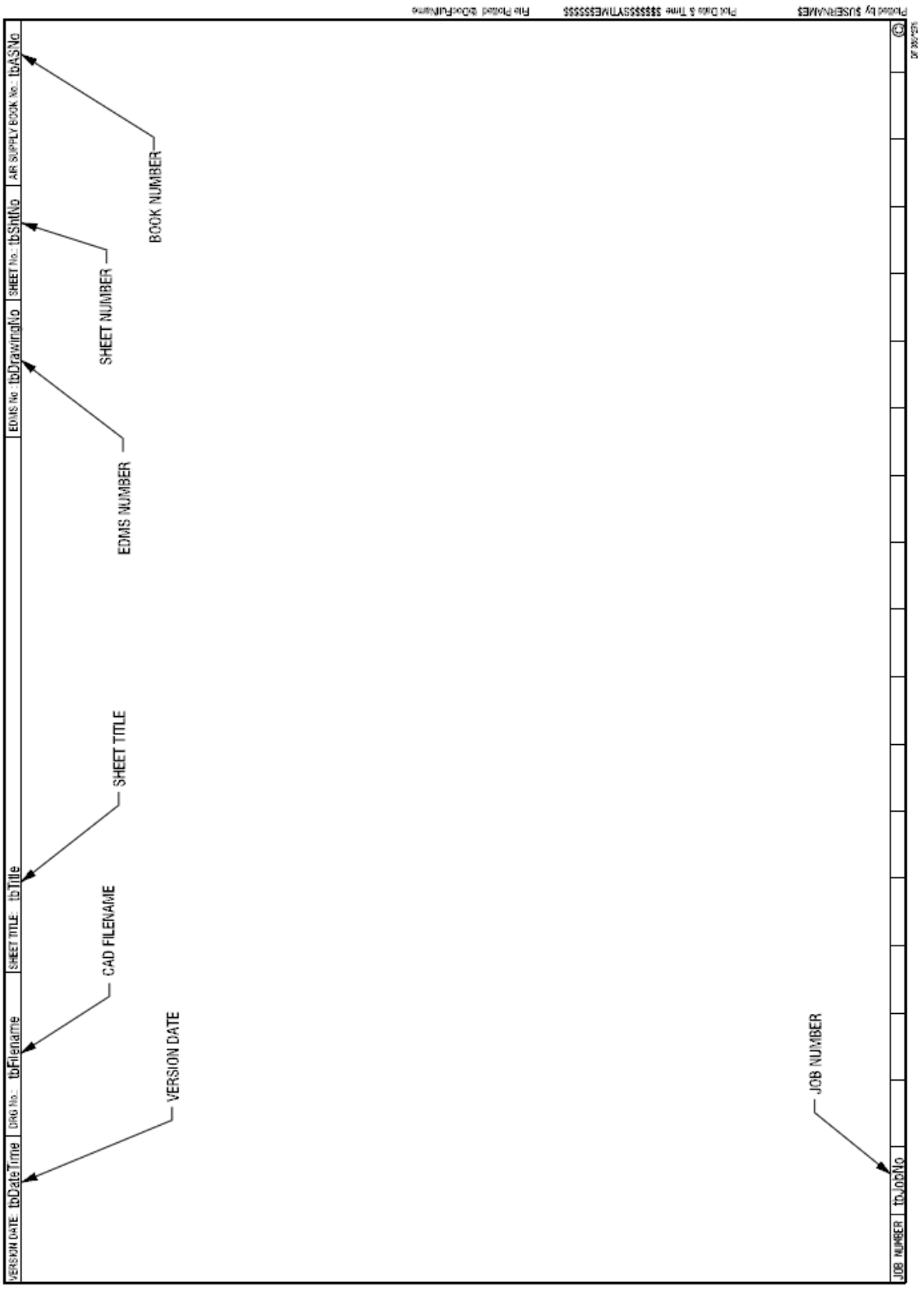


Figure 128 - Typical air supply book airline sheet

14.1.3. Mechanical drawings

Mechanical drawings shall use the title block as shown in Figure 129.

© State of NSW through Transport for NSW 2021

The smart tag fields for other signal drawings details box shall be populated in accordance with Section 7.1.1 of this standard.

The smart tag fields for other signal drawings sign-off box and revision box shall be populated in accordance with Table 40 and Table 41 of this standard.

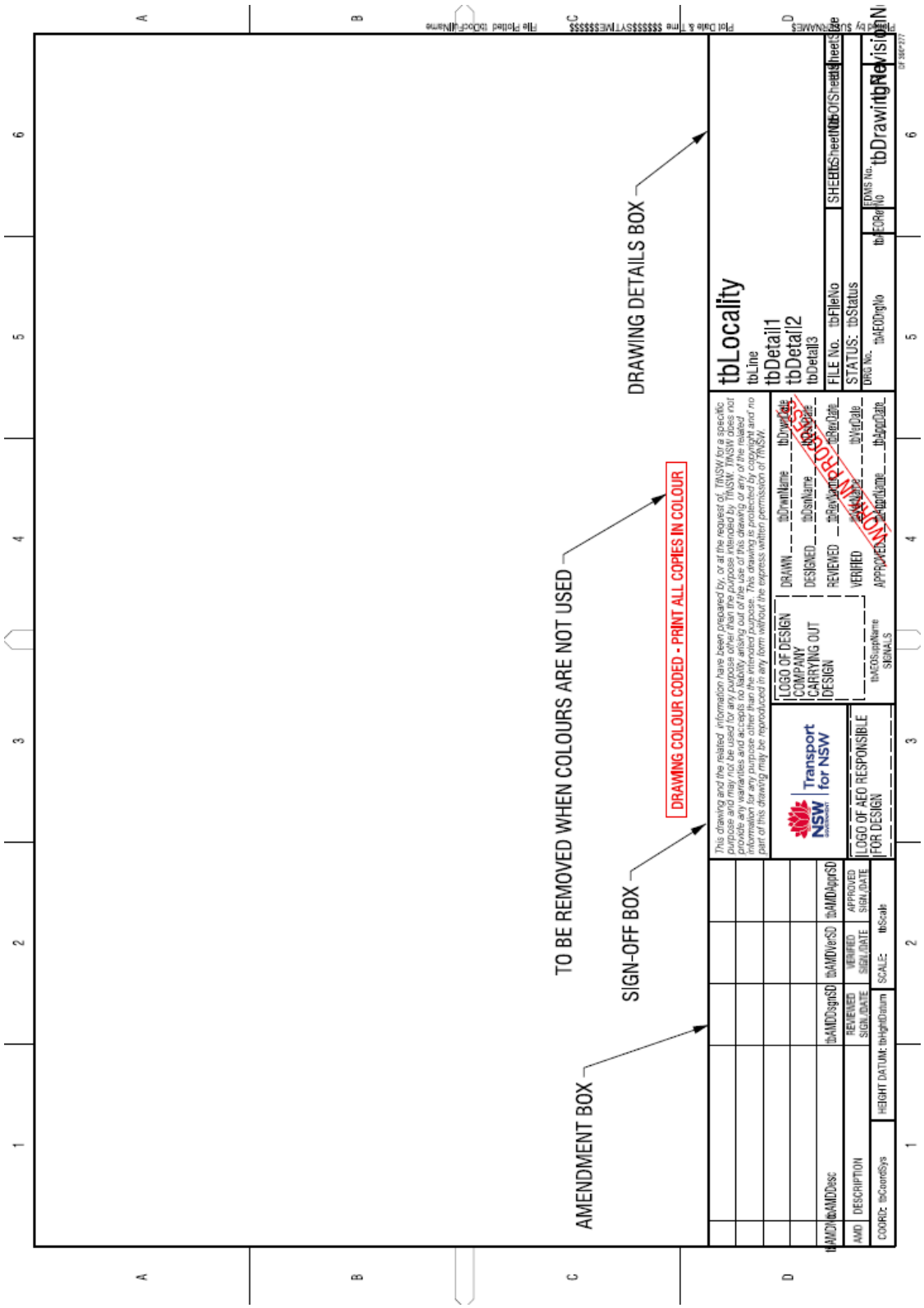


Figure 129 - Typical signal drawings title block

14.1.4. Signalling and track insulation plans

Signalling plans and track insulation plans shall use the title block as shown in Figure 130.

The smart tag fields for other signal drawings details box shall be populated in accordance with Section 7.1.1 of this standard.

The smart tag fields for other signal drawings sign-off box and revision box shall be populated in accordance with Table 40 and Table 41 of this standard.

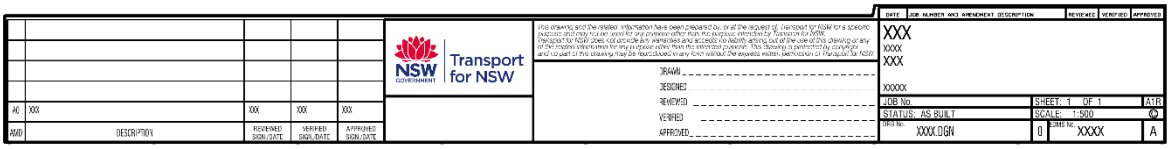


Figure 130 - Signalling plans and Track Insulation plans title block

14.1.5. Signalling plan and track insulation plan extracts

An extract template cell is to be used when designs require the use of signalling plan and track insulation plan extracts.

Smart tags have been placed in the cell to enter the “Plan Name and Type” and the “Extract Number”. See Figure 131 for an illustration of this.

The smart tag fields for other signal drawings details box shall be populated in accordance with Section 7.1.1 of this standard.

The smart tag fields for other signal drawings sign-off box and revision box shall be populated in accordance with Table 38 and Table 39 of this standard.

© State of NSW through Transport for NSW 2021

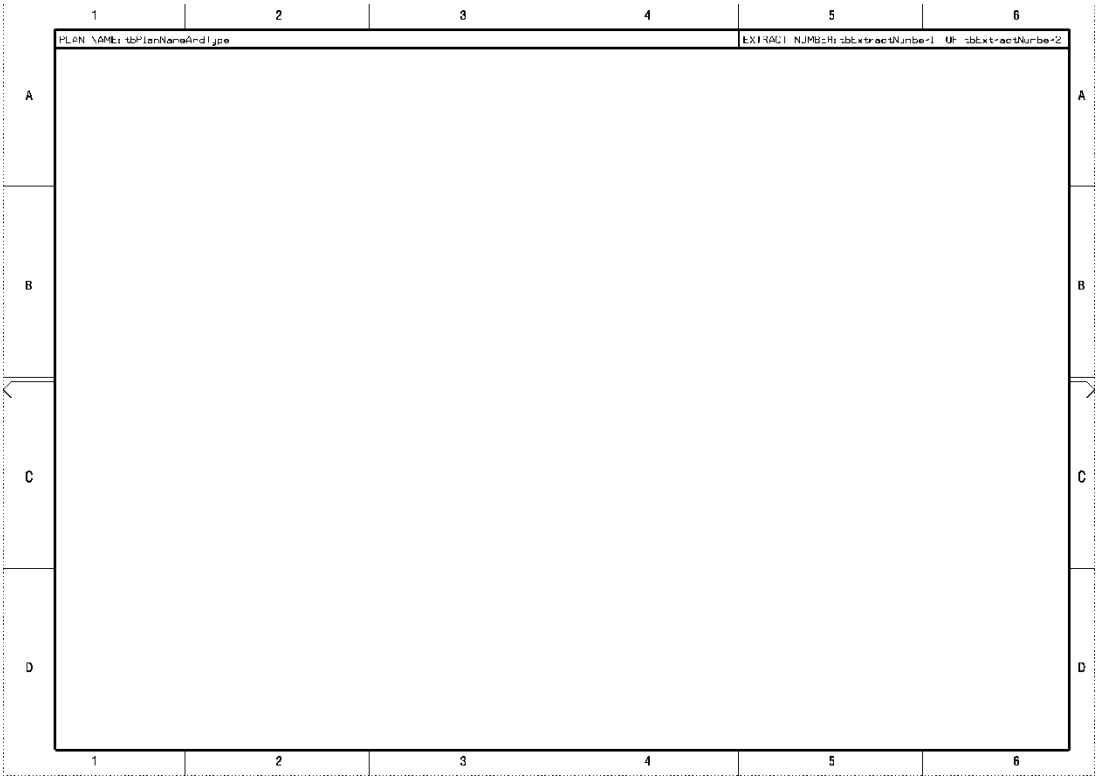


Figure 131 - A3 plan extract template

14.2. Seed files for signal drawings

The following seed files should be used for creating signal drawings files (2D drawings with title block):

- A3circuitbookcovesheet.dgn file should be used for circuit book cover sheet
- A3circuitbookwiringsheet.dgn file should be used for circuit book wiring sheet
- A3airsupplybookcovesheet.dgn file should be used for air supply book cover sheet
- A3airsupplybookairlinesheet.dgn file should be used for air supply book airline diagram
- Model2Dsheet2DseedV8.dgn seed file should be used for signalling plans, track insulation plans and balise plans.

These files are available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R7 *Signals CAD Resources*.

14.3. Cell libraries for signal drawings

The following cell libraries should be used for creating signal drawings:

- AC Vital Relays.cel
- Air Main Supply.cel
- Banner.cel

© State of NSW through Transport for NSW 2021

- Bushbar Couplers Links.cel
- Coils.cel
- Contractors.cel
- DC Vital Relays.cel
- Electrical Components.cel
- Electrical Detector Contacts.cel
- Flasher Units Contact.cel
- General.cel
- Indicators.cel
- Instrument Contacts.cel
- Lever Contacts.cel
- Level Lock Symbols.cel
- Lightning Arrestors.cel
- Locations.cel
- Lquad.cel
- Miscellaneous.cel
- Motors.cel
- Non Vital Contacts.cel
- Non Vital Relays.cel
- Power Supply.cel
- Push Button.cel
- Relay Rack.cel
- SD_ATP.cel (for Signalling plans only)
- SD_SIG_PLANS.cel
- SD_SIG_POWR.cel
- SD_SIG_SPEED.cel
- SD_TRACK_INS.cel
- Signal Contacts.cel
- Signals.cel

© State of NSW through Transport for NSW 2021

- Solenoids.cel
- Switch Machine Contacts.cel
- Switches.cel
- Timers.cel
- Track Relays.cel
- Train Stop.cel
- Vital Contacts.cel

A complete list of cells can be obtained by downloading the resource files from the AMB section of the TfNSW website and opening the cell libraries.

Download file T MU MD 00006 R7.

14.4. Signal drawings general requirements

The current digitised signalling plans, track insulation plans and circuit diagrams should be updated and converted to MicroStation V8 DGN format. The new and amended plans, including signalling plans, balise plans, track insulation plans, circuit diagrams, compressed air system drawings, driver's diagrams, weekly notice insertions, equipment housing plans and level crossing plans shall be prepared using MicroStation V8 DGN format.

SolidWorks should be used for modelling 3D mechanical components.

14.4.1. Design history

For revision control purposes and change management in MicroStation, design history should be initiated. After a drawing file amendment is signed off, the changes shall be committed to the design history. The file is then saved and the modified date of the drawing file (dgn) is recorded.

For drawings that do not have a design history initialised, the design history should be initiated prior to starting amendments and then committed on completion of the changes.

All seed files for signal drawings have design history initialised, by default.

14.4.2. Submission package

All signal drawings (except circuit books and air supply books) shall follow the submission package requirements as explained in Section 8.3. All submission packages shall conform to the RIM's Engineering and Records Management procedures.

All signal drawings shall be submitted to the VPR at the as-built design stage.

© State of NSW through Transport for NSW 2021

Based on the requirements of the records custodian (RIM), signal drawings (or controlled/interim copies) may be required to be submitted to the VPR during the following design stages (in addition to the as-built design stage):

- ref or final concept
- AFC
- testing
- commissioning

Other signalling drawings, using typical signal drawing title block as explained in Section 14.1.3 shall be submitted to the VPR during the following design stages:

- reference or final concept stage
- approved for construction (AFC) stage
- as-built stage

14.4.3. Folder structure

The following folder structure shall be used for submitting the drawing files and drawing image files for signalling drawings.

Circuit book and air supply book

An EDMS number shall be allocated in accordance with the circuit book and air supply book.

Individual drawing files belonging to a circuit book or air supply book shall be stored in an EDMS number folder, which shall be a sub folder in the circuit book folder or air supply book folder.

A single image file, containing multiple sheets shall be created for each EDMS number. The image file shall be stored in the drawing image file folder.

Other signal drawings

Drawing files belonging to all other signalling drawings shall be stored in 'Others' folder, which shall be a sub folder under 'signal' folder.

Single image file, containing single sheet shall be created for each EDMS number and shall be stored in drawing image file folder.

Figure 132 shows the folder structure of the circuit book and air supply book drawing package; a template of this folder structure can be downloaded from the AMB section of the TfNSW website.

Download T MU MD 00006 R8.

© State of NSW through Transport for NSW 2021

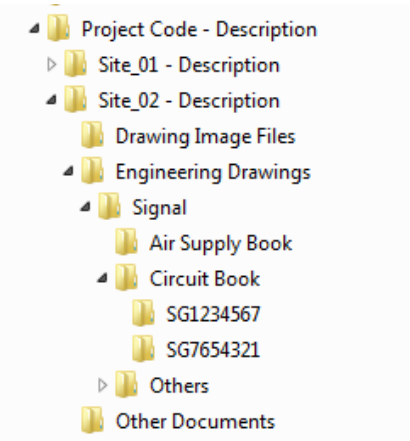


Figure 132 - Folder structure for signal drawings

14.5. Types of signal drawings

Based on the design content, signal drawings are classified into the following drawing types:

- signalling circuit diagram
- air system drawing
- signalling plans
- balise plans
- track insulation plan
- mechanical drawings
- fuse and terminal analysis
- rack layout
- relay contact analysis

  Note: These drawings types refer to the ones that are produced using CAD applications.

14.6. Signalling circuit diagrams

Signalling circuits shall include the details in accordance with SPG 0703.

All circuits shall be drawn in a clear, logical and uncluttered manner with adequate vertical spacing between circuit elements. Ease of reading and understanding should be given priority in setting out circuits.

The circuits should be placed onto the drawing grid. All wires and components should have points snapped together.

The circuits shall be laid out to minimise wires crossing each other. Where wires cross each other, the vertical wire shall be broken at the point where it crosses the horizontal wire.

© State of NSW through Transport for NSW 2021

The circuits shall have the circuit name as the heading printed on the left side of the sheet.

14.6.1. Signal drawing levels

The signalling circuit and analysis drawings use various levels, colours, and line styles to indicate 'new', 'removed' and 'maintenance' information. All elements in circuit drawings shall be drawn on levels, line work, and text styles pre-set to levels.

If other levels, colours or line styles for temporary work are created, then they shall be removed from the drawing before the final drawings are submitted to the VPR.

14.6.2. Text styles for signalling circuit diagrams

Text should be placed in the drawing using the menu toolbar, provided by TfNSW. The menu toolbar can be imported into MicroStation by setting up the dgnlib file. The text shall always be in upper case format.

The text styles should be used when placing text. The text style settings should not be modified.

Table 46 provides the list of text sizes and styles for circuit diagrams.

Table 46 - Text styles and sizes for circuit diagrams

Text style	Text size	Purpose
CB_Text_18	1.8 mm	Detail (for example, relay contact numbers), part numbers, notes
CB_Text_25	2.5 mm	Element (for example, relay and contact names), notes
CB_Text_35	3.5 mm	Circuit headings
CB_Text_50	5.0 mm	Miscellaneous labels

14.6.3. Master sheet templates

Borders, covers, indexes and analysis drawings such as ‘Q’ type relay analysis sheet, cable analysis sheet, fuse and terminal list sheets should be created from respective templates. The drawings shall be created using the standard prototype dgn as a template.

Note: The master sheet templates are the only acceptable dgns that can be placed in any circuit drawing for the purpose of a master sheet.

Where a master sheet that is not listed needs to be created, then the full details of the sheet shall be referred to AMB for approval.

© State of NSW through Transport for NSW 2021

14.6.4. Signalling circuit symbols

The signalling circuit symbols shall be in accordance with T HR SC 00004 ST *Signalling Design requirements – Signalling Symbols* and shall be placed in the circuit drawing in the form of cells. For circuit diagram cell libraries, see Section 14.9 of this standard.

The cells should be inserted on a 5 mm grid in the circuit drawing and connected to other cells using smart lines only. To edit the text values in cells, the Edit Tag tool should be used. The cells should not be dropped or exploded. When drawing a second wire from a connection point, this line should be offset by 2 mm using the 1 mm grid for reference.

The source records should show the way it exists, and those standard cells shall not be used where they do not accurately represent the installed item. In this case, the item should be represented as it exists.

Figure 133 shows the alignment of cells on a grid system.

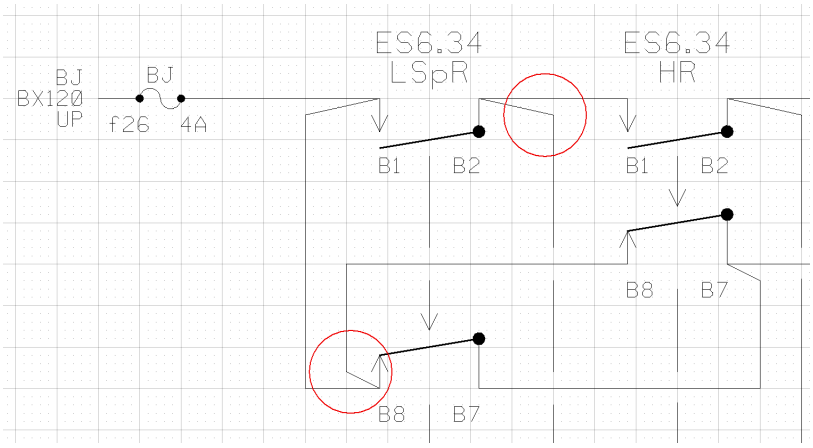


Figure 133 - Circuit drawing alignment on grid

14.6.5. Equipment rack layouts

The rack layouts shall be drawn to full size in design model and referenced into an A3 circuit sheet model. The dimensions should be placed in the A3 sheet view with reference units enabled and association lock activated. Annotations such as tables shall be placed in the A3 sheet view.

The rack layouts shall show the correct positions of all items of equipment mounted on the rack, including spare spaces. Terminations, fuses and other items shall be drawn to their correct length including end posts and spacers.

The following details are also required for each item:

- function name of the item (mandatory)
- configuration (or voltage)
- type or brand

© State of NSW through Transport for NSW 2021

Figure 134 shows an example of an annotation for a relay.

Figure 134 - Relay annotation

The annotations for a relay are as follows:

- relay name - 258 NLR, 8-8, QN1 in the format
- voltage – 12V
- contact configuration – 8-8
- type QN1

Where descriptions are long, an identifier marker may be used. A reference table is permitted; however, this is not preferred.

The cells are provided for the most commonly used equipment. New equipment or equipment without a cell can be drawn in accordance with the design requirement.

To improve the legibility of the equipment rack layouts, the text styles as shown in Table 47 should be used when placing the text.

Table 47 - Text styles and sizes for rack layout

Text style	Text size	Purpose
CB_Narrow_18	1.8 mm	Labels
CB_Narrow_25	2.5 mm	Details and labels

14.7. Compressed air system diagrams

The air system diagrams shall include details in accordance with SPG 0703.

The schematic single line diagrams shall be provided for compressed air systems.

The starting and finishing kilometres and equipment kilometres should be provided on air main schematics to enable pinpointing of valve locations.

14.7.1. Air supply drawing format and composition

New and amended air supply drawings shall be prepared using MicroStation software.

For the air supply drawing seed file, see Section 14.2 of this standard.

© State of NSW through Transport for NSW 2021

The air supply diagrams shall be provided in A3 size books of drawings. These books shall have control pages and amendment sheets, similar to the circuit book requirements. An index and legend sheet should also be provided.

Refer to SPG 0703 for more information.

14.7.2. Air supply drawing levels

The air supply diagrams use various levels, colours, and line styles to indicate 'new', 'removed' and 'maintenance' information. If other levels, colours or line styles for temporary use are used, then they shall be removed from the drawing before the final drawings are submitted to the VPR.

14.7.3. Text styles for compressed air system diagrams

Text should be placed in the drawing using the AMB menu structure. Text shall always be in upper case format.

Table 48 provides a list of text sizes and styles for air supply diagrams.

Table 48 - Text style and size for compressed air system diagrams

Text style	Text size	Purpose
AS_Text_18	1.8 mm	General text
AS_Text_25	2.5 mm	General text
AS_Text_35	3.5 mm	General text
AS_Text_50	5.0 mm	General text

14.7.4. Air supply pneumatic symbols

The air supply symbols shall be in accordance with AS 1101.1 *Graphic symbol for general engineering – Hydraulic and pneumatic systems* and SDG 004 *Standard Signalling Symbols* and shall be placed in the circuit drawing in the form of cells.

Where an air supply element that is not listed is required to be created, then the full details of the element shall be referred to the AMB for approval.

14.8. Signalling plans

A signalling plan shows the layout and location of signalling equipment.

The signalling plans shall be drawn on a drawing grid by setting one grid unit space equal to 10 m in the model space.

© State of NSW through Transport for NSW 2021

14.8.1. Signalling plan composition

The signalling plan should display any structure, equipment or feature in or adjacent to the rail corridor which can affect the signal controls or signal sighting.

Refer to SPG 0703 for details on signalling plan composition.

14.8.2. Scale

The signalling plan should use scales from the range 1:500, 1:1000, 1:2000, 1:5000 and 1:10000. The standard scale for interlocking areas shall be 1:2000 subject to full details being clearly and legibly shown. Changes to scale shall take place only at kilometre points. Signalling plans should be scaled longitudinally.

14.8.3. Track lengths

Track lengths are measured and certified by qualified signalling staff. These are measured from block joints, wheel sensors, SI units or to the middle of a tuned loop. Track circuit lengths may not add up to signal kilometres as signals are placed relative to defined survey points while tracks are true measured distances.

14.8.4. Track centreline

The centreline of all symbols for equipment and structures shall be as longitudinally correct to scale as possible and laterally correct relative to the track centre lines and laterally spaced for legibility.

14.8.5. Text styles and sizes for signalling plan

The ‘working’ text style should be used for signalling plans. This text style is available for download from the AMB section of the TfNSW website.

Download file T MU MD 00006 R7.

The text should be placed using the appropriate style with the assigned height and width. The text should not be copied and then the height and width modified.

14.8.6. Global origin

The global origin is the primary set out point for the drawing. It is the basis for the diagram and the starting point for the linear track measurement for the section being documented.

Figure 135 shows an example of global origin marked in the drawing.

© State of NSW through Transport for NSW 2021

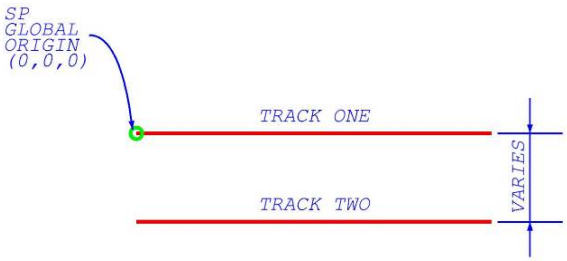


Figure 135 - Global origin

14.8.7. Signalling plan file continuation

Figure 136 shows the continuation of tracks in the signalling plan.

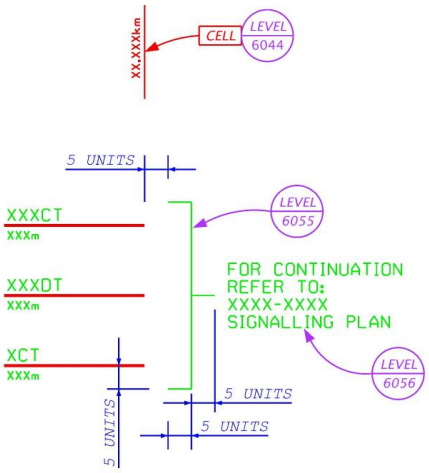


Figure 136 - Continuation of tracks

14.8.8. Curvature and gradient

The curve and gradient diagrams are drawn above the track centrelines set out with track distances. The power system supply and distribution information together with the trackside cabling details including the number of cables, cable sizes, termination points, joints and other information shall be drawn below the track layouts.

The curve component of the diagram should illustrate where they occur on the track with the track kilometrage listed and curve radius shown in metres. The curve should also indicate the direction of the curve if that is a left hand or right hand curve. Each curve should start in the middle reference line and curve to the left or the right or go straight if there is no curve as shown in Figure 137.

The gradients details that are shown relative to track illustrate the different gradients by the ratio of the rise or fall, to the distance of the gradient run. The location of changes in gradient shall also be marked on the signalling plan.

© State of NSW through Transport for NSW 2021

Figure 137 shows the geo-physical layout of the track. It shows both gradients and curvatures. This information is essential in the spacing and positioning of signals. For example, if a signal is placed on a curve then the sighting distance of the signal is affected.

The curvature and gradient information shall be kept compact and closely spaced to avoid occupying excessive space on the plan. A gradient or curvature profile may be restarted to avoid the information being excessively wide.

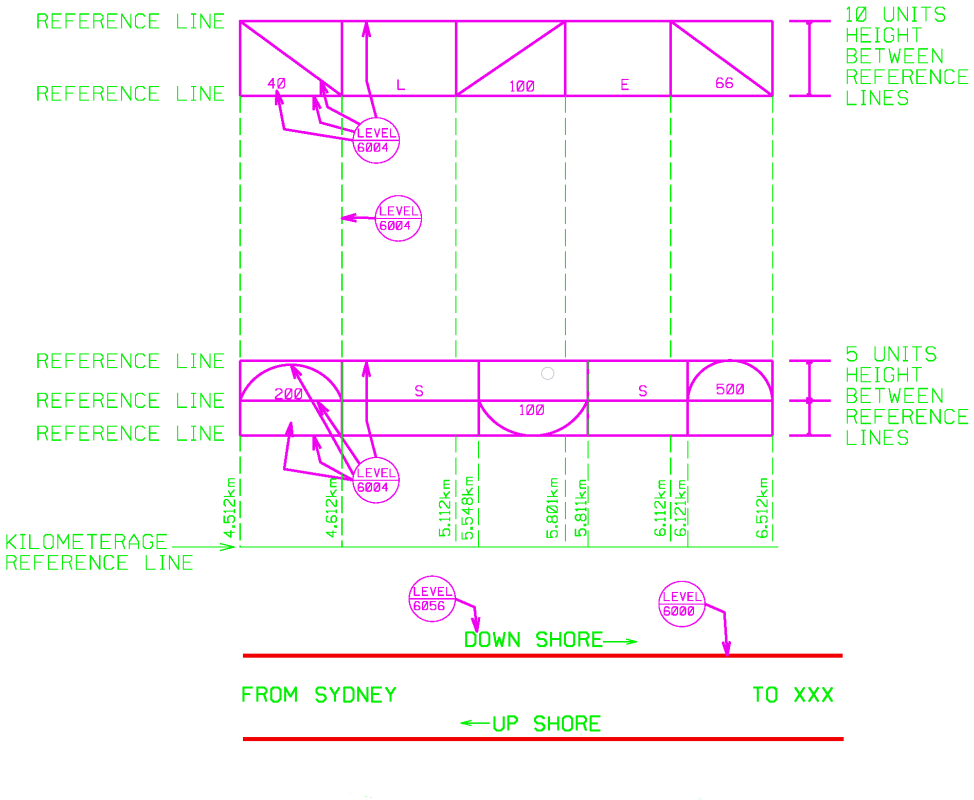


Figure 137 – Gradients and curvatures

14.8.9. Placing equipment and text on signalling plans

Care should be taken to minimise drawing clutter to maintain clarity and readability.

The signals and equipment should be placed along the track. They should be represented by graphic cells or text.

Equipment placement on the schematic diagram is based on linear kilometrage location and is either determined by survey or designated by the signalling engineer.

Equipment on diagrams should be represented using cells from the cell library to ensure that only standardised symbols are used.

In case the equipment is not located on the diagram at its specified location, due to a conflict with other plan items, then the items may be located in a slightly different location and indicated by an arrow to locate the correct position.

© State of NSW through Transport for NSW 2021

Signal bases, trainstops, wheel sensors or insulated rail joints shall generally be shown adjacent to each other or in accordance with the requirements of SPG 0703. Balise groups shall be shown as close as practically possible to the signal or infrastructure that they apply.

The flat end of a point machine should be in line with the facing point lock. The machine should be shown on the side on which it is located.

For track identification, track lengths and track names (which include the letter 'T') such as 167BT are required. Audio frequency track circuits should show applicable frequencies such as 1700Hz, 2300Hz, 2000Hz or 2600Hz.

Figure 138 shows two parallel tracks with one-track circuit in the DOWN direction and one in the UP direction. The track lengths are shown and measured between the insulated rail joints (IRJ's) or tuned loops. The tracks shown are of the frequency type.

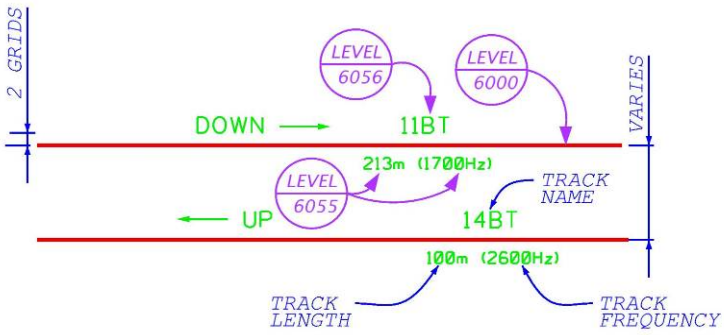


Figure 138 - Track description

Kilometre posts

Figure 139 shows the kilometre and half kilometre posts that should be shown with the distance noted above the post.

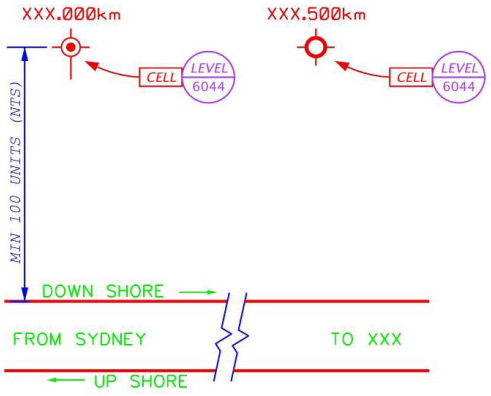


Figure 139 - Kilometre posts

© State of NSW through Transport for NSW 2021

Platforms and station names

Figure 140 shows a station platform in relation to the running tracks. The station name is placed in relation to the platform.

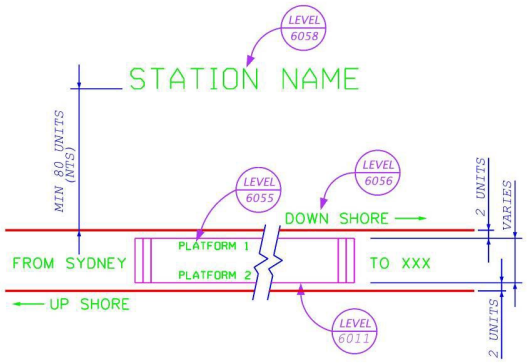


Figure 140 - Platform and station name

Figure 141 shows a station platform in relation to the curved running tracks.

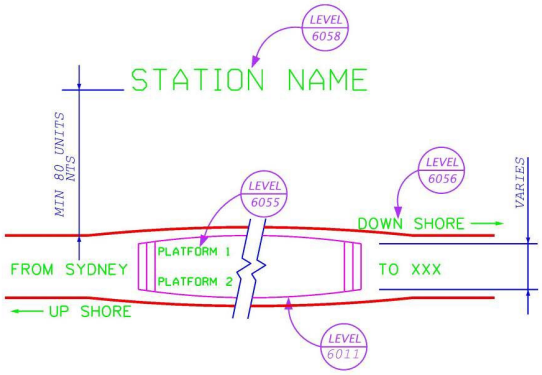


Figure 141 - Curved platform

Streets, bridges crossings over/under

Figure 142 shows the over line crossing and under line crossing for a signalling plan.

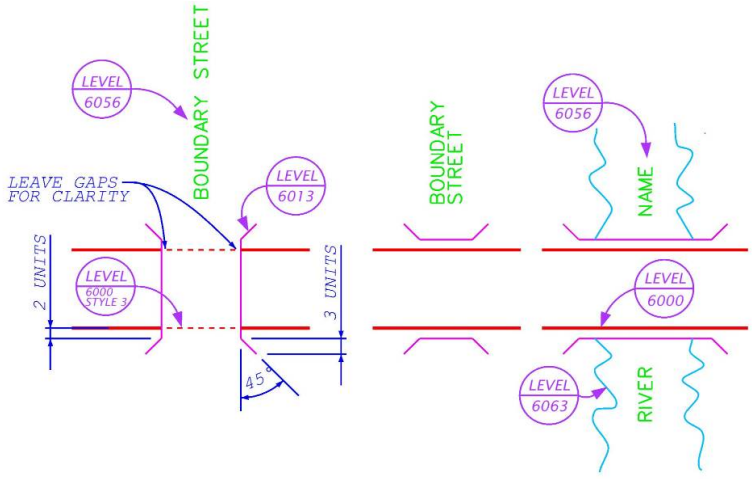


Figure 142 - Over line crossing and under line crossing / bridge

© State of NSW through Transport for NSW 2021

Crossovers and turnouts on signalling plans

Figure 143, Figure 144, Figure 145, Figure 146, and Figure 147 show the crossovers and turnouts in a signalling plan.

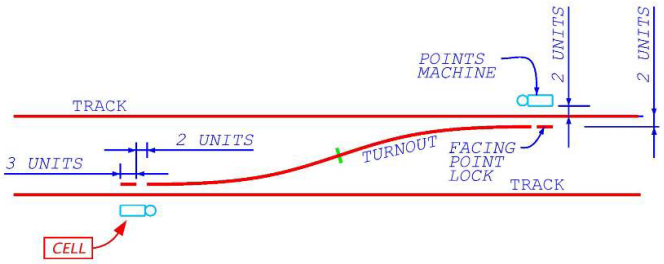


Figure 143 - General layout

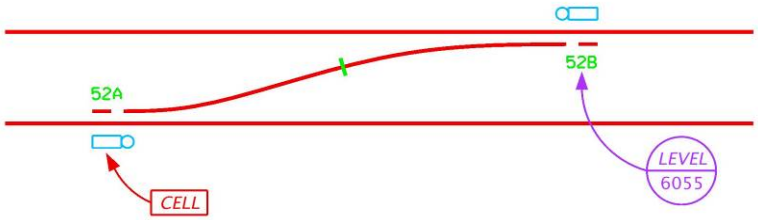


Figure 144 - Facing point locks (FPL) both ends

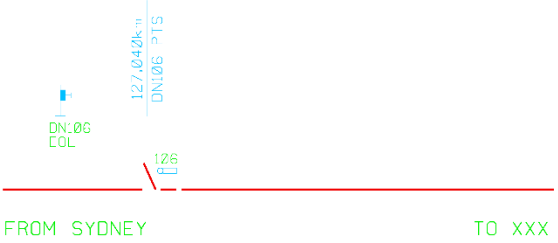


Figure 145 - Catchpoints

© State of NSW through Transport for NSW 2021

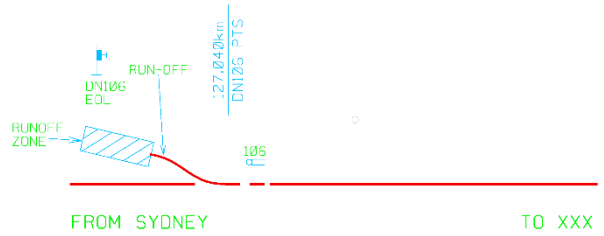


Figure 146 - Run off points

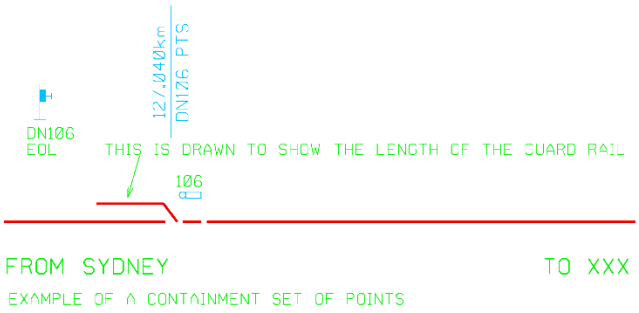


Figure 147 - Containment catchpoints

14.8.10. Axle counters

Wheel sensors shall be drawn as a perpendicular line through the track to represent the track sections they create. The wheel sensor is represented by a filled circle to the side of the line the wheel senor is installed on.

Stagger of wheel sensors and correct placement relative to other equipment shall be shown.

Wheel sensor names generally need only be provided on signalling plans if naming cannot be discerned from track names or if placed for a special purpose.

Axle counter wheel sensor naming

Wheel sensors are named after the track sections they separate. Naming generally follows the main direction of travel. This is up to designer discretion, particularly in crossovers, yards and single line sections.

Where there is more than one wheel sensor separating the same tracks (For example, in a crossover or redundant configuration) wheel sensors shall be provided with a suffix (1), (2), (3)

© State of NSW through Transport for NSW 2021

for each wheel sensor. The wheel sensor suffix shall be shown on the signalling plan. Odd numbers suffix used for wheel sensors placed on Down Rails, even numbers on Up Rails.

Wheel sensor names not conforming to the general rules or placed for special functions shall be provided with a unique name noted on the signalling plan. Figure 148 shows wheel sensor naming convention.

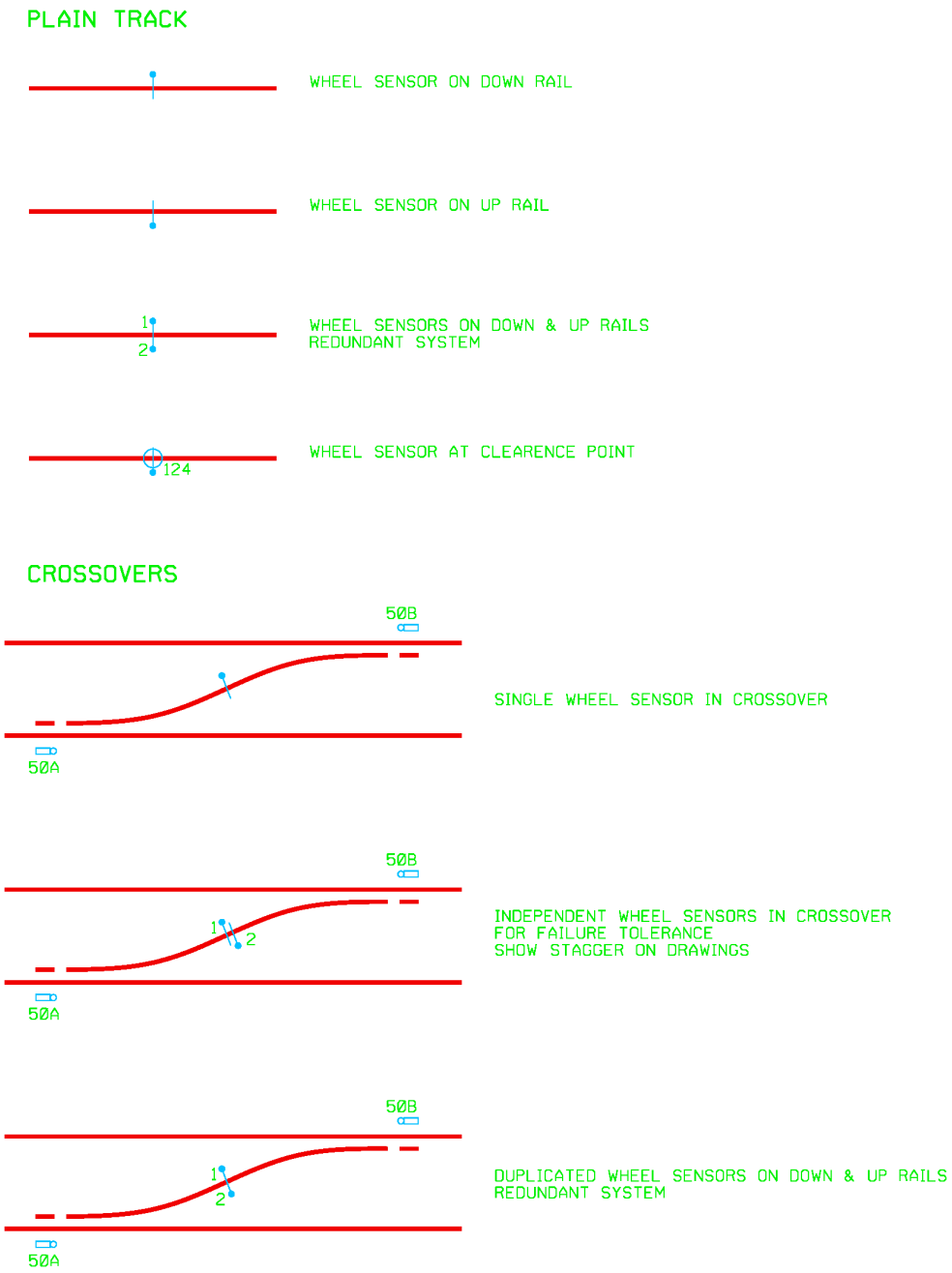


Figure 148 - Showing wheel sensor naming convention

© State of NSW through Transport for NSW 2021

14.9. Track insulation plans

The track insulation plan (TIP) is a full sized CAD drawing that is drawn using the civil permanent way as a basis and then presented as a scaled track schematic diagram of the rails, including check rails, guard rails and catch point runoffs, showing detailed insulated joints, wheel sensors, track circuits, traction return, track insulation and bonding arrangements. It shows the basic civil and structural infrastructure including gantries, stanchions, location of insulated joints, level crossings (road crossing and pedestrian crossings), platforms and stations.

The track layouts shall be taken from the permanent way CAD files as a reference.

14.9.1. Axle counter wheel sensors on track insulation plans

Wheel sensors are completely insulated from the rail and form no part of the track circuitry or traction return bonding. Wheel sensors are mechanically mounted to rail and are shown on TIP for information only.

Correct relative placement of equipment, including stagger of wheel sensors, shall be shown on the track insulation plan.

Wheel sensors shall be drawn on the rail they are installed on.

Naming and kilometrage of wheel sensors shall be included where placement is not discernible from an adjacent signal or position in a turnout, if placed for a special function or in condensed plans with significant scaling.

Example of axle counters on a TIP shown in Figure 149 and Figure 150.

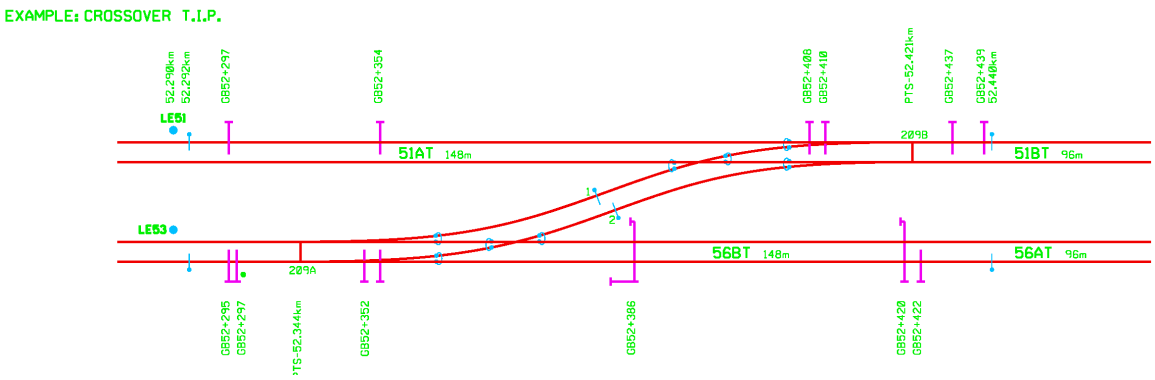


Figure 149 - Axle Counters on a TIP

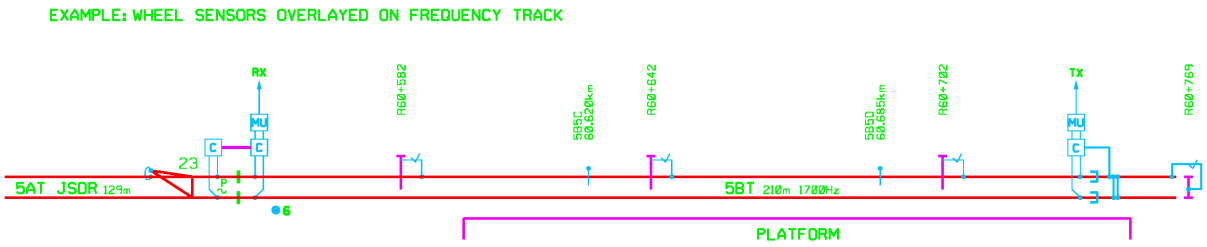


Figure 150 - Axle Counters on a TIP

14.9.2. Scale

The track insulation plans when printed shall have a longitudinal and lateral scale of 1:500. A larger scale such as 1:250 is permissible in complex yard areas; however, symbols are placed as standard cells and not scaled.

14.9.3. Orientation

The track insulation plans are oriented in such a way that Sydney is always on the left side of the drawing. Where there are no junctions, the track lines may be drawn as a straight line and each rail is represented by one line. Where there are diverse routes (junctions), the tracks shall be drawn to represent the curvatures of those tracks.

14.9.4. Drawing sheets

All drawings sizes shall be in accordance with AS 1100.101. The maximum height of a 'roll plan' is A1 (594 mm) up to a maximum of five linear metres in length. The drawings should be manageable in size, and a smaller width is preferred to permit safe use in outdoor conditions.

14.9.5. Track insulation plan global origin

The global origin is the primary set out point for the drawing. It is the basis for the diagram and the starting point for the lineal track measurement for the section being documented.

Figure 151 shows an example of TIP global origin.

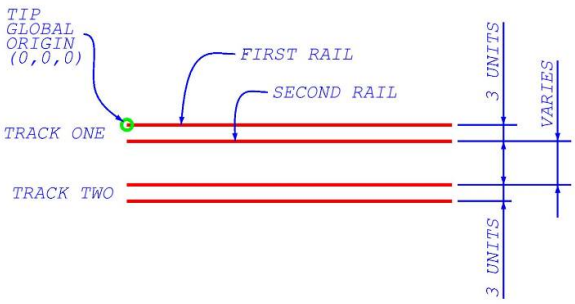


Figure 151 - TIP global origin

© State of NSW through Transport for NSW 2021

14.9.6. Track insulation plan file continuation

Figure 152 shows the TIP file continuation of tracks.

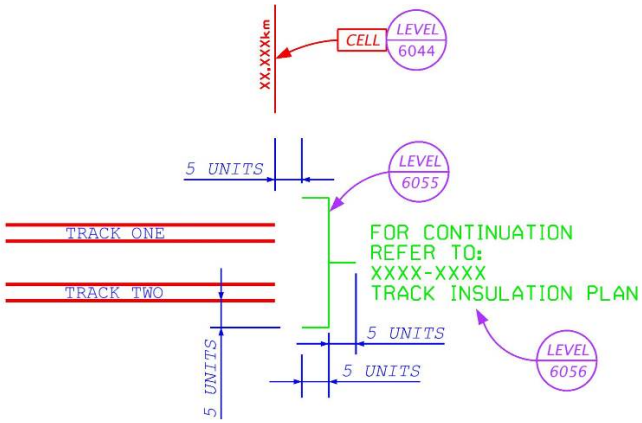


Figure 152 - File continuation

14.9.7. Track insulation plan drawing arrangement

For new designs, the track insulation plan shall be on a single length of track with a maximum roll length of five metres.

14.9.8. Track insulation plan composition

Refer to SPG 0703 for information on track insulation plan composition.

Track description

The track description should include the following information:

- track types such as CSEE, AC, Jeumont Schneider
- for jointless track circuits, the measurement shall be in metres, measured between block joints

  If there are no block joints in a jointless track, then the measurement position should be in the middle of the tuned loop.
- track name which refers to the line where it is installed – that is, 'IL' would be Illawarra or where there are multiple lines it can be 'S' for suburban or 'L' for local included in the description.

  Refer to ESG 100.29 *Signal Design Principles –Naming of Locations, Track and Sidings* for names of tracks and signals.
- frequency for audio track circuits

© State of NSW through Transport for NSW 2021

Figure 153 shows an example of a track description.

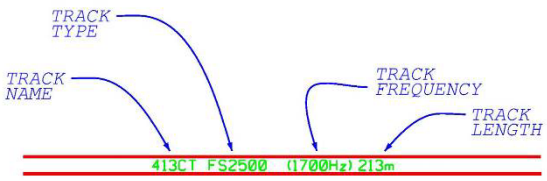


Figure 153 - Track description

Stanchions (OHWS)

Stanchions are provided to support the overhead wiring (1500 V) to power electric trains. Stanchions come in various types such as portal and single post.

The position of the stanchions is recorded on civil plans. These plans should be used as a base for the TIP to ensure correct placement of stanchions.

The kilometre placement of stanchions on the TIP should be done by measuring the distance from the main kilometre post.

For example, MH14+046 = Stanchion Name

14.046km = Stanchion Placement

Figure 154 shows an example of a stanchion.

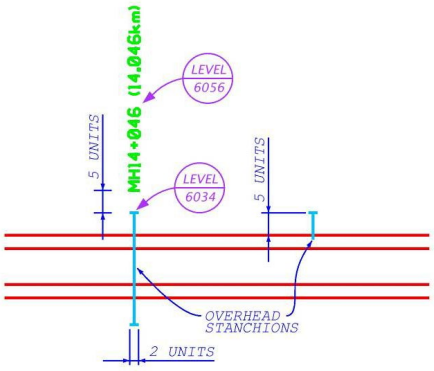


Figure 154 - Stanchions

© State of NSW through Transport for NSW 2021

Spark gap connections

Figure 155 shows an example of placement of spark gaps.

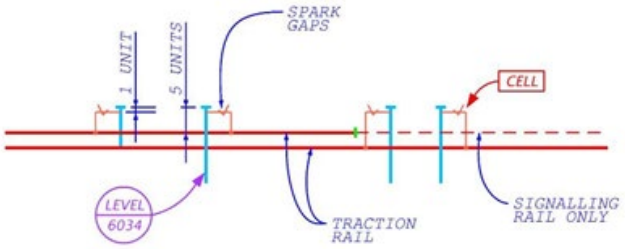


Figure 155 - Spark gap connection

Kilometre posts

The kilometre and half kilometre posts should be shown with the distance noted above the post as shown in Figure 156.

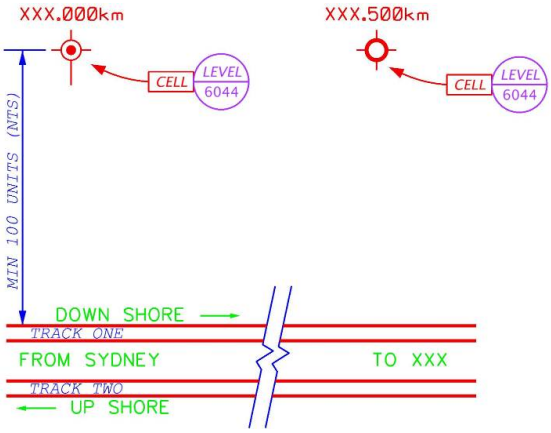


Figure 156 - Kilometrage post

Platforms and station names

Figure 157 shows a station platform in relation to the running tracks. The station name is placed in relation to the platform.

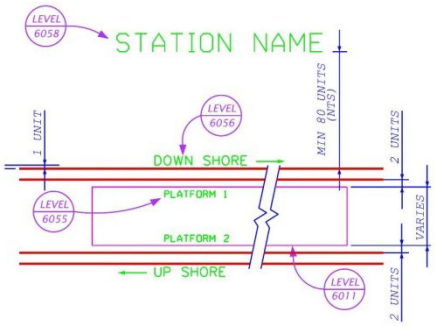


Figure 157 - Platform and station names

© State of NSW through Transport for NSW 2021

Overline and under line structures

Figure 158 illustrates the underbridge or overbridge on a track insulation plan.

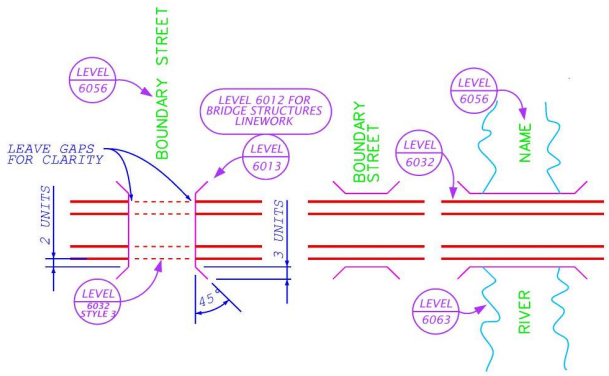


Figure 158 - Over line crossing, under line crossing and bridge

Audio frequency track (20 m) for track insulation plan only

With the audio tracks, adjacent tracks shall be of a different frequency.

All UP tracks should have even frequency that is, 2000 Hz or 2600 Hz.

All DOWN tracks should have an odd frequency that is 1700 Hz or 2300 Hz.

Figure 159 shows an example of an audio track circuit arrangement.

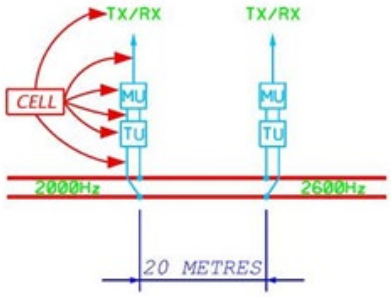


Figure 159 - Audio track circuit arrangement

© State of NSW through Transport for NSW 2021

CSEE tuning units with SI Unit (23 m)

Figure 160 shows a CSSE tuning unit.

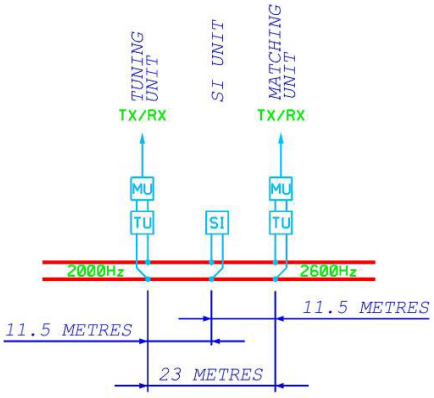


Figure 160 - CSEE tuning units

14.9.9. Equipment symbols placement

Figure 161 and Figure 162 show adjacent tracks of a different type. When this occurs, the joints shall be installed. The type of impedance bonds installed should be specified by the designer in accordance with SDG 004 *Standard Signalling Symbols*.

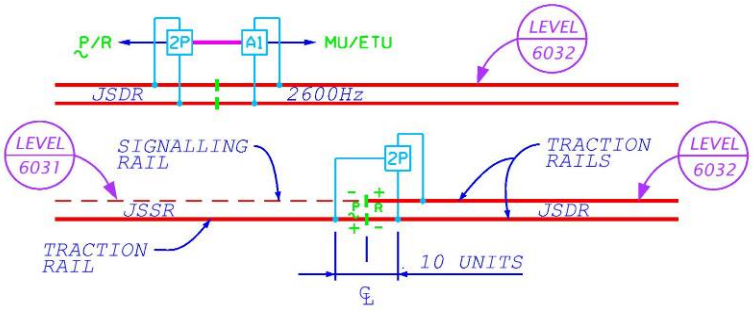


Figure 161 - Jeumont Schneider single rail to Jeumont Schneider double rail

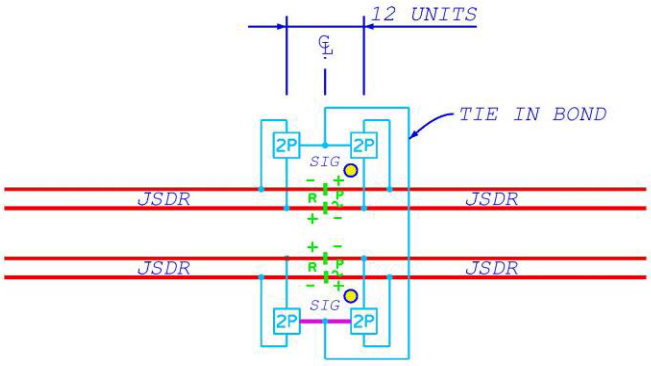


Figure 162 - Jeumont Schneider double rail to Jeumont Schneider double rail

© State of NSW through Transport for NSW 2021

14.9.10. Catch points types on track insulation plans

Examples of the different types of catch points are shown in Figure 163, Figure 164, and Figure 165.

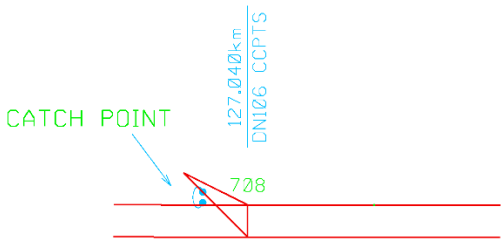


Figure 163 - Catchpoint

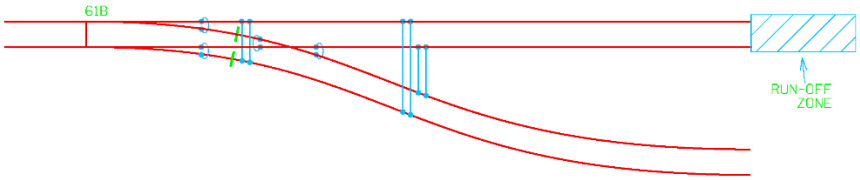


Figure 164 - Run-off points

© State of NSW through Transport for NSW 2021

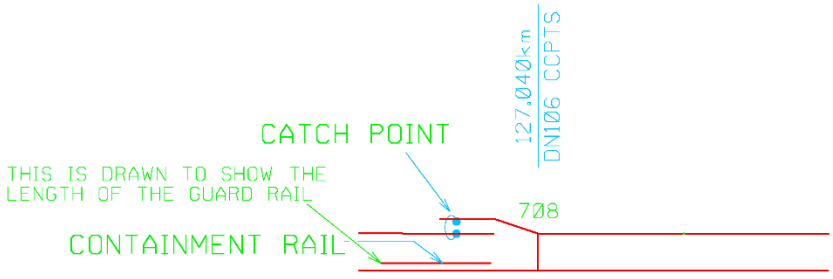


Figure 165 - Containment catch point

14.9.11. Locations of signals and signal names on track insulation plan

Figure 166 shows signals location on a TIP.

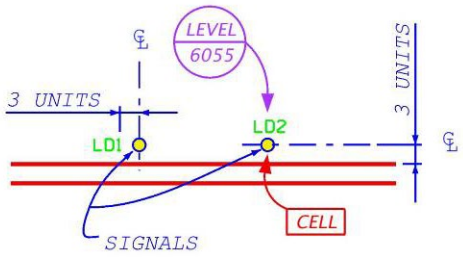


Figure 166 - Signal location

14.9.12. Insulated rail joints, parallel bonds on typical crossover

Figure 167 shows a typical crossover with double rail track circuits and parallel bonds. The insulated rail joints (IRJs) between the UP and DOWN roads shall separate the two roads electrically.

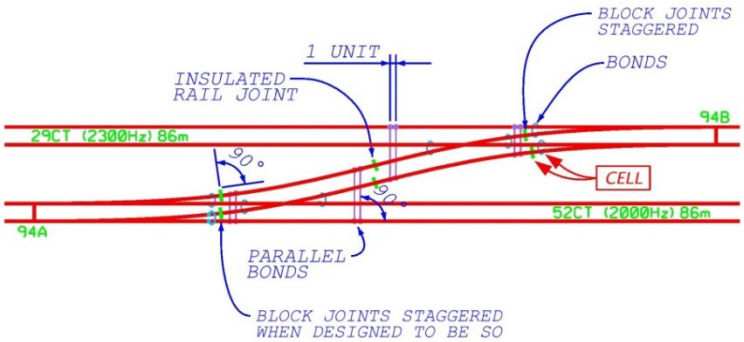


Figure 167 - Insulated rail joints

The IRJs should be drawn at right angles to the track line and centred at the centre of the radius of the curve and as close as possible.

© State of NSW through Transport for NSW 2021

Parallel bonds should be drawn as close as possible to the block joints and at right angles to the main track.

In some cases, the insulated rail joints in adjacent rails may be staggered. This stagger should be shown on the track insulation plan. If necessary, a larger scale detail may be provided to make this clear.

Figure 168 shows a staggered rail insulated joint.

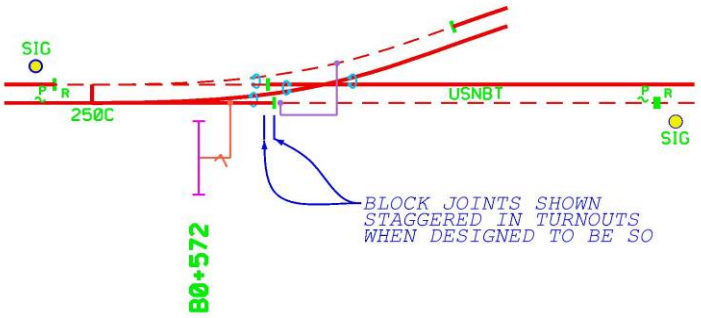


Figure 168 - Staggered insulated rail joint

14.10. Mechanical drawings

Mechanical drawings should be drawn utilising the SolidWorks application and should be generated from a 3D SolidWorks model.

All new drawings shall be produced in SolidWorks format.

For existing drawings, minor changes may be retained in the same format (for example, *.dgn or *.dwg) and significant changes shall be upgraded to SolidWorks format.

The drawings shall show the arrangements of mechanical equipment. The mechanical systems shall be fully detailed and include all fixtures, fittings, manufacturing, fabrication and finishing details in accordance with SPG 0703. If a drawing is converted from one format to another, a full check of the drawing is required before release.

14.10.1. Section symbols

The section symbols for cutting plane and detail shall be in accordance with Section 7 of AS1100.101.

14.10.2. Levels for mechanical drawing

The mechanical component and assemblies in SolidWorks models do not use levels. Levels are used only in the mechanical drawing format.

© State of NSW through Transport for NSW 2021

14.10.3. Text styles for mechanical drawing

The text for mechanical drawings should be placed in the drawing in accordance with AS 1100.101. The text shall always be in upper case format.

The text style for mechanical drawing is restricted. Table 49 provides the standard sizes for the clarity of drawing presentation.

Table 49 - Text style and size for mechanical drawing

Text style	Text size	Purpose
Arial Narrow	2.5 mm	General text
Arial Narrow	3.5 mm	General text
Arial Narrow	5.0 mm	Title text
Arial Narrow	7.0 mm	Big title text

14.10.4. Model filenames for assembly, subassemblies and components

The SolidWorks filename of a new assembly shall begin with M (in upper case only) followed by a catalogue number and drawing number. The file extension is .SLDASM in upper case; for example, M10-001.SLDASM.

The subassemblies of a larger item may be identified as sections. The filenames of subassemblies shall have the same drawing number as the general arrangement with the addition of -1, -2 and so on, such as M10-001-1.SLDASM, M10-001-2.SLDASM.

Each component is identified by its design part number which is formed by its drawing number along with A, B, or C and so on to link each other. The component may be listed in different subassemblies. The filename of the component model shall begin with M (in upper case only) followed by the catalogue number and drawing number and _A or _B or _C and so on to identify the item. The file extension is .SLDPRT in upper case.

For example, Design Part Number: M02001A, M02001B, M02001C

Filename: M02-001_A.SLDPRT, M02-001_B.SLDPRT, M02-001_C.SLDPRT

14.10.5. Format for bill of materials

Figure 169 shows the format and information required in the bill of materials (BoM) for a mechanical drawing.

ITEM No	PART No	ITEM DESCRIPTION	QTY	MAT/SPEC	FINISH	DWG REF	STOCK CODE
1	AE 1..5.600	ENCLOSURE 300X380X210MM WITH SWING HANDLE	1	STAINLESS STL		M06-313 SHT 5/5	
2	M06313B	FRONT ENGRAVED PANEL	1	WHITE TRAFFOLYTE		M06-313 SHT 3/5	
3	M06313A	FRONT METAL MOUNTING PANEL	1	STEEL	ZINC PLATED	M06-313 SHT 3/5	
4		FRONT PANEL MOUNTING STUD ASSEMBLY	4			M06-315 SHT 3/4	

Figure 169 - Bill of materials - sample format

© State of NSW through Transport for NSW 2021

14.11. Other signal drawings

The type of drawings explained in Section 14.11.1 through to Section 14.11.4 shall include details in accordance with SPG 0703.

14.11.1. Equipment housing

The layout plans for equipment housings including huts, relay rooms, signal boxes and control centres shall be to scale and shall detail precise floor, wall and ceiling positions for all items.

14.11.2. Level crossings

The level crossing layout plans shall show, to a scale of 1:50, the physical arrangements at road rail or controlled pedestrian crossings.

14.11.3. Structures and drawings

The working drawings for structures and buildings shall be fully detailed and shall include architectural and structural details, specifications, computations, arrangements for services together with assembly, mounting and erection details where appropriate.

14.11.4. Clearance diagrams

The trackside structures such as signals and signal gantries, which have been expressly approved in writing to protrude into the area of the standard structure gauge shall be detailed on clearance diagrams. Such diagrams shall detail the precise location of structures, including associated ladders, stays and fittings, in relation to the standard structure gauge including distances from rail level, running edge and overhead traction wires and equipment. The track curvature and superelevation shall also be shown on these diagrams.

14.12. Other reference material

The following documents can be referred for additional information on drafting signal drawings:

- T HR SC 00001 ST *Circuit Design Standard – Typical Circuits*
- SDG 002 *Circuit Design Standard Obsolete Signalling Circuits*
- T HR SC 00003 ST *Circuit Design Standard – ETCS Level 1 Interface Circuits*
- ESG 100 *Signal Design Principles*
- T HR SC 00719 SP *Computer-Based Interlocking Equipment*
- TMGG 1550 *Signalling Documentation Guidelines*

© State of NSW through Transport for NSW 2021

15. Fleet CAD requirements

Sydney Trains (ST) shall be able to maintain any assets delivered in order to provide rail (or other) passenger services.

The Fleet CAD requirements are applicable to the fleet drawings produced for TfNSW rail projects. These requirements should be read in conjunction with Section 6 of this standard.

Where conflict exists between the two sections, then the Fleet CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

All drawings shall comply with the methodologies shown in AS 1100.101, AS 1100.201 and AS 1100.3. Any non-conformance with this requirement will require an approved concession.

All drawings shall include an EDMS fleet drawing number such as "FL0000000".

PDF copies of drawings shall also be supplied with approved CAD files unless a concession has been approved to only supply pdf copy drawings.

Supplied CAD files, for new drawings, shall not be generated by inserting raster image files into the CAD file (hybrid file) unless a concession has been approved to supply drawings in that manner. CAD hybrid files can be used to carry out amendments on old tiff file format drawings.

Unless otherwise agreed and documented, all Fleet drawings supplied to Sydney Trains are supplied with the IP rights to allow the drawings to be utilised for the maintenance, overhaul, and upgrade of the equipment. This includes the rights to amend and update the drawings as required. This also includes the rights to provide the documentation to third parties who have been contracted by Sydney Trains for the purposes of upgrading, overhauling or maintaining the asset.

15.1. Developments

Complex sheet metal components shall include a fully dimensioned development on the detail drawings. The developments shall also include the bend lines. Bend lines are light solid lines which stop before intersecting the outline. Bend lines are the camp point where the metal starts the bend. “BEND UP” or “BEND DOWN” is added on the side which is being bent.

15.2. Standard graphics used on fleet drawings

Figure 170 shows standard graphics which can be incorporated on drawings as required. The image is available as an AutoCAD dwg or dxf format file.

© State of NSW through Transport for NSW 2021

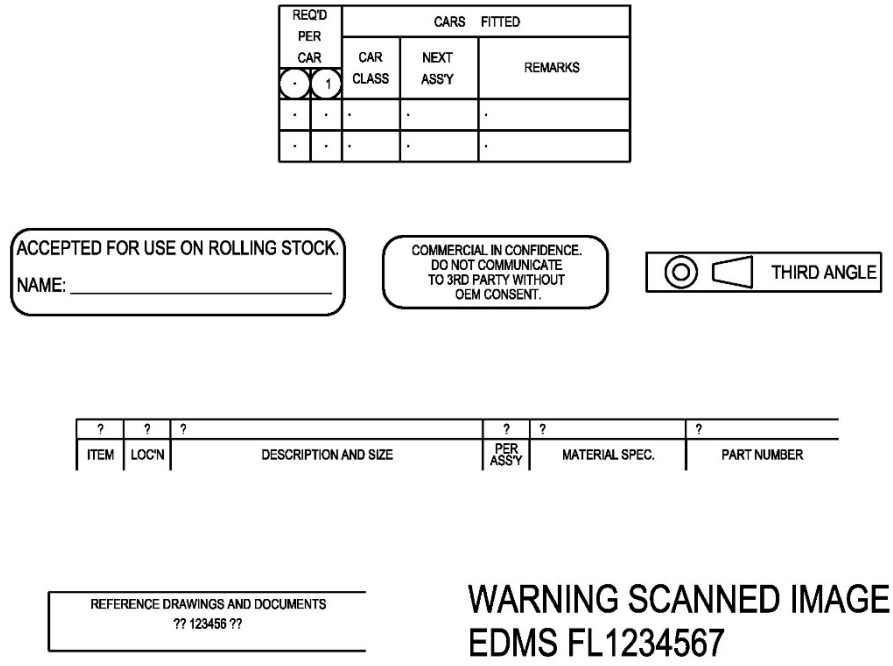


Figure 170 - Standard graphics used on Fleet drawings

15.3. Drawing sign off

Where the intellectual property (IP) is owned by Sydney Trains then new drawings shall be supplied on TfNSW drawing borders. Placing a company drawing utilising company borders within a TfNSW border is not acceptable. The TfNSW borders provide fields for the company drawing number and company drawing revision. The main drawing number and revision fields are for the FL drawing number and associated revision.

Where the drawing sign off is completed by non-Sydney Trains staff or a concession has been approved to supply the drawings on company borders then new drawings shall be reviewed for suitability and completeness by Sydney Trains. All significant issues shall be rectified by the contractor. New drawings supplied by contractors shall include the "ACCEPTED FOR USE ON ROLLING STOCK." stamp for internal (Sydney Trains) sign off. Drawings which have not been signed off in this manner will not be accepted into the Planroom. Subsequent amendments by contractors can utilise this same stamp as an internal sign off or may be signed off in the amendment table, as agreed.

An example of an acceptance stamp is shown in Figure 171.

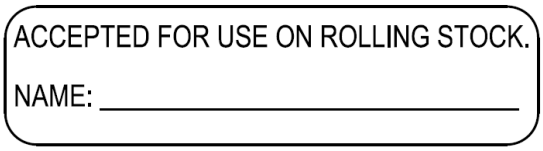


Figure 171 - Example of an acceptance stamp

© State of NSW through Transport for NSW 2021

15.4. Reference list

Drawings shall include a reference list which is typically applied to the top right corner of the drawing on the inside of the border (or other approved location). An example of a reference list is shown in Figure 172.

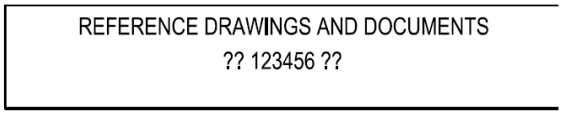


Figure 172 - Reference list example

The references shall include all applicable assembly/arrangement drawings, all applicable engineering modifications and related information drawings which are not called up on the assembly drawings.

15.5. Item or parts list

Assembly and arrangement drawings which call up items or parts used in the assembly shall use an item or parts list placed above the title block of the drawing joining to the RHS inside border (or other approved location). An example of an item or parts list is shown in Figure 173.

?	?	?	?	?	?
ITEM	LOC'N	DESCRIPTION AND SIZE	PER ASSY	MATERIAL SPEC.	PART NUMBER

Figure 173 - Example of an item or parts list

15.6. Title block for fleet drawings

The fleet design drawings shall use the drawing title block as shown in Figure 174 and Figure 175.

The titles for fleet drawings shall be kept short and definitive. The first two lines of the drawing title shall be based on the technical maintenance code (TMC) available in the AMD-05-TSD-007 (Formerly RS 0041CM) *Fleet Architecture Manual*. The first line in the title block is based on level 1 and level 2 of the Fleet Architecture Manual. The second line in the title block is based on level 3 and level 4 of the Fleet Architecture Manual. The subsequent 3 lines in the title block are used to describe what the drawing is about. For example:

(*Line 1) (Level 1)* DDS (T SET) *(Level 2 not required as it applies to all cars)*

(Line 2) (Level 3) DOOR - *(Level 4)* PASSENGER BODYSIDE

(Line 3) TORQUE CYLINDER FLOW CONTROL VALVE

The appropriate TMC code would be RT00-04040107

© State of NSW through Transport for NSW 2021

(Line 1) (Level 1) DDIC (V SET) – *(Level 2)* ALL MOTOR CARS SERIES 1-4

(Line 2) (Level 3) BOGIE – *(Level 4)* AXLE BOX

(Line 3) BEARING HEAT SENSOR ASSEMBLY

(Line 4) MOUNTING BRACKET

The appropriate TMC code would be RI01-02040000

Where the drawing relates to more than one fleet type then the more generic Level 1 descriptions shall be used. These do not require any Level 2 descriptions. For example, if the drawing applies to C sets and K sets, then the first line would be as follows:

(*Line 1) (Level 1)* ALL ELECTRIC ROLLING STOCK *(Level 2 not required)*

Do not change the size or font of the text in the titleblock. The "smart tags" only need to be edited to the required text string. If the text string does not fit into the titleblock then is allowable to scale the text in the X direction only. The maximum scale required should be 0.7.

Where the TMC does not apply, the first word should be the key noun. For example:

(Line 1) HOOK FOR BOGIE BELLOWS REMOVAL

© State of NSW through Transport for NSW 2021

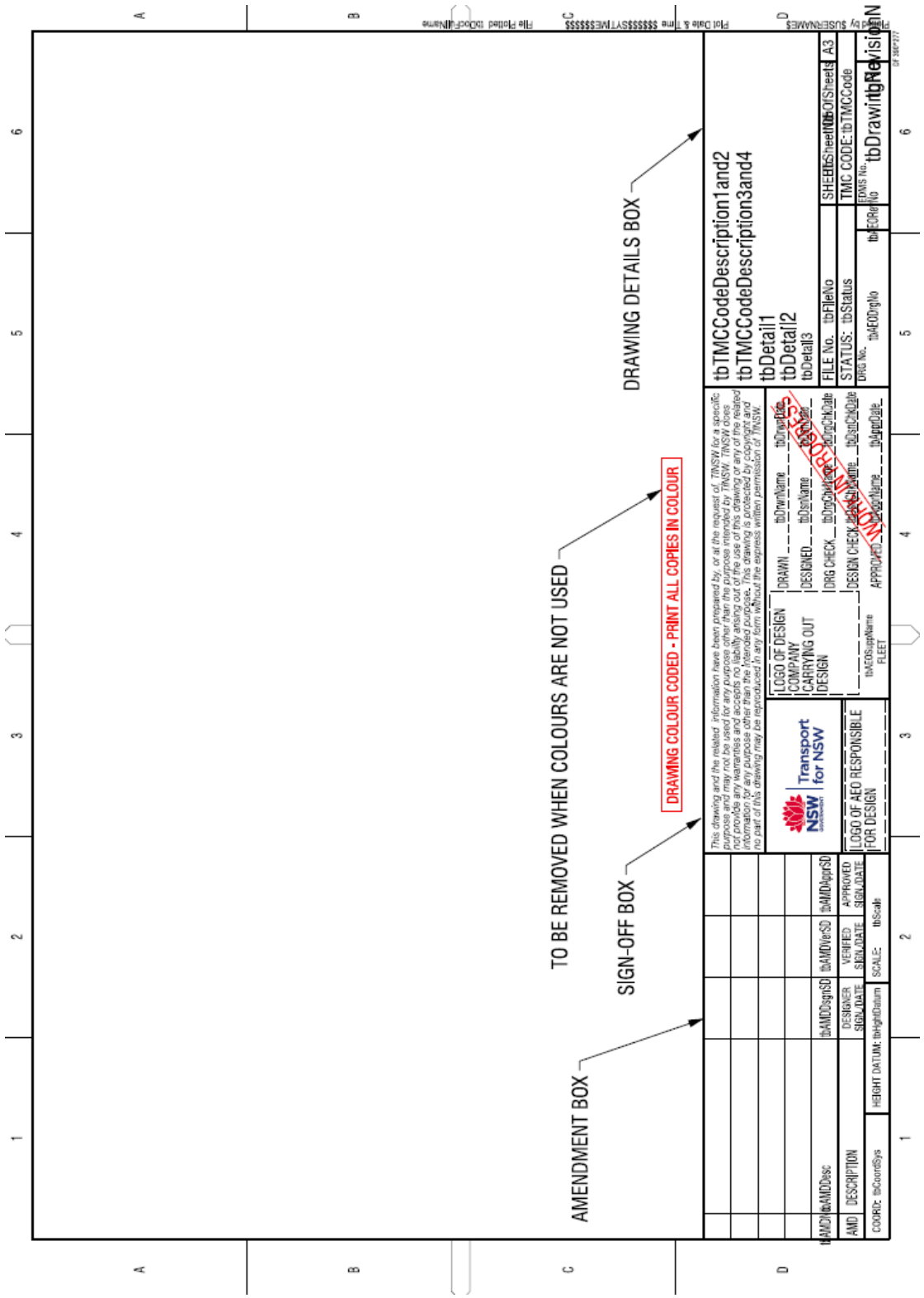


Figure 174 - Typical title block for fleet drawings

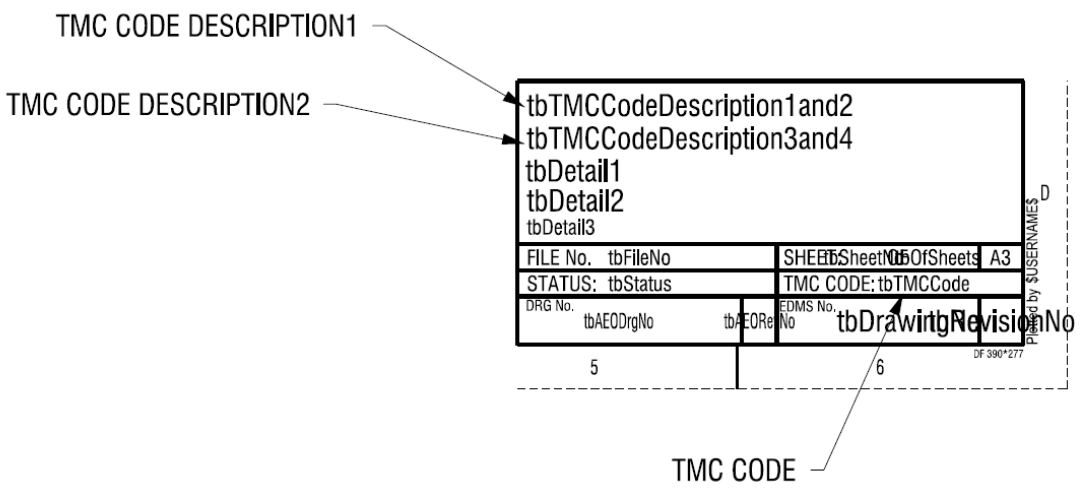


Figure 175 - Drawing detail box – Fleet design drawing

15.7. Section, auxiliary and detail view symbols

The symbols for cutting plane and section views shall be in accordance with Section 7 of AS1100.101 (Example Figure 7.1). Auxiliary views (Example Figure 6.8) are detailed in Section 6.3.7 and detail views (Example Figure 6.9b) are detailed in Section 6.3.8.

15.8. Text styles for mechanical drawing

Where the text is controlled by a tag then the tag only needs to be edited, with the exception of an X scale applied in the titleblock TMC text on lines 1 and 2.

All notes on drawings shall use the true type font Arial Narrow.

Material list text and amendments utilise 2.5 mm high text.

General notes and dimension text utilise 3.5 mm high text.

Headings such as "SECTION X-X" or "VIEW A" utilise 5 mm high text.

Letters used on section line arrows, detail arrows and view labels utilise 7 mm high text.

15.9. Line styles

All line work is to comply with section 3.1 and 3.2 of AS 1100.101 with the following exceptions:

- Thick lines used at the ends of section lines are 0.7 mm thick.
- Outlines, weld and surface finish symbols are 0.35 mm thick.
- Centrelines, hidden lines, existing lines, dimension linework, detail boundaries, are 0.25 mm thick.
- The minimum line thickness on any drawing is 0.25 mm thick.

© State of NSW through Transport for NSW 2021

- Tangent edge / intersection lines / transition lines such as where an arc blends into an edge as on a fillet are not to be shown on the drawing.

15.10. Dimensions

Dimensions shall be in accordance with AS 1100.101.

Dimensioning shall minimise confusion to the reader. "TYP" is not to be used. Assumed centrelines (the position of the centreline is not established via a dimension to an edge or feature on the drawing) are not to be used. Dimensioning should be to physical locations on the object rather than intersection points which are extensions of physical edges. Dimensioning to centres of bend radii and fillets are acceptable.

Where a dimension methodology has been chosen on a drawing such as a radius or diameter then all similar dimensions on that drawing shall be dimensioned in a similar manner unless it is not possible to do so.

15.11. Types of drawings

Detail (manufacturing) drawings include all tolerances, surface finishes, material specifications, welding details and related specification, and so on, required to manufacture suitable replacement parts. Detail drawings shall reference the appropriate next assembly or application drawing.

Sub-assembly and assembly drawings include assembly details such as assembly tolerances and fits, welding details and related specification, fastener fitting details such as tightening torques for bolts, use of thread locking compounds as appropriate, and so on. Sub-assembly and assembly drawings shall reference the appropriate next assembly or application drawing. Sub-assembly and assembly drawings shall call up all the associated components whether they be detail drawings or standard component parts as purchased from Blackwoods or Farnell (or similar).

Arrangement and general arrangement drawings show equipment layout, important notes and dimensions, and so on, relating to the arrangement. Arrangement and general arrangement drawings shall call up all the associated components whether they be assembly, sub-assembly or detail drawings or standard component parts as purchased from Blackwoods or Farnell (or similar); for example, Blackwoods 02094506.

15.12. Amendments to fleet drawings

Existing fleet drawings with CAD files using TfNSW borders shall be amended with all locations of amendments identified with an amendment marker. The amendment table is to use a very brief description of the change, which can be as simple as "DRAWING REDESIGNED." or

© State of NSW through Transport for NSW 2021

"ITEM 5 ADDED." or "DIM 112 was 98.". Each amendment description cell can only have one line of text.

Existing fleet drawings with CAD files using non-TfNSW borders shall be amended with all locations of amendments identified with an amendment marker. The grid reference for each marker is to be included in the amendment with a brief description of what has changed at each location. The amendment is concluded with a "DRAWN", "CHD" and "APPROVED" location for a digital signature sign-off.

Existing fleet drawings which only have tiff (raster) files and no CAD files are to be amended using a CAD hybrid file where the tiff file is inserted at full size onto a blank (without CAD border) CAD file. The amendment is to be carried out similar to the requirements in the previous paragraph.

If the drawing is a CAD file then the previous revision's hand written initials or digital signatures are to be replaced by typed in data as part of the amendment. Only the current revision is to be digital signatures.

The following list of letters shall not be used for amendments: upper case I, upper case O, upper case S, upper case U.

Where an existing drawing is superseded by another drawing, then an amendment shall be done adding a note similar to "THIS DRAWING IS SUPERSEDED BY DRAWING FL0000000 FOR FUTURE WORK.". A new drawing will have a note similar to "THIS DRAWING SUPERSEDED DRAWING FL1111111 FOR FUTURE WORK.". If the superseding drawing is an existing drawing then an amendment shall be carried out adding a note similar to the new drawing.

The locations of the details should be marked or tagged with the appropriate amendment marker, which is a 6 mm diameter circle 0.35 mm line thickness with the amendment letter 3.5 mm high centrally located within the circle. Figure 176 shows a sample circle with the amendment letter centrally located. Approved alternative methods may be used.

Figure 176 - Sample circle with amendment letter

15.13. Item numbering

Item bubbles provide information of items listed in the Bill of Materials (BOM). Item bubbles shall have a diameter of 10 mm with 0.35 mm line thickness with text that is Arial Narrow and 3.5 mm high centrally located within the circle.

© State of NSW through Transport for NSW 2021

Appendix A AMB CAD support documents

The following is a list of CAD support documents that are available on the AMB website.

- cell libraries
- seed template files
- line style resource file
- text style resource file
- level structure – dgnlib file
- folder template
- metadata spreadsheet
- general - title block template
- DSS - title block template
- DSS – accurate filed drawing template
- signal – title block template
- fleet – title block template

© State of NSW through Transport for NSW 2021

Appendix B Format and examples of smart tag and metadata fields

Table 50 provides the format and examples for smart tags and metadata fields used in the CAD drawings.

Table 50 - Smart tag format and examples

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
1	Engineering discipline	M	M*	Pick list	CV,EL,FL or SG only	
2	EDMS ID	M	M*	Free text - 7 characters	1234567	
3	EDMS amendment level	M	M	Free text up to 2 characters (alphabets - upper case)	A, B, AB, etc.	
4	EDMS amendment date	M	NR	Date (dd/mm/yyyy)	28/03/2014	
5	Location	M	M	Free text up to 40 characters (alphanumeric - upper case)	JANNALI, EAST HILLS, EPPING	T MU AM 01007 TI (tab 1 - Location)
6	Corridor and kilometrage	M	M	Free text up to 40 characters (alphanumeric - upper case)	ILLAWARRA LINE 22.617 km	T MU AM 01007 TI (tab 2 - Corridor)
7	Job description detail 1	M	M	Free text up to 40 characters (alphanumeric - upper case)	PLATFORM RECONSTRUCTION	
8	Job description detail 2	M	M	Free text up to 40 characters (alphanumeric - upper case)	CONCRETE DETAILS	
9	Drawing type	M	M	Free Text up to 40 characters (alphanumeric - upper case)	ALIGNMENT, SECTIONS, PLAN	

© State of NSW through Transport for NSW 2021

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
10	Document purpose	M	M	Pick list	CONCEPT DESIGN, PRELIMINARY DESIGN, DETAILED DESIGN, FOR CONSTRUCTION, AS-BUILT, TENDER or STANDARD DRAWING only	
11	Design company name	M	M	Free text up to 20 characters (alphanumeric - upper case)	XYZ CONSULTANTS	
12	Design company document number	M	R	Free text up to 30 characters (alphanumeric - upper case)	NSRU_UGL_124578_CV_001	if not same as EDMS drawing number
13	Sheet size	M	M	Pick list	A0, RA0, A1, RA1, A2 or A3 only	
14	Sheet number	M	M	Free text up to 2 characters (numerals)	2	
15	Total number of sheets	M	M	Free text up to 2 characters (numerals)	6	
16	Document set name	M	O	Free text - 9 characters (alphanumeric - 2 letters and 7 numerals)	CV1234567, usually the name of first image file of submission package	Hidden tag in title block
17	Document type	O	O	Pick list	DRAWING, PHOTOGRAPH, PARTS LIST, SPECIFICATION, TECHNICAL DATA, UNKNOWN/OTHER	Hidden tag in title block
18	SRA document number	O	NR	Free text up to 20 characters (alphanumeric - upper case)	275-1264	
19	File number	NR	O	Free text - 10 characters (alphanumeric - upper case)	M-101-457	

© State of NSW through Transport for NSW 2021

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
20	Design company revision level	NR	R	Free text up to 2 characters (alphanumeric - upper case)	0, 1, 2, 3 etc.	if design company document number field is used
21	Drawn by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	D.KNIGHT	
22	Drawn date	NR	M	Free text up to 10 characters (numerals)	15/12/2015	
23	Designed by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	L.WHITE	
24	Designed date	NR	M	Free text up to 10 characters (numerals)	15/12/2015	
25	Drawing checked by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	M.MARSH	
26	Drawing checked date	NR	M	Free text up to 10 characters (numerals)	16/12/2015	
27	Design checked by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	H.SIMPSON	
28	Design checked date	NR	M	Free text up to 10 characters (numerals)	16/12/2015	
29	Approver	NR	M	Free text up to 15 characters (alphanumeric - upper case)	C.KENNEDY	
30	Approved date	NR	M	Free text up to 10 characters (numerals)	18/12/2015	

© State of NSW through Transport for NSW 2021

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
31	Design discipline code	NR	M	Pick list	AR, CV, EL, FL, SG, SS, TR, or TE only	
32	Co-ordinate system	NR	O	Pick list	MGA, ISG, LOCAL or '-'	
33	Height datum	NR	O	Pick list	AHD, ASSUMED or '-'	
34	Scale	NR	M	Free text up to 10 characters (alphanumeric - upper case)	1:100, 5:1, NTS, etc.	
35	Amendment level	NR	M	Free text up to 3 characters (alphanumeric - upper case)	1, 2, A0, A1, B0, B1, etc.	
36	Amendment description	NR	M	Free text up to 32 characters (alphanumeric - upper case)	APPROVED FOR CONSTRUCTION, ISSUED FOR REVIEW	
37	Amendment designer sign and date	NR	M	Free text up to 14 characters (alphanumeric - upper case)	L.W., S.R.S., 15/12/15	
38	Amendment verifier sign and date	NR	M	Free text up to 14 characters (alphanumeric - upper case)	H.S., T.L.C., 16/12/15	
39	Amendment approver sign and date	NR	M	Free text up to 14 characters (alphanumeric - upper case)	C.L.K., D.S., 18/12/15	

M - Mandatory

M - Mandatory, it is one field in smart tag - EDMS drawing number*

O - Optional

NR - Not required

R - Required, see additional information column

© State of NSW through Transport for NSW 2021