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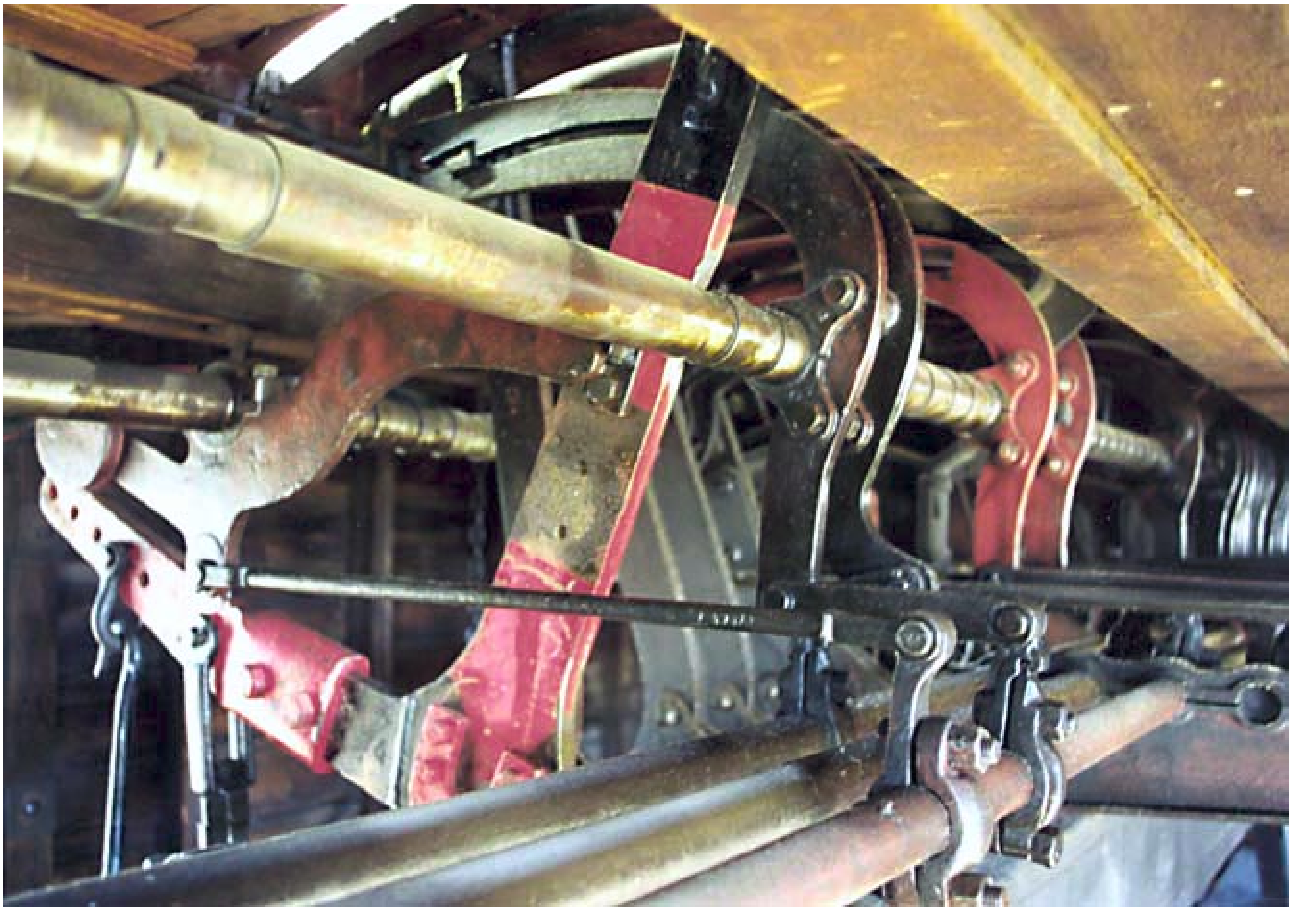

The interlocking between the gate lever and the gate stop lever at Kyneton is shown in the upper photograph. This used the older gate lock instead of the more modern two faced quadant that was found at most other Victorian interlocked gates. The tail of the gate lever, shaped like an upside down T is prominant in the middle of the picture. To the left, and in front, of the gate lever is the gate lock itself, suuported by the lock shaft at the extreme left. Immediately behind the gate lever is the cam for the gate stop lever which works the gate lock. Notice that it only has one rise in the cam slot, at the back notch. At the bottom right can be seen the soldiers clamped to the rocking shaft that transfers the locking along the frame - in this case between adjacent levers. In this photo the gates are across the railway and the gate stop lever is in the back notch. Photo taken on 17 February 2000.

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Minutes of Meeting held Friday September 15, 2006, at the Surrey Hills Neighbourhood Centre, 1 Bedford Avenue, Surrey Hills

Present: – W.Brook, B.Cleak, G.Cleak, G.Cumming, G.Dunn, C.Gordon, A.Gostling, G.Henderson, W.Johnston, K.Lambert, D.Langley, S.Malpass, B.McCurry, A.McLean, J.McLean, T.Murray, T.Penn, B.Sherry, P.Silva, R.Taaffe, R.Whitehead & R.Williams.

Apologies: – N.Bamford, J.Churchward, J.Gordon, G.O'Flynn, C.Rutledge, S.Turnbull, A.Waugh & A.Wheatland.

Visitors: – G.Hampson, G.Tasker.

The President, Mr. David Langley, took the chair & opened the meeting @ 20:09 hours.

Minutes of the July 2006 Meeting: – Accepted as read. S.Malpass / R.Williams. Carried.

Business Arising: – Glenn Cumming advised that he had recently seen the Dandenong train control board in storage in the heritage area at Newport.

Glenn Cumming reported that the Warragul signal control panel had been obtained and was now in storage at Seymour. The SRSV thanks the Dept of Infrastructure and member Laurie Savage for their assistance with this project.

Graeme Henderson noted that significant signal bridges still exist at Cootamundra (17 arms), Junee, Griffith, Werris Creek and Ballarat.

David Langley noted the signal bridge still in use at Scarborough in the UK.

Correspondence: – The annual return for 2005 and payment was sent to Corporate Affairs.

Various emails & phone calls had been transacted in preparation for this year's tour. W.Johnston / R.Taaffe.

Reports: – Tours. Glenn Cumming provided final details for the tours this weekend of Spencer Street No.1 Box, Metrol and West Tower.

Market Street Signal Bridge. Peter Silva reported that the truss had recently been moved inside East Block at Newport Workshops, thanks to Victrack. The truss is now undercover ready for work to begin. Workers are now needed. Peter also commented on the excellent work of Mike Saunders who continues to restore signal reversers for this project.

General Business: – David Langley tabled a diagram of proposed signalling alterations at Reversing Loop Junction.

Keith Lambert described signal alterations at Flemington Racecourse including interlocked roll out protection and motorised gates for the stabling sidings.

Keith Lambert suggested that the proposed station at Box Hill East might not now go ahead.

Keith Lambert noted that the windows at Flinders Street "E" Box had recently been bricked up.

Bob Whitehead reported the new Down platform at Craigieburn is now in use & overhead wire has been strung over the Down Line between Broadmeadows – Somerton Signal Box.

Bob Whitehead reported that the Up Refuge Siding at Broadford has been removed and the Refuge Siding at Kilmore East is out of use.

Bob Whitehead advised that a new passenger station has been announced to be constructed in the Linton Junction area.

Bob Whitehead noted that goods trains to and from Echuca were still running via Bendigo.

Bob Taaffe provided details on the following projects in New South Wales.

Re–signalling in Newcastle will see the closure of Woodville, Hamilton Juncion, Wickham and Newcastle Signal Boxes.

Gosford will be re – signalled with an SSI.

A new Platform No.5 will be provided at Hornsby.

A new platform will be provided at Berowra.

At Chatswood, a big slew for the new line is due to take place soon.

The Cronulla Line re – signalling is due for commissioning soon.

The quadruple track on the East Hills Line will be extended to Revesby.

Design work has commenced for re – signalling at Auburn and Clyde.

The pistol grip frame from Sefton Park Junction has been moved to the Powerhouse Museum.

Graeme Henderson provided the following news from New South Wales.

The works for the new flyover at Sandgate were described in detail.

The block working between Exeter – Bundanoon – Wingello is to be replaced, possibly by the end of 2006.

Plans for re – signalling between Harden – Demondrille were described.

The crossing loops at Matakana and Kinalung have been extended to 1800 metres in length.

Keith Lambert reported on work in the sidings at Lilydale for stabling Xtrapolis trains including the provision of a theatre indicator.

Keith Lambert suggested that the remote control of Long Island Junction will now be an intermediate siding with motor points. The block section will be Frankston – Stony Point.

Tom Murray reported on a derailment on the SG Line between Seymour – Mangalore last week. It was suggested that the train could not be moved until all the stake holders had attended the scene.

Bill Johnston spoke about a recent incident where a train went past a red signal at Dandenong.

Andrew McLean gave a description of track & curve speeds on the Bendigo Line following the completion of the upgrade works.

Brett Cleak reported on the installation of pedestrian gates at Alphington & Beaconsfield and boom barriers at Hastings & Wangaratta.

Steve Malpass reported that the route indicators on the signal bridge at Viaduct Junction now show "B", "M" and "R".

Syllabus Item: - The President introduced member Bob Taaffe to present the Syllabus Item.

Bob presented a selection of slides from his collection featuring views of railway signalling in New South Wales from the 1970's.

At the completion of the Syllabus Item, The President thanked Bob for the entertainment & this was followed by acclamation from those present.

Meeting closed at 22:15 hours.

The next meeting will be on Friday 17 November, 2006 at the Surrey Hills Neighbourhood Centre, Bedford Avenue, Surrey Hill, commencing at 20:00 hours (8.00pm).

Signalling Alterations

The following alterations were published in WN 30/06 to WN 40/06 and ETRB A circulars. The alterations have been edited to conserve space. Dates in parenthesis are the dates of publication, which may not be the date of the alteration.

27.07.2006 **Tarranginnie** (SW 191/06, WN 31/06)

From the 27.7., the siding was booked in for use by track machines only. The siding had been booked out of use on 28.6.2004 by SW 2054/04.

27.07.2006 **Diapur** (SW 192/06, WN 31/06)

From the 27.7., the siding was booked in for use by track machines only. The siding had been booked out of use on 28.6.2004 by SW 2055/04.

30.07.2006 **Craigieburn** (SW 194/06, WN 30/06)

On Sunday, 30.7., a crossover was provided between the Up and Down main lines. The crossover is not in service.

30.07.2006 **Bentleigh** (SW 193/06, WN 30/06)

On Sunday, 30.7., illuminated red pedestrian symbols and 'Another Train Coming' signs were installed at Centre Rd.

The illuminated pedestrian symbol is a red illuminated pedestrian on a black background. When a train approaches the level crossing, the symbol will start to flash and the bell will commence to ring. After 7 seconds the pedestrian gates will commence to close and the red symbol will be continuously illuminated. It will stay on until the train clears the level crossing.

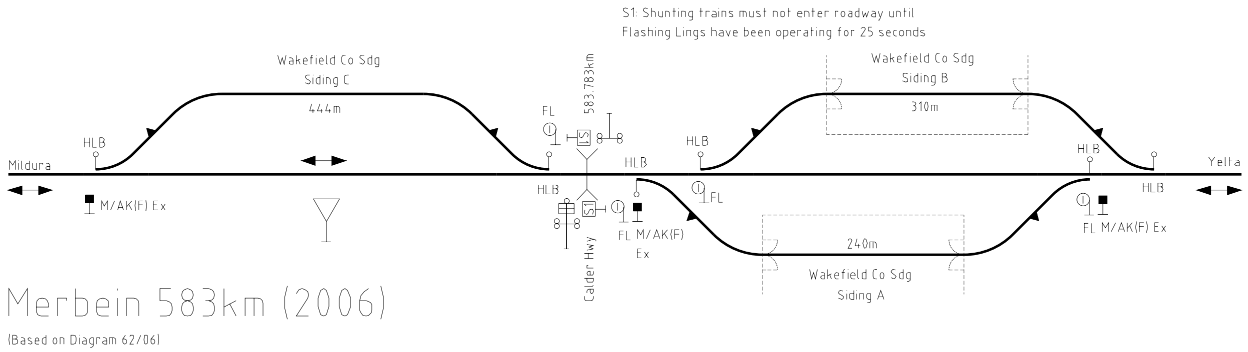
The 'Another Train Coming' sign (yellow lettering on a black background) will illuminate if more than one train is approaching the level crossing. It will illuminate as soon as the second train strikes the approach track and will remain illuminated until all trains are clear of the crossing.

04.08.2006 **Newport Workshops** (SW 197/06, WN 30/06)

On Friday, 4.8., a flag derail was installed on the lead to No 1 Track, Suburban Maintenance Depot, to protect the overhead isolation in that track.

04.08.2006 **Merbein** (SW 188/06, WN 30/06)

On Friday, 4.8., flashing lights were provided at Calder Hwy (583.783 km via Ballan) on the Down side of Merbein. Operation of the flashing lights will be automatic for all through movements. An ST21/ Annett key (F Pattern) exchange apparatus and four V5PSW keyswitches were provided. Note that the siding points at Merbein are not locked by the Annett key. Operating Procedure 94 was issued (the former Procedure 94 was cancelled by SW 1174/99). Diagram 62/06 (Mildura to Yelta) was issued.



09.08.2006 **Sale** (SW 195/06, WN 30/06)

On Wednesday, 9.8., the signal head on Post 1 was replaced by a LED unit.

12.08.2006 **Hastings** (SW 200/06, WN 32/06)

On Saturday, 12.8., boom barriers were added to the existing flashing lights at Cool Store Rd (64.725 km) on the Up side of Hastings. Up Home F was abolished. Level crossing predictors were provided at Cool Store Rd and Hodgins Rd. Amend Diagram 16/05 (Baxter to Stony Point).

13.08.2006 **North Geelong A** (SW 207/06, WN 32/06)

On Sunday, 13.8., the signalbox and interlocking frame were abolished. Points 32, 33, and 34 are now operated from Geelong and are numbered 71, 73, and 75 (respectively). Ground Discs 9, 9B, 9C, 9D and Dwarf GLG74 were abolished and Dwarfs GLG32 (from No 26 Rd), GLG34 (No 25 Rd), GLG36 (No 24 Rd), and GLG 38 (No 23 Rd) were provided. All these Dwarfs may show Clear Low Speed. Dwarfs GLG72, GLG134, and GLG136 were altered to show Clear Low Speed. Operating Procedure 54 was re-issued and 57A was cancelled. Diagram 58/06 (North Shore - North Geelong - Fyansford) replaced 60/05.

(15.08.2006) **Donnybrook** (SW 201/06, WN32/06)

The length of the Up platform is 57 metres (55 metres between safety rails) and the Down platform is 63 metres (62 metres between safety rails). Amend Diagram 28/91 (Craigieburn - Wallan).

(15.08.2006) **Seymour** (SW 209/06, WN 32/06)

Operating Procedure 103A was issued to cover the interface with the Seymour Railway Heritage Centre due to the leasing of the head shunt from the baulks to Dwarf 50 to the SRHC from the baulks. Circular SW 165/06 was cancelled.

(22.08.2006) **Morwell** (SW 215/06, WN 33/06)

The Network Services Plan pages relating to the line between Dynon and Bairnsdale have been re-issued. The re-issue noted that the Morwell to Morwell Briquette Siding is closed and reference to this line is to be deleted.

24.08.2006 **Bairnsdale** (SW 218/06, WN 33/06)

From Thursday, 24.8., the keyswitches and padlocks were altered to be operated by a V5PSW key and the independent keys were withdrawn. Operating Procedure 130D was reissued to reflect the operation of the signalling equipment by a compentent employee who is not necessarily a Signaller. The Signaller will continue to be on duty for all train movements.

27.08.2006 **Werribee - Geelong, Sunshine - Ballarat, Watergardens (Sydenham) - Bendigo** (SW 216/06, WN 33/06)

From Sunday, 27.8., permission is granted for certain services on these lines to operate at up to 160 km/h.

27.08.2006 **Sunshine - Ballarat, Watergardens (Sydenham) - Bendigo, Werribee - Geelong, Pakenham - Traralgon** (SW 220/06, WN 34/06)

All self propelled rollingstock (including locomotives, track machines, and track maintenance vehicles) not fitted with TPWS are restricted to 80 km/h on these lines.

27.08.2006 **Fairfield - Alphington** (SW 209/06, WN 34/06)

On Sunday, 27.8., automatic pedestrian gates were provided at the Perry St foot crossing (9.727 km).

(29.08.2006) **ETM** (SW 224/06, WN 34/06)

A trial has commenced of RD60 end-of-train markers on the Apex trains.

(29.08.2006) **West Tower** (SW 222/06, WN 34/06)

Permission has been granted for VLine to exclusively use No 5 Arrival Road.

(29.08.2006) **Geelong** (SW 222/06, WN 34/06)

Permission has been granted for VLine to use the East and West Gantry Tracks at Geelong Loco.

(29.08.2006) **Donald - Carwarp** (SW 223/06, WN 34/06)

Diagrams 2/06 (Donald Loop - Morton Plains), 4/06 (Birchip - Woomelang), 10/06 (Lascelles - Nunga), and 12/06 (Ouyen - Carwarp) replaced Diagrams 32/01 (Donald to Woomelang) and 44/97 (Lascelles - Carwarp) as in service.

30.08.2006 **Laverton** (SW 210/06, WN 35/06)

On Wednesday, 30.8., the '65' indicator on Down Home LAV12 was converted to LEDs.

30.08.2006 **North Shore - Midway Sdg** (SW 226/06 & 227/06, WN 34/06)

On Wednesday, 30.8., a new level crossing was provided at Bayside Road (67.138 km) on the Midway Siding. Flashing lights were provided. The flashing lights will be manually operated by V5PSW keyswitches. Operating Procedure 56A was reissued.

Midway Siding leads off the Apex Quarries No 1 Road and crosses Bayside Road and then The Esplanade. A motorised gate is located on the Down side of The Esplanade at the entrance to the Midway site. V5PSW keyswitches are located on the Up side of Bayside Road and the Down side of The Esplanade. A Stop board and derail is located on the Up side of Bayside Road adjacent to the keyswitch. A third keyswitch, operated by an independent Fortress key, is located inside the Midway site. This keyswitch must be operated before either of the V5PSW keyswitches. The independent key is held by the operator of the Midway site.

When a train is to enter the siding, it must pull forward in the North/South line of the Phosphate Siding until it is clear of the points to the Midway Siding. The train will be pushed forward and stopped at the Stop board. The derail is to be removed. The Midway employee will operate the third keyswitch provided the siding is clear of road vehicles. This will illuminate a yellow light above the Bayside Road keyswitch. Operation of this keyswitch will open the motorised gate and start both sets of flashing lights. The flashing lights will cease to operate as the train clears each level crossing, and the gate will automatically close when the train clears it. Outward movements are similar, however, it should be noted that there is no provision for trains to stop and reverse between the level crossings. Any movement must completely clear both level crossings before reversing.

01.09.2006 **Centrol** (SW 251/06, WN 36/06)

On Sunday, 1.6., the allocation of the Train Control rooms was altered. The rooms are as follows:

Room 3	Senior Train Controller
Room 4	Melbourne - Warrnambool, Sunshine - Brooklyn - Newport (West Line)
Room 5	Melbourne - Bairnsdale, Frankston - Stony Point, North Geelong - Yelta, Robinvale & Kulwin, Ararat - Maryborough - Castlemain, Portland - Maroona
Room 6	Latrobe RFR Control Panel
Room 7	Melbourne - Ballarat - Ararat, Ouyen - Panitya, Murtoa - Hopetoun, Dimboola - Yaapeet, Northern Power Station (Port Augusta), Stirling Nth - Coalfield (Leigh Ck)
Room 9	Melbourne - Bendigo - Piangil, Moulamein & Deniliquin, Eaglehawk - Inglewood
Room 10	Melbourne - Albury, Tocumwal, Echuca, Dookie & Oaklands, Albion - Jacana

It is planned that Room 1 will be a future Train Control back up room, Room 2 the future West Tower Control Panel, and Room 8 the future Bendigo RFR control panel.

01.09.2006 **Sunshine** (SW 216/06, WN 36/06)

On Friday, 1.9., Sigview screens were provided in the signalbox to indicate the sections between Sunshine and Rockbank and the track indications on the former Deer Park to Deer Park West panel were decommissioned. The control buttons and track indication faceplates on this panel were replaced with blank faceplates.

01.09.2006 **Horsham** (SW 250/06, WN 35/06)

On 1.9. the points in the hand worked crossover between Nos 3 and 4 Roads on the Down side of the Goods platform were fitted with hand locking bars to secure the points for the straight road. Amend Diagram 6/03 (Murtoa - Dimboola).

03.09.2006 **Wangaratta** (SW 228/06, WN 34/06 & WN 36/06)

On Sunday, 3.9., boom barriers were provided at Sandford Rd (231.132 km) on the Up side of Wangaratta. The boom barriers are worked by a HXP level crossin gredictor for broad gauge movements. Note that a boom barrier release key switch is provided in the Test Cabinet at the crossing, and the switch must be used to disengage the boom drive mechanism during a failure before manually operating the boom barriers. Diagram 56/06 (Glenrowan Loop to Wodonga Loop) and 60/06 (Wangaratta) replaced 36/99 and 32/97 respectively.

(05.09.2006) **Heatherdale** (SW 213/06, WN 35/06)

The Madden St underbridge has been abolished due to Eastlink Freeway works.

07.09.2006 **Kilmore East** (SW 255/06, WN 36/06)

From 7.9., the Refuge Siding will be booked out of service due to the points being disconnected from the interlocking frame. The siding may be used to stable track machines provided the station is switched in and the signal maintenance technician is in attendance to operate the points.

09.09.2006 **Upper Ferntree Gully** (SW 221/06, WN 36/06)

On Saturday, 9.9., Points 17 were replaced by a tangential turnout on concrete sleepers. The point machine was replaced by a a M23A dual control machine.

09.09.2006 **Pakenham** (SW 220/06, WN 36/06)

On Saturday, 9.9., the Westrace software was upgraded. The system will now indicate the position of the points after the system has been restarted after a shut down. This will avoid having to manually operate the points to allow them to function.

10.09.2006 **Beaconsfield** (SW 215/06, WN 36/06)

On Sunday, 10.9., automatic pedestrian gates were provided at the Up end of Beaconsfield platform (46.910 km).

11.09.2006 **Craigieburn** (SW 231/06, WN 37/06)

On Monday, 11.9., the new 160 metre Down platform was brought into use. The temporary Down platform was removed.

13.09.2006 **Bridgewater** (SW 264/06, WN 37/06)

On Wednesday, 13.9., the siding was booked into service and is available for all traffic.

16.09.2006 **Book of Rules, Section 36** (SW 256/06, WN 38/06)

From 0001 hours on Saturday, 16.9., Version 1.8 will replace Version 1.7C of these rules.

16.09.2006 **Bairnsdale** (SW 260/06, WN 36/06)

From Saturday, 16.9., a Signaller will not be in attendance for the arrival of Train 8431 provided the train operates on Train Staff.

(19.09.2006) **Keon Park** (SW 229/06, WN 37/06)

Points 7 have been replaced by a tangential turnout on concrete sleepers. The clamp lock was replaced by a claw lock.

(19.09.2006) **South Yarra - Malvern** (SW 225/06, WN 37/06)

Diagram 79/06 replaced 09/94. The diagram has been redrawn to VRIOG (Victorian Railwa Industry Operators Group) standards.

22.09.2006 **Rockbank - Boral Siding** (SW 276/06, WN 38/06)

On Friday, 22.6., this siding was booked into service. The maximum speed in the siding must not exceed 10 km/h.

24.09.2006 **Moonee Ponds - Essendon** (SW 223/06, WN 38/06)

On Sunday, 24.9., automatic pedestrian gates were provided on the Up and Down sides of Park Street. Amend Diagram 27/02 (Kensington - Essendon).

(26.09.2006) **Sulky Loop - Cope Cope** (SW 272/06, WN 38/06)

Diagrams 36/06 (Sulky Loop - Talbot), 38/06 (Maryborough), 40/06 (Dunolly), 42/06 (Bealiba - Emu), 76/06 (St Arnaud), and 44/06 (Sutherland - Cope Cope) replaced 36/96 (Sulky Loop - Talbot), 12/97 (Maryborough), ? (Dunolly), and 32/96 (Bealiba - Cope Cope).

(26.09.2006) **Bacchus Marsh** (SW 277/06, WN 38/06)

When it is necessary for stopping passenger trains to cross at Bacchus Marsh due to late running, the Train Controller must check that the Down train is a single Vlocity car or a Sprinter consist. This is to allow the Driver can change ends by walking through the train.

07.10.2006 **Hastings** (SW 239/06, WN 40/06)

On Saturday, 7.10., boom barriers were provided at Hodgins Road (64.378 km). Amend Diagram 16/05 (Baxter to Stony Point).

08.10.2006 **Flemington Racecourse** (SW 233/06, WN 40/06)

On Sunday, 8.10., motorised derails and wheel crowders were provided in No 2 Track, No 3 Track and the Loop line. The hand operated derails in Nos 2 & 3 Tracks were abolished. The new derails are worked from a new unit lever control panel in the signalbox, with lever 77 working the Derail in No 2 Track (ahead of Ground Disc 73), 78 the Derail in No 3 Track (ahead of Dwarf 68), and 79 the Derail in the Loop line (ahead of Post 64). The Derails are worked by electro hydraulic point machines. Amend Diagram 3/00 (Flemington Racecourse Line).

08.10.2006 **Blackburn** (SW 249/06, WN 40/06)

On Sunday, 8.10., two crossovers were provided between the Up and Down lines on the Down side of Blackburn. The crossovers are spiked out of use.

09.10.2006 **South Dynon - PN Locomotive Provisioning Centre** (SW 291/06, WN 40/06)

On Monday, 9.10., Crossover 127 was abolished and secured normal. Dwarfs 124 and 128 were abolished. Amend Diagram 77/97 (South Kensington).

Continued on page 110

The Hump

The New Melbourne Yard

(Continued from Somersault Vol 29 No 5)

In the previous two installments of this series, the operation of the Melbourne hump yard was described. In this installment, the mechanisms used to brake and route the wagons will be described.

Introduction

The 'engine' that powers a hump yard is gravity, and a good place to start to consider the technical design of a hump yard is to consider the various grades of the hump itself. It was not simply a matter of piling earth into an artificial mound and laying tracks down one side.

The hump converted the potential energy of a cut at the top of the hump into kinetic energy as it rolled down the slope. The hump had to be sufficiently high that the resulting kinetic energy of the worst running cut was sufficient to allow the cut to roll through the curves of the switching area, then run the full length of the longest sorting siding in the face of the most adverse wind. A steep descending grade allowed the cuts to accelerate quickly, aiding throughput, and a sharp vertical curve at the summit assisted in consisently separating the cuts.

The design of a hump yard is complicated by the fact that not all cuts roll equally well. Based on overseas work, McKenzie & Holland (who supplied the hump equipment) assumed that the best running cuts would have a rolling resistance of 2.24 lbs per ton, while the worse running wagons would have a resistance of 20 lbs per ton. This range of rolling resistances caused two problems.

The first was that better running cut could build up too much speed and roll right out of the other end of the sorting sidings, or, more likely, collide heavily with wagons already standing in the sorting siding. The control equipment was designed so that the buffing speed, or the speed at which a cut hit the wagons already standing in the sorting siding, was less than 3 mph. The group retarders had the task of removing the excess kinetic energy to ensure a buffing speed of less than 3 mph.

The first second problem was that a slow running cut could be overtaken by a following fast running cut on its trip down the hump. One way reducing this problem was a high hump with a steep descent. This accelerated all wagons quickly. Unfortunately, in Melbourne the height of the hump was limited by the site, as described previously. A second solution to this problem would be to push the cutsbover the hump sufficiently slowly that there would be enough separation that a catch up could not occur. But this solution would have lead to an extremely low humping speed, and severely limited the throughput of wagons over the hump. Instead, the primary retarder was used to slow down the faster runners so that the average speed between the hump and the group retarders was similar for all cuts. In addition, there were at least two other subtle design features that assisted in separating out the slow and fast running cuts. These features will be described later in the article.

The hump

The hump itself was quite low by international standards. The total fall between the crest of the hump and the switching area was only 15.21 feet. The crest looks looks higher than this due to the two tracks that pass underneath the crest.

The hump was composed of a compound vertical curve. On the approach side, the curve was of 3450 foot radius, while the departure side it was 1000 foot radius.

As the wagons crested the hump, each cut would break away when its centre of gravity was at the point where the slope equaled its rolling resistance. The relatively sharp 1000 foot vertical curve was intended to start all cuts running close to the same point. Even so, it was calculated that the best running cut would start to roll when its centre was about 1 foot from the crest, while the worst runner would start when its centre of gravity was about 9 feet from the crest. Even though this meant that the fast runners would only have an 8 foot head start, this was sufficient to cause problems with ensuring that cuts were properly separated, particularly when they were single wagons. To solve this, small Strahan & Henshaw hydraulic retarders were installed just beyond the hump crest. These prevented a cut from breaking away until the last wheel of the cut was free of the retarder, and consequently ensured that each cut started to roll at the same point.

The grade off the hump was 1 in 26.75. The primary retarder was situated in the final section of this grade. After the primary retarder, the grade flattened to 1 in 98 through the king and queen points to the group retarders. This grade was chosen so that the slowest runners would not slow down in this section (although the better runners would accelerate).

Through the group retarders the grade steepened to 1 in 39.8 (B and C Balloons) or 1 in 33.5 (A and D Balloons). The grades through the group retarders ensured that if it was necessary to stop a cut in the retarder, it would roll away when it was released. Beyond the group retarders the track was level through the points leading to the various sorting tracks (this was known as the switching area). Due to the restricted area, the connections to a number of these tracks were sharply curved and flange lubricators were fixed to each rail just beyond each secondary retarder. These flange lubricators were not initially provided, but it was noticed that the accuracy of the control equipment improved in wet weather. Flange lubricators were then provided, not to reduce the rolling resistance, per se, but to reduce the variability in resistance on the various routes and hence improve the ability of the hump computers to predict how far a cut would roll.

The sorting tracks fell at 1 in 1000 away from the hump. This grade was chosen so that the best running cuts would not accelerate (although this meant that poorer running cuts would slow down as they ran down a sorting track). At the southern end of each sorting track there was a level section 50 feet long followed by a upward grade of 1 in 300, with a total rise of around 1 foot. This rising grade was designed to prevent cuts running out of the sorting tracks; even this short rise could stop cuts running at up to 8 feet per second (around 5.5 mph). Because of their profile, the sorting tracks were often referred to as the 'bowl'.

Beyond 'C' and 'D' Balloons the tracks fell steeply towards the goods sheds and loading areas. To prevent underbraked cuts from running out of the end of the Balloon, inert retarders and catch points were provided at the end of each of track in these balloons. The inert retarders were of the Westinghouse Style F design, a single rail, weight responsive, type which could absorb kinetic energy equivalent to 4 feet per second. The tracks beyond 'A' and 'B' Balloons were flat and it was originally not intended to provide intert retarders in these Balloons. However, during tests it was noticed that a strong southerly wind could actually blow wagons backwards towards the hump. To prevent this movement, spring loaded inert retarders were provided in each sorting track in 'A' and 'B' Balloons 45 feet from the start of the up grade and a second spring loaded inert retarder was provided in each track just at the start of the up grade.

Route selection and progression system

In order to route the wagons correctly, the automatic system had to know the destination road of each cut and track its progression from the hump through the switching area. The route information was normally obtained from the paper tape and converted into commands to operate each set of points as the cut approached the points.

The track from the crest of the hump to beyond the final set of points was divided into a number of short track circuits. The track circuits were normally about 55 feet in length. The standard four wheeled wagon in Victoria was 25 feet between coupler pull lines, and bogie wagons were normally twice as long. That meant that each track circuit could accommodate one bogie vehicle or two four wheeled wagon.

To ensure fast operation of the track circuits, high voltages were used across the rails. Single end reactance fed track circuits were used with a 70 volt AC supply voltage (50 volts on the rails). These had an operation time of 200 ms (1/5 of a second) and worked reliably with even the lightest wagon. The speed was sufficiently fast not to introduce errors in measuring cut length or speed.

Associated with each track circuit was a set of relays (the storage bank) which recorded the destination (and certain other information) of the cut currently approaching the track circuit. The progression system moved this information from one track circuit to the next as the cut moved along the track.

The transfer of information from one storage bank to the next was surprisingly complicated. Information about a cut was maintained in the storage bank associated with the track circuit immediately in advance of the cut. The information was transferred onward to the next storage bank when four conditions were met:

* The track section became occupied by the approaching cut
* The storage bank associated with this track section contained information
* The next track section was unoccupied
* The storage bank associated with the next track section was empty.

A complicated circuit was used to ensure that the information was accurately copied from one storage bank to the next. In essence, information was transferred individually from one relay in the storage bank to the matching relay in the next storage bank. Only when the source and destination relays matched would the next bit be transferred. When the last bit was transferred correctly, the source storage bank was cleared. If the transfer failed, the source storage bank would be automatically cleared when the cut vacated the track circuit. This would mean that the routing information for that cut be lost and the cut would run to whatever storage track the points happened to lie for. This automatic clearance would be detected and signalled to the operator as a misdrop.

The progression system also detected when a catch-up occured. A catch up occurred if the storage bank associated with the next track section was occupied when the transfer was attempted. This caused an alarm to be sounded, and also cleared the storage bank that was to be transferred. This destroyed the routing information associated with the overtaking cut, which would then follow the preceeding cut as a misdrop. However, following cuts would be correctly routed.

The point motors were simple direct acting air cylinders with an operating time of less than one second. Provided the track circuit over the points was clear, the points were driven when the routing information was loaded into the storage bank immediately approaching the points. The point control circuits included magnetically latched relays so that after the storage bank was cleared, the points remain in their last position until driven the other way by a following cut. Clearly, there was no possibility of stopping an approaching cut if the points failed to complete their movement, and special circuitry was included to prevent derailments in this circumstance. The point track circuit extended for at least 20 feet in advance of the toe of the point blades. If the points were not detected correctly when a cut entered this track circuit, the points were driven back to their original position; the 20 feet giving ample time for this to occur. This obviously caused a misdrop, and the appropriate alarm was given and the routing information was spilled from the storage bank.

The retarders

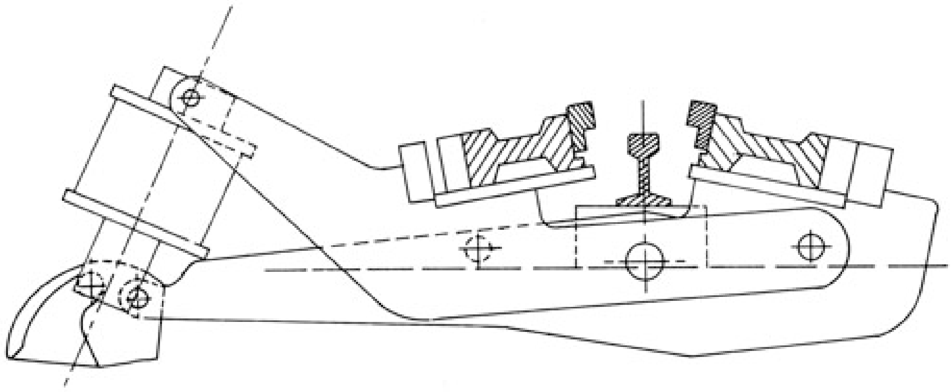
The primary and group retarders were electro-pneumatic Westardair Type D retarders manufactured by Westinghouse Brake and Signal. They braked the wagons by clasping the wheel treads between two brake beams in a pincer or nutcracker action. A retarder consisted of separate brakes on each rail.

A cross section of one of the retarders is shown in the drawing at the top of the next page. Two levers were provided which rotated around a common pivot mounted below the rail. An air cylinder was provided between the long arms of the levers, and T shaped brake beams on the short arms. When air was admitted to the air cylinder, the long arms of the levers were forced apart and the brake beams forced against the wheel treads.

To reduce air consumption and improve the response time, the normal 'operating' position of the brake beams was close by each rail with just enough gap to allow free passage of wagon wheels. From here, the retarders could be quickly brought together to brake the wagons. The gap between the braking beams in the operating position was not sufficient, however, to allow the passage of locomotives. A clever cam operated gain stroke mechanism allowed the brake beams to be fully lowered away from the rail when the air was fully exhausted from the cylinder.

Each retarder was 100 feet long, made up of two 50 foot units which could be independently controlled. Even within this 50 foot length, the break beam was constructed from a number of articulated beams. Each separate beam was operated by one cylinder. The articulation ensured that individual wheels were properly braked even though they were of different widths.

The retarder on each rail was operated by 20 cylinders (ten in each 50 foot length) working with compressed air at up to 100 psi. The ceiling air pressure was controlled by the minimum wagon weight in the cut to prevent light wag-



CROSS SECTION OF RETARDER

ons from being lifted off the rails and running on the brake beam. The weight of each wagon was measured by the deflection of a rail near the crest. Wagons were divided into four categories and this selected the maximum pressure that could be applied by the air cylinders as shown in the following table:

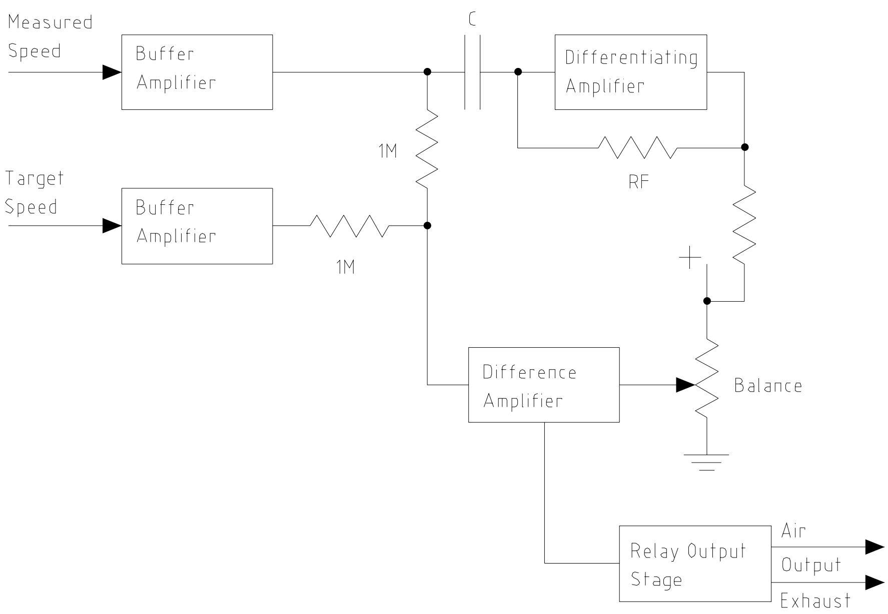
Category	Axle Load	Ceiling Pressure
XL (extra light)	<4.5 ton	25 psi
L (light)	4.5 to 7.5 tons	50 psi
M (medium)	7.5 to 10.5 tons	75 psi
H (heavy)	>10.5 tons	100 psi.

Within this ceiling, the actual pressure applied would normally be calculated automatically by the control circuitry. As described in the previous part of the article, the pressure could also be selected manually by the Retarder Operator.

As a cut approached and passed through a retarder its speed was continually being measured by a radar. The speed measure was fed into a simple analog computer together with the target speed. The computer operated the inlet and exhaust valves of the air cylinder to brake the wagon to the desired speed and maintain it there while the cut was traversing the retarder. The sole difference between the primary and group retarders was the method of calculating the target speed. This will be described in the next two sections. However, it should be mentioned that the retarder operator could manually select a target speed from the control panel. This was used if the mechanisms used to calculate the target speed were malfunctioning.

The control mechanism was implemented by the 'Speed Control Panel'. This took the mean of the measured and target speeds and compared this with a reference voltage. If the mean was greater than the reference voltage, the inlet valve was opened to increase the pressure in the air cylinders; if the mean was lower the exhaust valve was opened to reduce the pressure. This comparison was continually carried out as the cut passed through the retarder, and the pressure in the air cylinders consequently continually changed as the speed of the cut varied.

The only complexity in the control was due to the fact that exhausting the air from the cylinder was relatively slow (due to the lower starting pressure). This meant that by the time the air pressure had dropped sufficiently to reduce the braking power, the cut would already have overshot the target speed and be travelling too slowly. To avoid this, a predictor was used to open the exhaust valve early. This was achieved by differenting the measured velocity of the cut to give its acceleration (in this case, deceleration). The rate of deceleration was used to proportionally increase the reference voltage used in the comparison. The effect of this was that comparitor thought that the cut was travelling slower than it actually was and consequently opened the exhaust valve earlier. The faster the cut was decelerating, the earlier the exhaust valve opened.



SPEED CONTROL PANEL

The control mechanism described above operated when the cut was in the retarder. To obtain the maximum braking power out of the retarder, air was admitted to the cylinders before the cut reached the retarder. This meant that an appropriate braking power would be applied immediately the cut entered the retarder. The amount of 'pre-pressure' depended on the measured approach speed, the target speed, the weight, and the effectiveness of the retarder. It was calculated by a circuit very similar to the one already given for the normal retardation. This gave the maximum initial retardation without risking over braking the cut.

The final complexity of the retarder control circuitry was the 'single wagon cut control'. Even the heaviest four wheeled single wagon could be braked by only half of the retarder. When the control circuitry detected that the approaching cut consisted of a single four wheeled wagon, the first half of the retarder was cut out and all retardation performed by the second half. This meant that the wagon was slowed slightly later, and meant that the average speed of the wagon down the hump was slightly higher than it would have been. In turn, this meant that a slightly higher humping speed could be maintained (6 wagons per minute). This was an innovation at Melbourne and was required due to the limited height of the hump.

The primary retarder

As previously mentioned, the primary retarder was situated at the foot of the accelerating grade. The purpose of the primary retarder was to brake the better running cuts so that they would not catch up with the slower runners in the switching area.

The primary retarder ensured that the average speed of the fastest and slowest runners was roughly equal between the hump crest and the group retarders. It was calculated that the best running cuts would be travelling at 18 feet per second when they entered the primary retarder. The retarder would brake the cut to a speed of 16.9 feet per second. After it was released from primary retarder, the cut would commence to accelerate again and would travelling at 21.4 feet per second by the time it reached the group retarders. The worst running cut, by contrast would be travelling at only 14.9 feet per second when it reached the primary retarder. It would not be braked at all, and would accelerate through the retarder and be travelling at 18.9 feet per second at the exit of the retarder, but decelarate slightly over the flatter grade to give a speed at the group retarders of 17.6 feet per second.

The target speed selection in the primary retarder was simple. The initial approach speed was used to select one of six target speeds:

Approach Speed (mph)	Category	Target Speed (mph)
>10.2	A	11.52
9.87 to 10.2	AB	11.8
9.54 to 9.87	B	12.07
9.16 to 9.54	BC	12.34
8.56 to 9.16	C	12.61
<8.65	AC	12.88

As can be seen, the faster the approach speed, the slower was the target speed.

The selection of the target speed was performed by the Velocity Descriminator Panel. This started by comparing the measured spead to the lowest approach speed band. If the approaching cut was travelling faster than the band, the relays in the Velocity Discriminator Panel stepped to the next band and repeated the comparison. This continued until the correct band was identified. The target speed was then feed into the retarder control circuit.

The Group Retarders

The function of the group retarders was to remove kinetic energy from the cuts so that they would buffer up to wagons already in the sorting track at less than 3 mph. As previously described, the hump was designed to give the worst rolling cut sufficient kinetic energy to run through the sorting area and then roll the complete length of a sorting track against the strongest headwind. Of course if this worse case senario did not apply, some of the energy supplied by running down hill from the hump crest would have to be removed by the group retarders.

Calculating the amount of energy to be removed was a complicated calculation which depended on a number of factors:

* Which sorting siding the cut was being routed to
* How full the sorting siding was
* The rolling resistance of the cut

The result of this calculation was expressed as a target speed which was fed into the retarder control circuitry. An accurate calculation of the target speed was critical to the successful operation of the hump yard. If the calculated speed was too high, the wagon would slam into the vehicles already in the storage siding, probably damaging the loading and possibly the wagons. On the other hand, if the calculated speed was too low, the cut would stop short in the sorting siding. At best, this would reduce the effective capacity of the sorting siding, and require the trucks to be pushed down. At worst, if the short stop was not noticed by the retarder operator and the ‘fullness' of the siding reduced, the computer would calculate a too high a target speed for following cuts dropped into that sorting track with consquent high impact speeds.

The first step in calculating the target speed was to estimate of the rolling resistance of the cut. This was estimated by the change in the cut's velocity between leaving the primary retarder and arriving at the secondary retarder.

Clearly, the kinetic energy of the cut when arriving at a the group retarder equals the kinetic energy it had when leaving the primary retarder, plus the potential energy gained in rolling down hill between the primary and group retarders, less the energy lost due to the rolling resistance. Given this energy balance, it is possible to show that the rolling resistance of a wagon is

$Rc = 2000 (Vi_2^2 - V_2^2) / 29.9 D_{23}$

where

R_c is the estimated rolling resistance (lb/Ton),

Vi_2 is the (pre calculated) velocity of an ideal wagon at the group retarders (mph),

V_2 is the measured velocity of the actual wagon at the group retarders (mph), and

D_{23} is the distance between the primary and group retarders (feet)

The value of Vi_2 was a constant for a given exit speed from the primary retarder. Since there were six possible exit speeds from the primary retarder, there were six possible values of Vi_2. The target speed category of the cut at the primary retarder was entered into the progression system when the cut was passing through the primary retarder and transferred with the route information to the control circuit for secondary retarder. Here it was used to select one of six Rc Ratio Panels. Each Rc Ratio Panel had been preset with a value for Vi_2. This value was added to the measured velocity to give an analog of Rc.

One complication was that Rc depended on the distance between the primary and group retarders (D_{12} in the above equation). This distance was measured from the point when the *last* wheel of the cut left the primary retarder (this was the point at which the cut started to accelerate), while V_2 was measured when the *first* wheel reached the group approach track. D_{12} is clearly depedent on the cut length. Cuts were classified into one of three lengths by the Primary Co-ordinator panel as the cut passed over three track circuits. Each Rc Ratio Panel actually contained 6 potentiometers (three pairs). The measured length selected the correct pair. One of the potentiometers gave the value for the velocity of the ideal cut, the other multiplied the measured velocity by a constant.

The target exit speed of a cut from the group retarders can be calculated in a similar fashion to the rolling resistance. The kinetic energy (i.e. velocity) when leaving the group retarder must be equal to the energy lost when rolling through the switching area, plus that which is lost running along the switching track, plus what remains upon buffing. The equation is consequently

V_3 = sqrt(V_5^2+29.9.D_{34}.(R_{34} - 20.G_{34})/2000 + 29.9.D_{45}.(R_{45} - 20.G_{45})/2000)

where

V_3 is the velocity when leaving the group retarder (mph)

V_5 is the velocity when buffing (mph) - nominally 3 mph

D_{34} is the distance from the exit of the group retarder to the clearance point of the switching area (feet)

R_{34} is the rolling resistance of the cut in the switching area (lb/Ton)

D_{45} is the distance from the clearance point of the switching area to the buffing point (feet), and

R_{45} is the rolling resistance along the switching track (lb/Ton).

The rolling resistance R_{34} varied for each switching track as it depended on the track alignment (curves, grades, and points) between the group retarder and the start of the switching track. It was estimated by measuring the actual value of R_{34} of a large number of test wagons during commissioning of the hump. For each wagon the calculated value of Rc was noted together with the actual value of R_{34}. A graph was then plotted of the calculated Rc versus the measured R_{34}. A straight line was then fitted to the plotted points. In operation, this straight line could be used to estimate the value of R_{34} given the estimated value of Rc. The estimate was obtained from the equation:

R_{34} = b.Rc + c

where

b is the gradient of the plotted straight line, and

c is the y intercept of the line.

The constants b and c differed for each destination switching track and were, of course, selected by the route held in the progression system.

The rolling resistance R_{45} was estimated in exactly the same way:

R_{45} = p.Rc + q

where

p is the gradient of the straight line, and

q is the y intercept of the line.

Since all of the switching tracks were straight and had the same gradient, only one value of p and q was used for all switching tracks..

The final variable is the clear distance along the switching track (D_{45}). The track fullness of a particular track was measured by means of two uniselectors connected in series. Uniselectors were devices which selected an output line depending on the number of pulses received on an input line. (Uniselectors were developed for early telephone exchanges. When someone dialled a number on the old dial telephones, say 6, as the dial rotated back to rest it generated six pulses. A uniselector counted the pulses at the exchange and selected the sixth output line.) In the hump each selector had 12 output lines. Every second depression of a treadle at the entrance to the switching track generated a pulse and stepped the first uniselector one step. When the first uniselector reached the twelfth output line, a pulse was generated to step the second uniselector one step, and the first uniselector was reset to 1. The output lines of the uniselectors were connected by resistors - 100 Ohms in the case of the first uniselector, and 1200 Ohms in the second. The effect of this was a variable resistor which started a 0 Ohms, and counted up to 14400 Ohms (144 wagons) in steps of 10 Ohms. A button was provided on the retarder control panel to manually step the uniselectors. This was used when cuts stopped short.

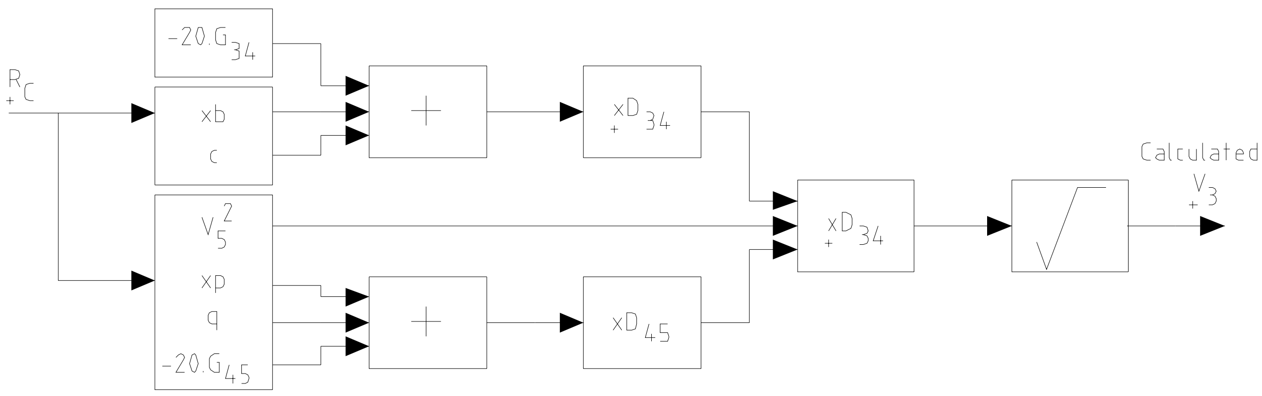
The target speed was calculated by means of a simple analog computer which is shown in block form below. The calculated Rc was fed in at the left. This was multiplied by the selected value of b and then added to constants '-20.G34' and 'c'. The output of this was multiplied by the constant 'D34'. At the same Rc was multiplied by the constant p, and added to the constants p and '-20.G45'. The result was multiplied by the counted D45. The two calculated terms were then added to the constant V52 (the desired buffing speed). The square root was taken of the sum, and the result was a voltage proportional to the desired target speed. These was fed into the control circuitry for the group retarder.

Although not mentioned in Holman's paper, the rolling resistance could be varied to take into account the weather. At some time after the retarder panel was installed, it was altered to incorporate a aenometer (wind gauge), and a multi position switch entered a series of biases depending on the speed of the wind.

References

Most of the information in these articles has been taken from the following three sources:

* Melbourne Automatic Hump Yard, E.P.A Holman, IRSE Australian Section, 13 November 1970
* Melbourne Yard Re-arrangement, L.A. Reynolds, Victorian Railways c1971
* Melbourne Yard, Hump Working Instructions including description and operation of Retarder Panel, 15 June 1970, Victorian Railways



COMPUTER BLOCK DIAGRAM

Toolamba - Echuca in 1980

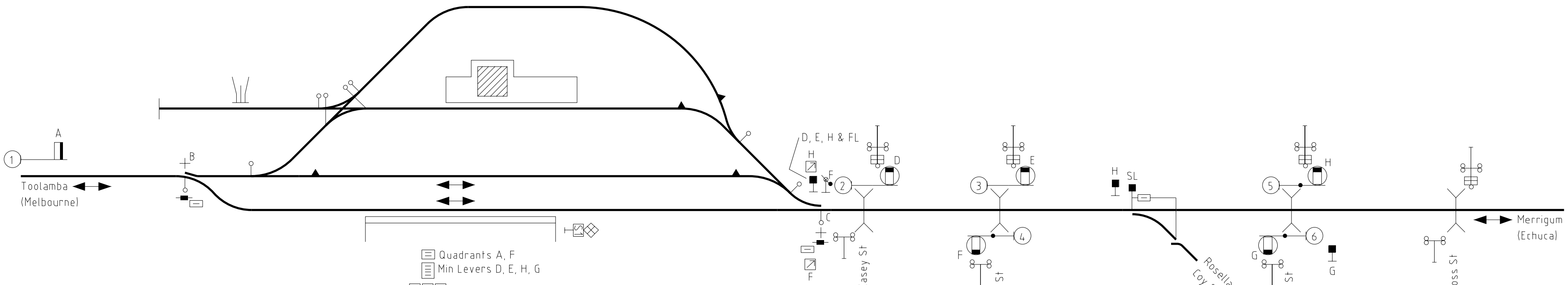
The line between Toolamba and Echuca has been reopened to allow freight from the Deniliquin and Moulamein lines to reach Melbourne without travelling through Bendigo. Today, there is only one siding between Toolamba and Echuce. Compare this with the situation only 25 years ago.

In 1980 there were still four stations on the line: Tatura, Merrigum, Kyabram, and Tongala and a rail motor stopping place at Ky Valley. The two smaller stations at Byrnside and Koyuga had been closed to all traffic in 1976 and 1978 respectively.

All of the four remaining stations were significant stations. Each was an electric staff station with plunger locked points and home signals. In the '70s there had been a significant investment in flashing light equipment on the line and each yard had at least one light signal. Each station had at least one private siding, although some were apparently out of use by this time as the Carnation Siding (Merrigum), and Atkin Siding (Kyabram) were not listed in the 1979 WTT.

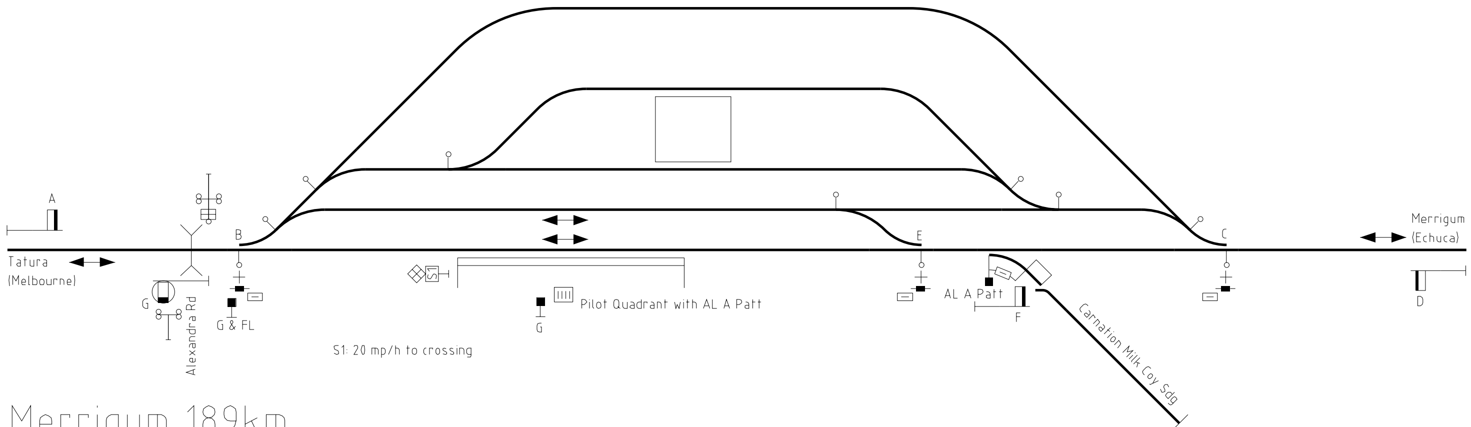
The 1979 WTT shows that the line was still served by two daily DERMs in each direction (and a Saturdays only parcels run from Toolamba to Kyabram). Even more interesting, a daily roadside goods was scheduled in each direction, even though Shepparton Freight Centre had been opened in 1978.

The final run of the passenger service was on Saturday 25 April 1981, and a co-ordinated bus service commenced the following Monday. In 1985, however, the line was still



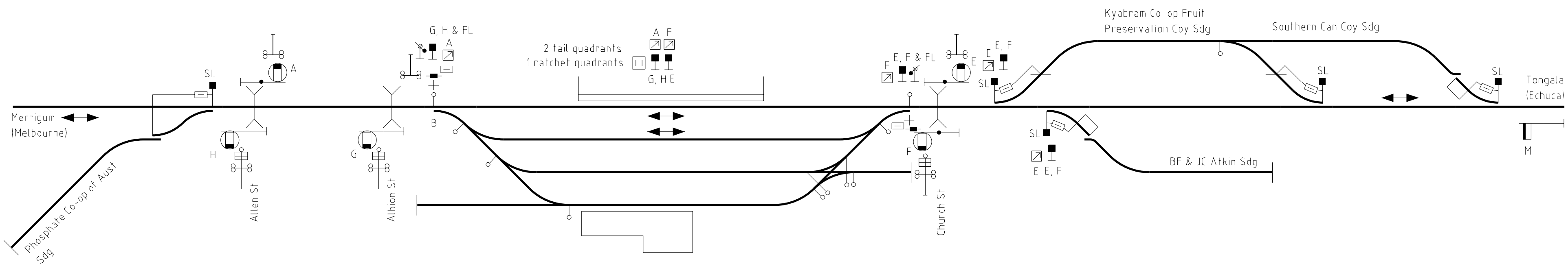
Tatura 177km

(Based on Signalling Arrangements MRF908 amended to 11.11.76, & RF1416 amended to 10.9.75)



Merrigum 189km

(Based on Signalling Arrangements MRF492 amended to 6.5.87, & RF1414 amended to 30.5.73)

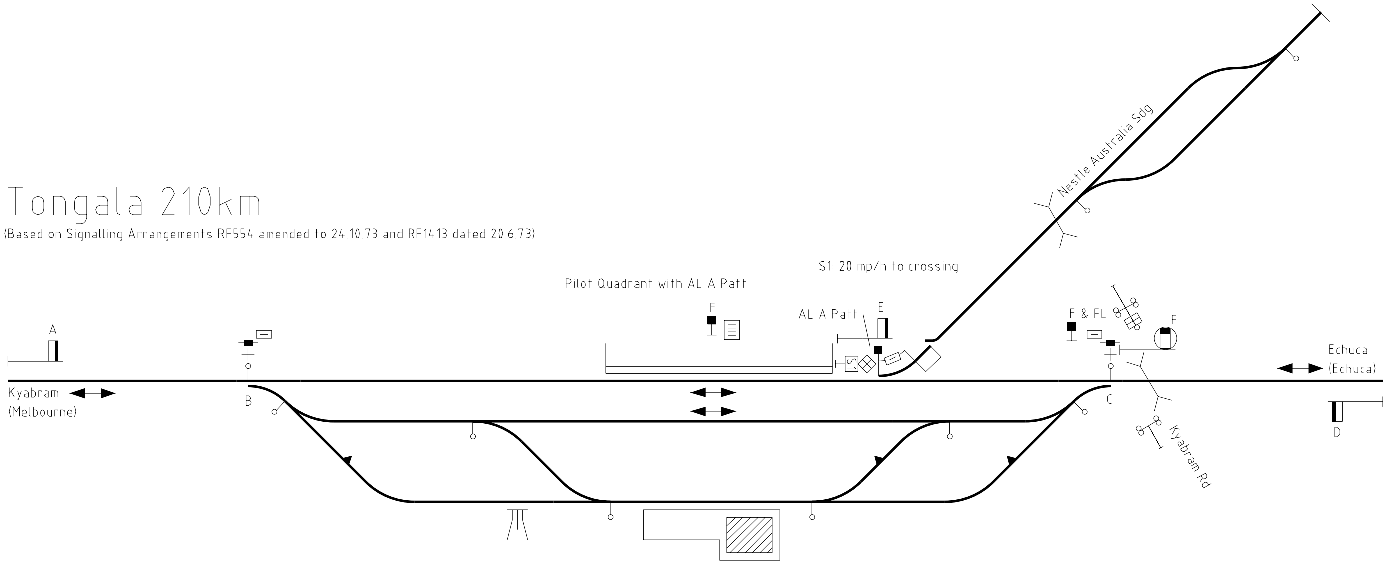


Kyabram 200km

(Based on Signalling Arrangements MRF1195 amended to 31.7.1980)

Tongala 210km

(Based on Signalling Arrangements RF554 amended to 24.10.73 and RF1413 dated 20.6.73)



served by a Down Fast Goods Mon - Fri in the wee small hours of the morning, returning as a Roadside in the middle of the day. By August 1986, however, the service had been reduced to a return Goods run on Wednesday and Friday only.

On 29 October 1986 the electric staff system was abolished and replaced by Train Staff and Ticket on the sections Toolamba - Kyabram - Echuca. Almost exactly three years later, on 21 October 1989, this was replaced by Train Order working on the same sections.

The yard at Merrigum was abolished on 6 May 1987, except for the Carnation Siding. The plunger locking and home signals were abolished at Tongala on 14 October 1987. Kyabram was extensively rationalised in 1988/9 with the Containers Ltd Sdg, Kyabram Co-op Sdg, Atkins Sdg, No 3 Road, and various dead end extensions being abolished.

Subsequently the line was mothballed. The last regular local traffic was, I believe, briquettes to the Nestle factory at Tongala which was worked as a switch trip from Echuca.

UNIFORM SIGNALLING IN VICTORIA, 1897

In Secretary's Branch file 97/7048 dated 17 August 1897 (found in VPRS 421/P0 Unit 281 File 25/20782) the Victorian Railways Commissioners directed that theEngineer of Existing Lines and the Traffic Manger confer as to the adoption of a uniform system in regard to signals and their location.

The starting point was a document produced early in August 1897 titled 'Vict Railys, Method of Signalling' which described the then standard practice of providing signals. The document reads as follows (the document has been reformatted slightly and text in square brackets was added to the original document sometime after it was written):

Double Lines.

Interlocked stations. Home signals provided close to facing or fouling points and Distant Signals about 600 yards out. If Block Post, Starting Signals also provided.

Non Interlocked stations. As a rule the same as at Interlocked stations, but in some cases similar to the Mordialloc line where the approach is good and gives an uninterupted view for a long distance, Home signals only are provided at a distance out from facing or fouling points.

Single Lines

Interlocked stations. Same as double lines. [Starting signals excepted]

Partially Interlocked stations such as Inglewood, Eaglehawk + Birregurra Junction stations. Home signal are placed close to the points that are worked from the locking frame. Distant signals provided only when approach renders it necessary.

Non Interlocked stations. Home signals provided about 250 yards out clear of facing points. No distant signals provided unless the approach warrants exceptional treatment (Instances) Creswick, Pyalong, Drouin, Ringwood, Collingwood, Everton (Up journey).

Lines worked by Tablet or Electric Staff. At intermediate stations with facing points locked by such Tablet or Staff. No signals are provided.

Lines where all trains [usually] carry the Ordinary Train Staff + are not allowed to run on Ticket without special Authority. Signals are not provided except at Staff Stations as per method for Non Interlocked stations.

[Gate Crossings. At some special places signals provided.]

On 17 August 1897 this document was referred to the Engineer for Existing Lines to consider with the Traffic Manager whether a uniform system could be adopted in regard to signals and their location. The Engineer for Existing Lines suggested that the document be sent to the Rule Book Board for report. (A new rule book was issued in 1898, and presumably, this board was responsible for compiling it). The members of this board appear to have been J. Richmond (Chairman), J.W. Macnamra, and H. Lewis. In the 1898 General Appendix, Richmond was listed as the Metropolitan Yard Inspector, Macnamra as the Superintending Inspector of Permanent Way, Suburban and Eastern Districts, and Lewis as the Locomotive Running Superintendent. It will be noted that Edward Ballard, the Assistant Engineer responsible for signalling matters, was not represented on the board.

The Rule Book Board reported on 27 September 1897 as follows:

With reference to the attached correspondence we have the honor to recommend that signals be provided and located uniformly as under:-

Double Lines

(1) Interlocked stations. Home and Distant

(2) Non-interlocked. Home at sufficient distance to protect train standing at station.

(3) Block Posts. Home, Distant, and Starter and if necessary Advanced Starter.

(4) Junctions. Home and Distant and where necessary Starting signal

(5) At all important Junctions a separate Distant signal to be provided in connexion with each Home Signal.

Single Lines

(1) Interlocked stations, Non interlocked staff stations, Tablet or Electric staff stations. Home and Distant.

(2) Non-interlocked and non staff stations (not included in clauses a, b, c, d, and e to follow). Home.

(3) Junctions. Home and Distant. Train being controlled into section ahead by means of staff.

No signals required.

(a) At stations (other than staff stations) through which all trains usually carry train staff and are not allowed to run on ticket.

(b) At intermediate stations on lines worked by Electric Tablet or Staff whete the sidings are locked by such Tablet or Staff.

(c) At intermediate non-staff stations the sidings of which are controlled by Annett's Lock ["Key on Staff" subsequently added]

(d) On lines worked by one engine as per Regulation 485.

(e) At gate crossings except under special circumstances.

Location of Signals

Home Signals governing facing points should be placed not more than 225 feet from such points otherwise additional saftety bars should be provided. If controlling fouling points they should be placed a short distance clear.

Distant signals - about 600 yards from Home or further if on heavy falling gradient.

Starting signals - ahead of Home Signals as circumstances require.

Sighting of Signals.

All signals to have "background" of sky if practicable.

Distant signals to be placed so as to be visible to an approaching Driver 300 yards distant.

Home signals to be visible when passing Distant and thereafter continually until reached. Where this cannot be satisfactorily accomplished additional Distant signals to be provided.

Starting Signals to be visible from Home.

Signals to be visible from place from which they are worked if possible to so arrange, - otherwise Electric Repeaters to be provided.

Minimum height of signals 15 feet from rail level

So that siding signals may bedistinguished from others, discs should be used for the former - and placed at any height required.

The distant signal of any station should not overlap either the starting or advanced starting signal of another station.

Whilst the foregoing principles are in our opinquire to be made to meet exceptional circumstances. Still we consider that no variation should be made without the sanction of the Heads of the three branches concerned.

This report was forwarded to Edward Ballard, Assistent Engineer (by 1898 he had the position of Signal Superintendent), who responded to the Engineer for Existing Lines on 2 November 1897:

Signal Arrangements.

In my opinion a uniform system regarding signals and their location cannot be made applicable to the Victorian Railways as the work of signal engineering must be governed in this, as in other countries, by local circumstances such as the various arrangements of lines-of-way at stations, the distances between station, curves, cuttings, gradients, and obstructions to sight. It has been customary in dealing with proposed signal arrangement for any place on the Victorian Railways for the Signal Engineer or his representative to make a personal examination of such place and to confer with all concerned in order to make himself acquainted with the local requirement; a plan of the proposed arrangements is then prepared and submitted to the Heads of Branches whose approval is obtained before the scheme is forwarded to the Commissioner for authority to carry out the work, and I beg to recommed that this method be continued. As regardsthe recommendations made by the Rule Book Board I am of the opinion that the broad basis to be laid down for signal arrangements should be simplified and I beg to sbmit for approval my explanation of the method generally observed on the Victorian Railways.

Method of Signalling

Double Lines

Interlocked Stations and Junctions. Distant Signals about 600 yards from Home Signal. Home Signal, adjacent to first fouling or facing points. Directing Signals ahead of Home signals if required to cover fouling or facing points other than those at Home signals. For "block posts" only: Starting Signals ahead of Directing or Home Signals. Advanced Starting Signals (if required) ahead of Starting Signals.

Non-Interlocked Stations. Distant signals provided only when view of approach to Home Signals is unsatisfactory. Home Signals about 200 yards clear from first fouling or facing points. Starting signals, ahead of Home signals for "block posts" only.

Single Lines

Interlocked Stations & Junctions. Distant signals about 600 yards from Home Signals. Home signals adjacent to first fouling or facing points. Directing Signals ahead of Home signals if required to cover fouling or facing points other than those at Home signals.

Partially Interlocked Junctions. Distant signals provided only when view of approach to Home signals is unsatisfactory. Home signals about 200 yards clear from first fouling or facing points. Directing signals adjacent to interlocked facing points.

Non-interlocked Junctions, Ordinary Staff Stations, Electric Staff Stations, Tablet Stations, Intermediate Stations on ordinary StaffSections where all trains do not carry Train Staff. Distant signals provided only when view of approach to Home signals is unsatisfactory. Home signals about 200 yards clear from first fouling or facing points.

Non-interlocked Stations on ordinary Staff Sections where all trains carry Train Staff, Intermediate Stationson Electric Staff or Tablet Sections where points in main line are secured by Staff or Tablet Lock, Stations on Lines worked by one engine. No signals.

Gates at level crossing. No signals except under special circumstances as regards view of approach.

A committee of senior officers from the three branches was then formed to produce a set of recommendations. The committe consisted the Rule Book Board, together with Edw Nicholls (Traffic Running Superintendent) and Edward Ballard (Superintendent of Signals). (The job titles are from the 1898 General Appendix.) The committee produce a report dated 4 February 1898. The report took the form of a large table summarising Ballard's statement of current practice, the recommendations of the Rule Book Board, and the recommendations of the committee.

The main difference between Ballard's statement and the committee's recommendation was that a separate Distant signal should be provided for each Home signal at junctions (this was implemented at a few locations); the provision of Distant signals at non-interlocked block posts on Double lines, and the provision of a white light on platforms of stations with no signals.

The Committee also recommended that the signalling arrangements at each station be jointly certified on a form similar to that used for interlocking. The recommendations were endorsed by the Chief Traffic Manager, Chief Mechanical Engineer, and Engineer for Existing Lines on 26 February. The Heads of Branches also noted that "The present signals to be attended whereever necessary to be bring them in accordance with the scheme now forwarded.

The recommendations as to uniform signalling were approved by the Commissioners on 5 March 1898. During March this decision was noted by the Chief Traffic Manager, Chief Mechanical Engineer, Engineer for Existing Lines, and Edward Ballard. On 28 March 1898 the Chief Traffic Manager noted that copies of the uniform practice had been copies and distributed to all concerned. The copies took the form of A680/98 dated 23 March 1898. The text of this circular was identical to the recommendations of the joint officers, and ran:

Double Lines

Interlocked Stations. Distant and Home Signals, and, when necessary, Directing Signals. If station a Block Post, Starting Signals and also Advanced Starting Signals where required.

Interlocked Junctions. Distant and Home Signals, and, when necessary, Directing Signals. If station a Block Post, Starting Signals and also Advanced Starting Signals where required. Separate Distant for each Home Signal at Junctions.

Non-interlocked Stations. Home Signals. If Station a Block Post, Distant and Starting Signals and also Advanced Starting Signals where required.

Single Lines

Interlocked Stations and Junctions. Distant and Home Signals, also Directing Signals where required.

Non-interlocked junctions. Home Signals. Also Distant Signals where required and as approved by Heads of Branches.

Ordinary Staff Stations, Electric Staff Stations, Tablet Stations. Home Signals. Also Distant Signals where required and as approved by Heads of Branches.

Intermediate Non-staff Stations on Ordinary Staff and Ticket lines. Home Signals.

Intermediate Non-staff Stations (on Ordinary Bock, Staff and Ticket lines) fitted with Staff or Annett's lock and key attached to Staff. No signals. Prominent White light to be exhibited on platform to indicate station to Driver of an approaching train.

Intermediate Non-staff Station on purely Staff lines. No Signals

Intermediate stations (on Electric Staff and Tablet lines) fitted with Staff or Tablet lock. No Signals. Prominent White light to be exhibited on platform to indicate station to Driver on an approaching train.

Stations on lines worked by one engine only. No Signals.

Level Crossings (Double or Single Lines). No Signals unless Head of Branch thinks one necessary.

Situation of Signals

Distant Signals about 600 yards out from Home Signals, according to grade of approach, not to overlap a Starting or Advanced Starting Signal of another station or Section. To be visible 300 yards away if possible.

Home and Directing Signals at Interlocked Stations controlling Facing Points to be not more than 300 feet away, otherwise additional safeguards to be provided. When controlling Fouling Points they should be a short distance clear. Home Signals to be visible after passing Distant Signals, and thereafter continuously to Home Signals where possible.

Home Signals at Non-interlocked stations at a minimum distance of 200 yards out from Facing or Fouling Points unless circumstances warrant a departure as to distance.

Starting Signals ahead of Home and Directing Signals. Advanced Starting Signals ahead of Starting Signals.

Signalling Alterations

(Continued from page 100)

(10.10.2006) **Book of Rules, Section 18 (Train Order System), Rule 15** (SW 296/06, WN 40/06)

Rule 15 (Verification of Train Orders) has been superseded. The new Rule requires the Driver to verify a Train Order whenever the Driver does not receive it directly from the Train Controller. To verify the Train Order, the Driver must read out the Train Order number, the Red Serial number, the Number and Class of the leading locomotive, the text, and the Driver's name. After the Train Order has been verified, both the Driver and the Train Controller must endorse their copy with the word 'Verified', the Driver's Name, and the date and time.

(10.10.2006) **Underground Loop** (SW 247/06, WN 40/06)

Diagrams 11/06 (Clifton Hill Loop), 13/06 (Northern Loop), 15/06 (Caulfield Loop) and 17/06 (Burnley Loop) replaced 35/80 (Caulfield & Burnley Loops), and 13/91 (Clifton Hill & Northern Loops)

(10.10.2006) **Newport Workshops** (SW 241/06, WN 40/06)

Diagrams 85/06 (Newport Workshops North Yard), 87/06 (Newport Workshops South Yard), and 89/06 (Newport Workshops East Yard) were issued.

(10.10.2006) **West Footscray - Tottenham** (SW 252/06, WN 40/06)

Diagram 21/06 replaced 17/96.

(10.10.2006) **Canterbury - Laburnum** (SW 248/06, WN 40/06)

Diagram 19/06 replaced 15/85.

11.10.2006 **Toolamba - Echuca** (SW246/06 & SW 293/06, WN 35/06 & WN 40/06)

From 0001 hours on Wednesay, 11.10., this line was restored to traffic. The Train Order sections Toolamba - Kyabram - Echuca were replaced by the section Toolamba - Echuca. Track Warrants may be issued on this section. Train Orders for movements towards Toolamba to or from the branch will include 'Proceed to Toolamba Junction'. When a competent employee is at Toolamba for movements to or from the branch, Toolamba will be an 'Attended Junction Location'. Train Orders issued to the employee at Toolamba will be issued at 'Toolamba Junction'.

Flashing lights were recommissioned at Mooroopna - Murchison Rd (168.493 km), Casey St (177.394 km), Hogan St (177.551 km), Park St (177.967 km), Ross St (178.336 km), Midland Hwy (181.694 km), Kyabram Rd (189.150 km), Allen St (198.943 km), Albion St (199.350 km), Church St (199.851 km), Kyabram Rd (210.674 km), and Cornelia Ck Rd (230.793 km). All of these crossings have been provided with remote monitoring equipment and the healthy state indicators have been abolished.

Drivers of trains must bring their train to a stand at the Stop boards at the Murray Valley Hwy, Echuca, and obtain permission from the Signaller to enter the yard (for Down trains) or to enter the section (for Up trains). The train must be moved forward cautiously until the flashing light signals commence to operate and a speed of 10 km/h must not be exceeded until the locomotives clear the crossing.

All points and signals on the line were abolished, except for 100 metres of No 2 Road at Tongala and the Staff locked Points B at the Up end. These points were secured normal and No 2 Road will not be available for use.

At Tatura the Up and Down Location Boards, Posts 1, 2, 3, and 4, Points B and C, Nos 2 and 4 Roads, and all signal quadrants, push buttons, and signal repeaters were abolished. The Master Key locked points at Scoons Siding (Kyabram) were abolished. At Kyabram the Up and Down Location Boards, Posts A, E, F, G, and H, Points B and D, No 2 Road, and all signal quadrants, push buttons, and signal repeaters were abolished. At Tongala the Up and Down Location Boards, Posts D and F, Points C (at the Down end), the points to the Nestle Siding and associated duplex lock, Annett key, and Annett lock, and all signal quadrants, push buttons, and signal repeaters were abolished.

GHERINGHAP - MAROONA

Continued from Somersault Vol 26 No 4

In Somersault Vol 26 No 3 and Vol 26 No 4, histories of most of the stations between Gheringhap and Maroona was published. Unfortunately, the history of the final station on the line, Tatyoon, was unaccountably missed. So, better late than never, here is the missing station.

TATYOON

(144 miles 13 chains, 232 km)

(08.04.1912) Opened for goods traffic by Construction Branch (WN 15*)

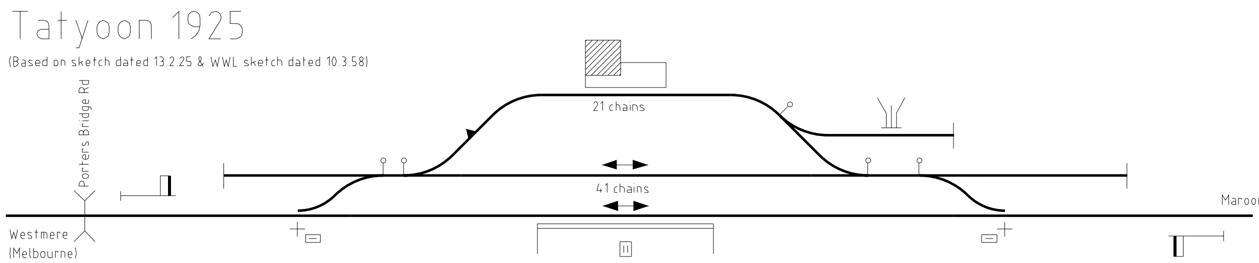
08.08.1913 Open for passenger and goods traffic with line. Opened as staff station working Train Staff and Ticket with sections Westmere - Tatyoon (No 1 Pattern) and Tatyoon - Maroona (No 2 Pattern). Up and Down Home signals provided. Main line points secured by Hand Locking Bar and Padlock. Goods traffic catered for by Goods shed and ramped goods platform. (WN 30)

02.09.1913 Train Staff and Ticket Westmere - Tatyoon - Maroona replaced by Electric Staff working with large instruments (WN 35, SR)

01.10.1913 Up and Down end points secured by plunger locks. Up and Down Home signal provided. (WN 40, SLR I, SANP)

(12.07.1921) Staff Exchange Box provided (WN 28*)

(24.05.1927) Composite Electric Staffs provided in both Westmere and Maroona sections account time interval working. (WN 21*)



19.08.1931 Stationmaster (Class 9) withdrawn. Now staffed by Operating Porters in Charge supervised by SM Westmere (WN 33)

(08.12.1931) Composite Staff Exchange Box provided. Two Composite Staffs provided for each section. When Composite Staff Exchange Box is in use, block section will be Westmere - Tatyoon. APIX or ACRE messages will not be sent or received at Tatyoon and Time Interval working will not be in use. Staff Exchange Box will be in use for any train as required by Train Despatcher. (WN 8)

03.12.1936 Large Electric Staff instruments replaced by Miniature instruments. Staff Exchange Box removed (WN 50*)

(17.01.1939) Telegraph instrument removed (WN 3)

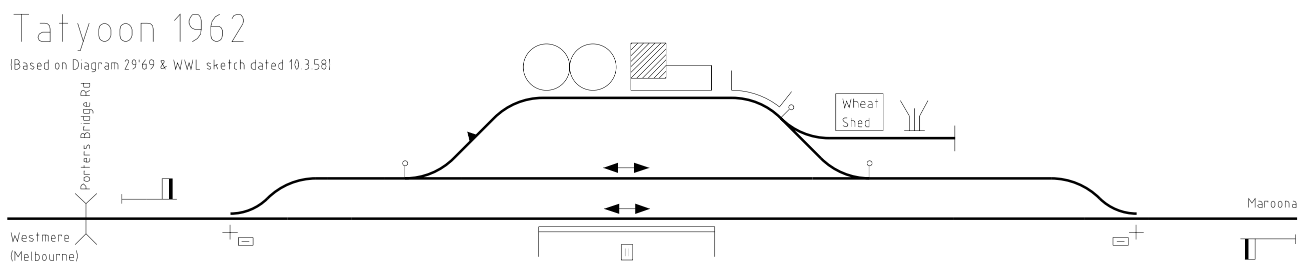
(30.06.1942) Staff Exchange Box provided. May be use for an Up or Down train to run after the Signalman has finished for the day (WN 26)

(25.09.1945) Composite Staff Exchange Box removed. (WN 39)

14.01.1952 Mixed service withdrawn (McClean)

04.10.1962 Up Home relocated 318 yards further out (WN 42)

25.10.1962 Crossing loop extended. Up end plunger locked points moved 80 feet further out. Down end plunger locked points moved 840 feet out (WN 45)



(25.05.1965) Composite Staff Exchange Box provided. When in use block section will be Westmere - Tatyoon. APIX or ACRE messages will not be sent or received at Tatyoon (WN 21)

30.08.1967 Crossing loop extended to 2900 feet. Trailable points replaced plunger locks. Location boards replaced to Home signals. Automatic Electric Staff instruments provided Westmere - Tatyoon - Maroona. (WN 36, SLR III)

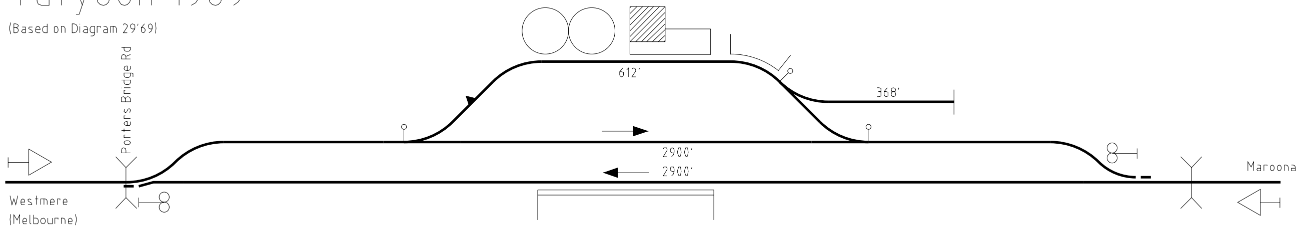
31.08.1967 ASM (Class 5, 2 positions) withdrawn. Caretaker (Class 4) provided (WN 46)

12.06.1974 The Up end points to No 3 Road were equipped with WSa lever (in lieu of a CCW lever) and secured by a Staff lock (WN 25, SLR III)

(27.06.1978) Caretaker withdrawn. Now no one in charge. (WN 26)

Tatyoon 1969

(Based on Diagram 29'69)



c1988 Electric Staff: Westmere - Tatyoon (Automatic A Pattern Miniature Electric Staff with battery instruments & earth return), Tatyoon - Maroona (Automatic B Pattern Miniature Electric Staff with battery instruments & metallic return) (Staff List)

13.11.1988 Train Order Working replaced Automatic Electric Staff Working. Sections Westmere - Tatyoon - Maroona, but note Westmere loop spiked out of use. Effective sections Pura Pura -Tatyoon - Maroona. Electric Train Detection provided (WN 46)

01.01.1995 Closed for gauge conversion. Line in use as a works siding. (WN 1)

23.05.1995 Line reopened as standard gauge. Points at each end of loop are spiked and padlocked. (WN 21*)

01.10.1995 Opened as Train Staff and Ticket station; section Vite Vite - Tatyoon - Maroona. Points worked by dual control point machines which will be manually operated. Arrival home signals are provied but are fixed at stop and all trains will be hand signalled past them. Location Boards are provided 2000 metres outside the home signals. Trains may shunt on the main line inside the location boards without the staff. (WN 40*)

(21.12.1995) Between 12.12 and 21.12 VP5PSW operation of the points and signals was commissioned. A keyswitch was provided at each end of the loop. The Signaller will operate the switch to 'Main' or 'Loop' position for 10 seconds. The points will run and the arrival home will clear. The points will automatically restore to normal after passage of the train. The same procedure will be followed to reverse the points for a departure from the loop. Voice announcement equipment was commissioned. This will announce that the train is in clear over the local radio. Staff Exchange platform provided. (WN 1*)

05.06.1996 Section Authority Working replaced Train Staff and Ticket Vite Vite - Fiery Creek Block Point - Tatyoon - Maroona. Loop continued to be operated by a signaller. ETAS provided. (WN 23*)

23.06.1996 Signaller withdrawn. The loop is now operated by automatic approach call. An approaching train will be automatically signalled into the main track. A train for the loop must come to a stand at the home signal. The route to the main track must be cancelled and the route to the loop called. The points are not trailable; if they are not set correctly for departure the points must be called to the correct position. (WN 26* & 45*)

02.12.1996 Grain Siding brought into use. The points are worked from non-trailable point machines rodded to catch points and secured by minature ST21 Master Key Locks. (WN 49*)

Tatyoon 1996