Selective Realignment of the Western Line

July 2014
Executive Summary.

1. In the late nineteenth century, sections of the new Western Line required realignment. Specific sections of track with steep inclines but less curvature were replaced with track with tighter curvatures. Steam locomotives could then haul heavier loads up the steep hills. The sections of disused gently curved track remain in place.

2. Tight curves along the Western Line between Lithgow and Blayney severely restrict speeds of existing XPT and Explorer train fleets. Any future replacement trains will also be restricted in speed, unless these sections are realigned.

3. This study identifies at least 24.5 km of track that needs realigning. 15.0 km of “adjacent” disused tract could be returned to service.

4. If an average speed along the realigned track is 100km/h, a travel time reduction of at least 18.5 minutes is applicable to the Dubbo - Orange -Sydney journey. 9.2 minutes is saved on the Bathurst-Sydney journey.

5. More saving in travel time would result with XPT and Explorer fleet replacements. If tilt technology was combined with track realignment, travel time estimates are:
   - Sydney – Dubbo 5hr 32 min
   - Sydney – Orange 3hr 59 min
   - Sydney - Bathurst 3hr 4 min.
   These are significant travel time reductions of 14 -16%

6. Patronage increase on the Western Line should follow service improvements. In Victoria, since the introduction of Regional railway track upgrades and modern diesel train sets in 2005, a 6.5% annual growth in patronage has occurred.

7. The total cost of such a project could be $150-300 million.

8. Map images of the rail track studied are included in the Appendix.
The problem

Track curvature on the Western Line is a limiting factor for train speeds. Train speeds are well below the capability of current XPT rolling stock. Any replacement of the current ageing XPT and Explorer train fleet would still have cruising speeds impeded by the tightly curved rail infrastructure.

Introduction.

Within professional railway circles, it is known that many sections of disused but gently-curved track footings, and some bridges, still exist along the Western Line.

The original Western Railway Line construction reached Bathurst in 1876 and Orange in 1877. The section beyond Lithgow drops from 905m.(above sea level), to 650m. at Bathurst and rises to 850m. at Blayney. Several railway track grades along the Lithgow - Blayney section were found to be too steep for 1890's steam locomotives and heavy loads. The costs involved in using multiple steam locomotives made “grade easing” of the railway track, economically feasible.

From the late 1890s onwards, the NSW Parliament approved realignment and deviations, by construction of tighter curvatures on selected sections of the Western Line. Heavier trainloads hauled by the steam locomotives-of-the-day, became possible. The foundations of many of these disused alignments of track and some bridges, remain intact.

Over the 1900’s, traction power of railway engines increased and could deal with steeper track. In 1982, 105 years after opening of the Orange Station, the diesel XPT train services were introduced and are still in use. These trains are defined as "High Speed Trains" with a maximum speed of 160 km/h. However, due to tight track curvature sections, the average speed on the Orange- Sydney trip is only 67 km/h. Faster speeds risk train derailment.

After 32 years of service, the XPT fleet is approaching its replacement date. 21st century trains are more advanced in technology, speed and comfort. However, speed of any future new rolling stock will still be “hobbled” by the outdated 19th century track along the Western Line.

Objectives of this study:

1. to identify sections of track with tight curvature
2. to calculate the total length of replacement track required
3. to estimate the travel time reduction with current XPT technology
4. to estimate the additional travel time reduction with tilt-train technology
5. to estimate the possible cost of the infrastructure project

Note: Professional surveys and estimates by railway engineers need to be made. However, for this study, publicly available maps and other documents were used to make a general estimate.

Method

Using 1:25,000 NSW Land and Property Maps and Google ® maps, sections of existing tightly curved track between Blayney and Lithgow were identified. Using the Topographic Map scale, the lengths of curved tracks were measured. The alignments of the disused track were identified on Topographic and Orthophoto (satellite photo) and measured.

The track lengths were totalled, travel times calculated and tabled using Excel.® For the existing curved track sections, an average speed of 55 km/h was assumed. For the realigned track, an

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2. Track structure and conditions p41-42. State and Regional Development Committee
3. Mr Max Michell and Mr. Dale Budd. (personal communications)
average speed of 100km/h was assumed. The saving of travel time from Dubbo, Orange and Bathurst to Sydney was calculated. Tilt trains can reduce travel times by 10% - 15%. For this exercise a conservative 10% reduction was assumed. 8

The cost of building railway track in NSW is difficult to estimate, as each project is different. Using information published in 2012 by the NSW Government,9 a range of $10-20 million per track kilometre was used, assuming this to be a “less complex” project. See Graph 1.

Graph 1

Results
1 Eight (8) sections of tightly curved track were selected. Seven (7) have adjacent original disused alignments. The eighth section was considered in need of re-alignment.

2 The total length of tightly curved track was measured at 24.5 km. This could be replaced by 15.0 km of much less curved track along the adjacent disused alignments. In two sections **, a deep cutting or a short tunnel may be needed (personal observation). See table 1.

Table 1

<table>
<thead>
<tr>
<th>Western Line sections &amp; lengths</th>
<th>Slow track km</th>
<th>New track km</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLAYNEY - BATHURST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blayney - Athol</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Athol- Newbridge 1</td>
<td>2.5</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Athol- Newbridge 2</td>
<td>2.3</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Newbridge – Gresham **</td>
<td>5.0</td>
<td>3.0</td>
<td>Disused alignment poorly marked –requires ? tunnel through 982m peak</td>
</tr>
<tr>
<td>Table 1 continued</td>
<td>Slow track km</td>
<td>New track km</td>
<td>Comment</td>
</tr>
<tr>
<td>BATHURST - LITHGOW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brewongle - Locksley</td>
<td>4.8</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Locksley - Gemalla **</td>
<td>2.5</td>
<td>1.5</td>
<td>? tunnel or deep cutting through 800m peak</td>
</tr>
<tr>
<td>Sodwalls Loop</td>
<td>3.5</td>
<td>2.0</td>
<td>Bridges across Solitary Creek intact ? useful</td>
</tr>
<tr>
<td>Adams Ck - Wallerawang</td>
<td>1.5</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

8 Persson, R: 2007. Tilting Trains, Description and analysis of the present situation. Literature study 10.2 Conclusions - General Aspects p 76 VTI. rapport 595A www.vti.se/publictions
9 NSW LEGISLATIVE COUNCIL: 2012. Rail Infrastructure project costing in New South Wales, p21 figure 3 General Purpose Standing Committee No 3: Report 26
3  Travel time calculation was 26.7 minutes at 55 km/h along 24.5 km of tightly curved track. Along the 15.0 km of realigned track, travel time was calculated at 8.2 minutes at 100km/h. The total time saving was 18.5 minutes between Blayney and Lithgow. See table 2.

Table 2

<table>
<thead>
<tr>
<th>Average Train Speed</th>
<th>Travel time min.</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 km/h</td>
<td>26.7</td>
<td>24.5 km. existing curved track</td>
</tr>
<tr>
<td>100 km/h</td>
<td>8.2</td>
<td>15.0 km. new realigned track</td>
</tr>
<tr>
<td>Time saving min. on realigned track</td>
<td>18.5</td>
<td></td>
</tr>
</tbody>
</table>

4  Table 3 shows travel time reduction from Sydney to each of the 3 major cities beyond Lithgow, following track realignment. The reduced travel times to Dubbo, Orange and Bathurst were 18.5, 18.5 and 9.2 minutes respectively. A further travel time reduction occurred when a 10% reduction for tilt-technology was applied. Total travel times from Sydney to Dubbo, Orange and Bathurst, reduced to 5hr 32min, 3hr 59min and 3hr 4 min respectively.

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Dunbo</th>
<th>Orange</th>
<th>Bathurst</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail distance from Sydney Km</td>
<td>462</td>
<td>323</td>
<td>240</td>
</tr>
<tr>
<td>Trip time on existing track Hrs &amp; min.</td>
<td>6hr 27m</td>
<td>4hr 44m</td>
<td>3hr 34m</td>
</tr>
<tr>
<td>Trip time on existing track min.</td>
<td>387</td>
<td>284</td>
<td>214</td>
</tr>
<tr>
<td>Trip time saving on realigned track min.</td>
<td>18.5</td>
<td>18.5</td>
<td>9.2</td>
</tr>
<tr>
<td>Trip time on realigned track min.</td>
<td>368.5</td>
<td>265.5</td>
<td>204.8</td>
</tr>
<tr>
<td>Tilt train 10% time reduction min.</td>
<td>36.9</td>
<td>26.6</td>
<td>20.5</td>
</tr>
<tr>
<td>Trip time on realigned track with tilt train min.</td>
<td>331.7</td>
<td>239.0</td>
<td>184.3</td>
</tr>
<tr>
<td>% time reduction with realignment and tilt train usage.</td>
<td>14%</td>
<td>16%</td>
<td>15%</td>
</tr>
</tbody>
</table>

5  Cost Estimation  This project was regarded as "less complex" and not a “Greenfield “ construction. Using $10-20 million/km. of track, an estimate of between $150 and $300 million for the 15 kilometres of realignment, was calculated.
Discussion  

The population of the cities of Bathurst, Orange and Dubbo totals 134,000 10. More people live in surrounding towns serviced by the CountryLink coach services, linking to the Western Line Passenger Services. The presence of many tightly curved sections of railway track is one of several factors restricting fast travel between Sydney and the regional cities.

Realignment alone of the 24.5 km of tightly curved track, should result in a saving of travel time of 18.5 minutes on the XPT, when travelling to Sydney from Dubbo or Orange. Similarly, 9 minutes of travel time is saved when travelling to Sydney from Bathurst on the “Bathurst Bullet” and the XPT.

Modern powerful trains with tilt train technology have been very successful in Europe and in Queensland. Total journey time reduction by 9% has been shown along the Stockholm-Gothenburg Line of 475 km. 11 In Queensland, the tilt train service now runs from Brisbane to Cairns. This study estimates a travel time reduction of 14-16% along the 462 km NSW Western Line using realignment and tilt technology. Tilt train introduction has been recommended to the NSW Government. 12

There is evidence that higher levels of rail patronage occur with express train travel and higher passenger comfort.

- The introduction of the NSW RailLink’s “Bathurst Bullet” return express recorded a patronage of 25,000 in the first 12 months of service. 13
- VicRail has upgraded both regional tracks and introduced Bombardier ® diesel trains into regional Victoria. This has resulted in a patronage increase of 6.2% annually since 2005 – ie. one million passengers per year. 14
- The Sydney Morning Herald quoted a report for the Director General of Transport for NSW, which stated that tilt trains could attract 60% more patronage* to NSW regional train services 15

Rebuilding selected sections of the track along the disused alignment is estimated to be $150-300 million. This is subject to a professional survey, reports and costing estimate.

Conclusion  

Track upgrade funding and identification of “priority areas that require immediate action” 16 is a recommendation to NSW Government by the Inter Regional Public Transport Inquiry. This should be a first step in upgrading rail infrastructure in Western NSW in the near future to take advantage of future modern passenger train sets.

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July 2014

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10 AUSTRALIAN BUREAU OF STATISTICS: 2012. 3218.0 Regional population growth, Australia.
Table 1. Estimated Resident Population, Statistical Local Area, NSW.
11 Persson, R: 2007. Tilting Trains, Description and analysis of the present situation.
12 NSW LEGISLATIVE ASSEMBLY 2014. Inter Regional Public Transport Report.
Future Trains and Buses Recommendation 30 , p90 State and Regional Development Committee
13 Bathurst Advocate: Oct. 21, 2013 The Bathurst Bullet celebrates first anniversary. Fairfax Medi
Fairfax Media
Track structure and conditions Recommendation 11, p44 .State and Regional Development Committee
APPENDIX

BLAYNEY - BATHURST PROPOSED REALIGNMENT

Blayney - Athol Curve
east of Blayney

300m radius - disused alignment marked.

Athol - Newbridge 1 Curves

300-350m radius. Disused alignment marked.

Athol - Newbridge 2 Curves

300-350m radius. Disused alignment partly marked.

Newbridge - Gresham Curves

300 m radius. Disused alignment poorly marked. 900m contour line + 982 m peak marked. ? Cutting +/- tunnel
Brewongle-Locksley Curves - east of Bathurst

300m radius. Disused alignment marked (and extends to adjacent map).

Locksley - Gemalla Curve

300m radius. No disused alignment. Rail follows 780m contour. ? cutting & tunnel under 800m peak.

Sodwalls Loop - west of Rydal

250m radius. Disused alignment seen on satellite image & Google Maps (marked manually). 4 existing bridges crossing Solitary Creek are marked on map.

Adams Creek Loop - west of Wallerawang

400m radius. Disused alignment seen on satellite image & Google maps.
Sodwalls Loop Satellite Image - showing disused alignment

Disused alignment clearly imaged and marked with arrows at Solitary Creek crossings
Adams Creek Satellite Image - showing disused alignment.

Disused alignment clearly imaged and marked with arrows.