The Cost Effectiveness of

Queensland Rail's

Infrastructure Maintenance

Central Queensland

Coal Systems

Rail Management Services Pty Ltd

November 2000

Disclaimer and Limitation

This report has been prepared on behalf of and for exclusive use of the Queensland Competition Authority, and is subject to and issued in accordance with the agreement between the Queensland Competition Authority and Rail Management Services Pty Ltd. Rail Management Services Pty Ltd accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

The report has utilised extensive QR staff interview information and data supplied by QR, maintenance contractors and other railway administrations. To that end, the report is a reflection of those data.

Acknowledgements

Queensland Rail provided data and open discussions on a variety of issues. Without their cooperation, this review could not have been conducted. The author is greatly appreciative of many Queensland Rail staff who sourced information and conducted field tours for the author. The author would also like to thank Mr Vince O'Rourke, CEO QR, for his kind permission to conduct this detailed review.

In addition, a number of contractors and other railway services providers assisted with information. Those organisations were: Barclay Mowlem, John Holland, and Rail Services Australia. The author would like to thank those organisations for their assistance.

Glossary

Above Rail Operator:	train operators who utilise access to the infrastructure.
Backbone Telecommunications:	The telecommunications assets that provide major trunk telecommunications and used by many groups simultaneously.
BCM:	Ballast Cleaning Machine; a track mounted machine designed to recover the track ballast and place it to spoil, or to clean it and return the cleaned ballast to the track and spoil the remainder.
Bomb bay doors:	Doors on bottom dump wagons that open like an aircraft's bomb bay doors, that is , longitudinally with the track.
Bridgemaster:	A supervisor with resources suitable for bridge works and generally available to the whole District.
Bottom Dump Wagon:	A wagon that releases its load from the underside. Wagons can be designed with either transverse (to the track) door operation or longitudinal door operation (bomb-bay doors)
Cant:	The cross-fall or bank of the track transversely, to counterbalance the effect of centrifugal force around a curve. Sometimes called superelevation.
Changeout:	The replacement of components.
CTC:	Centralised Traffic Control. A generic term for remote monitoring and control of field signalling systems. The systems in use in QR utilise track based detection using electrical circuits in the track.
District:	A geographic area, a number of which make up a Region in the Track Organisation. District resources or gangs are available to the entire District, whereas Local Gangs and resources are generally confined to a small track length within the District.
Dragging Equipment Detector (DED):	A track-mounted device capable of detecting whether a piece of rollingstock equipment has fallen off the rails or is not in its design configuration, such as derailed wheels or hanging brake-gear.
EBA:	Enterprise Bargaining Agreement

ER: Employee relations, including personnel management and industrial relations

FMEA: Failure Mode Effect Analysis. An analysis of work functions designed to ensure levels of maintenance are appropriate to the impact of a failure.

Frog: The component in a turnout where one rail from one line crosses the other rail from the other line. The shape of the two rails coming together and diverging apart is in the shape of a frog. Also, swing nose frog, relates to an arrangement where the continuity of each rail is maintained instead of having a gap by a section of rail that swings from one line to the other.

Geotextile: A man made fabric used in earthwork applications to constrain movement of material whilst allowing water drainage.

Gross Tonne km: The total weight of a loaded train by distance travelled.

Head: Usually ‘rail head’. The bulbous portion at the top of the rail section where the wheel runs.

Head Hardened: As applied to rail. The heat treatment of the head of the rail to make the head more wear resistant.

Hot Box Detector: (HBD): a track mounted device with the function of measuring the axle box temperatures of a passing train. Axle box bearings have a risk of failing, causing bearing heating and eventual axle box shearing, resulting in a derailment.

Interlocking: Generally signalling interlocking, where various functions, such as points switching, cannot occur without other conditions occurring, such as the passage of a train. Proprietary systems for this function are known as VPI, Westrace, Microlok and Relay.

ISG: Infrastructure Services Group, the group responsible for the provision of construction and maintenance services on the infrastructure except for the backbone telecommunications.

Level (1,2,3,4,5): Queensland Rail is organisationally structured on levels from 1 (Chief Executive) to 7 (semi-skilled) workers.

Local Resources: Resources of gangs whose field of work is confined to a relatively small geographic part of the District, which in turn is a subset of the Region.

MGT: Million Gross Tonnes

NAG: Network Access Group (Network Access), responsible for train path management, infrastructure expenditure and access revenue.

Net Tonne km: The weight of the payload by distance travelled.

Operator: A train operator. Usually providing the train drivers whom operate the trains and supply the train asset.

Operational Systems: An organisational subgroup of ISG comprising signalling and communications asset maintenance and construction.

Production Resources: In the context of Major Track Program Maintenance, those resources available to the whole district and designed for rapid output of finished work, such as with mechanised equipment and large gangs concentrating on specific jobs. This contrasts with routine or caretaker maintenance local track gangs.

QR: Queensland Rail including all business functions, above rail, ISG, NAG.

Rail Infrastructure: Means Rail Transport Infrastructure as defined in *the Transport Infrastructure Act 1994* for which QR is the Railway Manager.

Railway Operator: A person who has, or is seeking, access from QR to operate Train Services on the Rail Infrastructure and who is, or who will become, Accredited in respect of those Train Services.

Region: Either the Northern Region, comprising all infrastructure north of Gladstone approximately, or the Southern Region. The coal lines of the Northern Region is the subject of this report.

Re-surfacing: Maintenance of the geometry of the track using a machine called a 'tamper' which lifts, lines and levels the track and packs the ballast to accommodate the new position of the track.

Roadmaster: A senior supervisor within a District allocated the responsibility of supervising resources that work across the District or are common across the District, in contrast to a TSS who supervises resources allocated to a sub section of the District.

Signalling System Interlocking: A mechanical or electrical system that prevents conflicting train movements that are dangerous. Signals and points are kept locked until the route is safe.

Tamping: Re-surfacing using a tamping machine called a 'tamper'. In Australia, companies generally referred to as 'Plasser' and 'Tamper' manufacture 'tampers'.

Tangent Track: Straight track (no curves).

TCR: Train control radio

Telemetry: For the signalling system, the communications system required to transmit field data.

Tight curves: Curves which are subject to high train forces and cause high maintenance requirements.

TLM: Track Laying Machine; a track mounted machine designed to be able to replace or place rail and sleepers simultaneously and continuously.

Trackside Systems: All assets, their maintenance and construction, comprising signalling, communications and overhead power provision.

Track Geometry Measurement: The measurement of the geometry of the track particularly the horizontal level and alignment of the rails and their relationship to one another.

TSS: Track Section Supervisor, usually a supervisor with a geographic allocation of the track asset.

Turnout: The track element that permits the divergence of one track from another such as to a siding.

Ultrasonic Rail Inspection: The detection of defects internal to the rail by way of ultrasonic waves and detection of the reflection.

UP & DOWN Tracks: The 'UP' direction is universally regarded as the direction of travel toward the capital city or port. In the Goonyella system case, the UP direction is toward Brisbane via the Blackwater system and is therefore away from the Hay Point and Dalrymple Bay ports.

Contents

1 Executive Summary ... 1
2 Maintenance and Construction History ... 4
2.1 Overview ... 4
2.2 Moura System (Moura Short Line) ... 4
2.3 Blackwater (Central Line) ... 4
2.4 Goonyella System ... 6
2.5 Newlands System ... 6
3 Design Parameters ... 7
3.1 Engineering Overview ... 7
3.2 Rail Replacement ... 8
3.2.1 Structural Strength ... 8
3.2.2 Wear Characteristics ... 9
3.2.3 Rail Internal Integrity ... 9
3.3 Concrete Sleeper Replacement ... 11
3.4 Bridge Strengthening ... 11
3.5 Signalling ... 12
3.5.1 Design and Historical Influence ... 12
3.5.2 Works Initiated by Others ... 12
3.5.3 New Line Construction ... 13
3.6 Telecommunications ... 13
3.6.1 Background ... 13
3.6.2 Telecommunications Backbone ... 14
3.6.3 Telemetry ... 14
3.6.4 Mobile Radio Communications ... 15
3.6.5 Maintenance Philosophy ... 15
3.7 Overhead Power ... 15
3.7.1 Construction and History ... 15
3.7.2 Product Improvements ... 16
4 Train Operations ... 17
4.1 Introduction ... 17
4.2 Access to the Infrastructure ... 17
4.2.1 Planning the Access ... 17
4.2.2 Daily Arrangements ... 17
4.2.3 Access Requirements ... 18
4.2.4 Conclusion ... 18
4.3 Condition of the Rollingstock ... 19
4.4 Speed of Trains ... 21
4.4.1 Impact Loading ... 21
4.4.2 Coal Contamination ... 22
4.5 Loading and Unloading ... 23
5 Current Work Programme Assessment ... 24
5.1 General Observations ... 24

5.1.1 Budget Structure and the 10 Year Plan 24
5.1.2 Budget Timing 25
5.1.3 Track Laying Machine Program Timing and Planning 26
5.1.4 Goonyella Relay Project 1999 27
5.1.5 Maintenance and Capital Programs 29
5.1.6 Conclusion 30
5.2 Routine and Preventative Track Maintenance 30
5.3 Major Track Program Maintenance by District Resources 31
5.4 Resurfacing (Tamping) 33
5.4.1 Background 33
5.4.2 Work Programme 34
5.5 Goonyella Track Laying Machine Program 35
5.5.1 'UP' Track Focus 36
5.5.2 Rail Replacement 36
5.5.3 Sleeper Replacement 37
5.5.4 Ballast Replacement 37
5.6 Rail Grinding 38
5.7 Trackside Systems Signalling and Telecommunications Maintenance 39
5.8 Trackside Systems Overhead Traction Power Maintenance 41
6 Activity Efficiencies 42
6.1 General Observations 42
6.1.1 Employment Practices 42
6.1.2 Employment Training and Competencies 43
6.1.3 Labour Pay Rates 43
6.1.4 Use of Equipment 44
6.1.5 Skill Demarcations 45
6.2 Routine and Preventative Track Maintenance 46
6.2.1 Labour terms of employment 47
6.2.2 Location and Work Content 47
6.2.3 Organisational Policies 47
6.2.4 Gang Equipment 48
6.2.5 Skill Levels 48
6.2.6 Track Structure 49
6.2.7 QR's 10 Year Plan 49
6.3 Major Program Maintenance by District Resources 49
6.3.1 QR's 10 Year Plan 50
6.4 Resurfacing (Tamping) 51
6.4.1 Costing 51
6.4.2 Labour Levels 52
6.4.3 Machine Utilisation 52
6.4.4 Other Cost Components 53
6.5 Track Laying Machine Program 53
6.6 Rail Grinding 55
6.7 Timber Resleepering 56
6.8 Rerailing 57
6.9 Track Geometry Measurement 57
6.10 Ultrasonic Rail Inspection 57
6.11 Trackside Systems Signalling Maintenance 58
6.11.1 Labour Arrangements 58
6.11.2 Work Activity Drivers 59

6.11.3 Indirect Costs 60
6.12 Trackside Systems Telecommunications Maintenance 60
6.13 Trackside Systems Overhead Traction Power Maintenance 60
7 Efficient Costs........ 62
7.1 Summary........ 62
7.2 Local Track Gangs........ 63
7.3 District Track Gangs 64
7.4 Rail Grinding........ 65
7.5 Facilities Maintenance 66
7.6 Infrastructure Services 66
7.7 Operational Systems Local Gangs 66
7.8 Operational Systems District and Construction Teams 67
7.9 Overhead Maintenance Teams........ 67
7.10 ISG Administration and Projects and Plant 68
8 Longer Term Maintenance........ 69
8.1 Introduction........ 69
8.2 Expenses Detailed........ 69
8.3 Plan Details........ 69
8.4 10 Year Maintenance Plan Review........ 70
8.4.1 Moura Maintenance Plan........ 70
8.4.2 Blackwater Maintenance Plan........ 71
8.4.3 Goonyella Maintenance Plan........ 71
8.4.4 Newlands Maintenance Plan........ 72
8.5 Summary of Adjustments to QR's 10 Year Plan........ 73
9 Institutional Factors........ 74
10 References 77
11 Attachment A 78
12 Attachment B 81

1 Executive Summary

A review of the cost effectiveness of QR's infrastructure maintenance for the coal systems has been undertaken. As effectiveness is determined by many inter-related factors, each of these factors has received appropriate attention.

The cost effectiveness drivers of infrastructure maintenance include:

- The engineering standards and design assumptions used for the structure and materials of the infrastructure
- The engineering and maintenance strategies adopted in the past
- The work programs and their applicability for the traffic task
- The timing of work undertaken
- The efficiency with which the work is performed

This review has been somewhat hampered by the lack of cost information from the 1997/98 and 1998/99 financial years particularly with regard to activity based costing, which is not employed within QR. As the financial accounting systems were in transition during this time and the structure of the organisation changed, it was impossible to determine appropriate accountability consistency to provide a level of confidence in the data to carry out this review. The budget for 1999/2000 was therefore used as a snapshot of cost information and was more appropriate for analysis and comparison than those transitional years. This budget was verified against the first year (1999/2000) of QR's 10 year maintenance strategy budget that was available in a different format and detail content. The main deliverable from this review was the reconstruction of QR's 10 year maintenance plan which took into account observations and data relating to the work methods and efficiency occurring during the 1999 calendar year.

The conclusions of this review are:

- A long-term view about the asset management of the coal system has only recently being embraced in a 'heavy haul' context by QR. Consequently, some maintenance activities being performed today result from short-sightedness in the past, due, in part, by collective views about the coal industry at the time of the investment decision. These views, particularly concerning the life of certain mines and the contracts entered into between QR and the mining companies, were instrumental in some important construction philosophies. Whilst the earthworks for the Goonyella system were built for a 10-year life, the system was duplicated presumably anticipating a much longer life. A robust long term set of strategies and plans are needed to avoid internal inconsistent decisions.

- Capital works have become an inseparable part of the maintenance activity and are used interchangeably with operating maintenance. Capital and maintenance resources are not optimised, each occurring somewhat independently of one another. There are significant delays between the completion of a capital program and the appropriate adjustment in maintenance resources

- Some aspects of QR's maintenance practices are world class, notably rail grinding, some on-track equipment such as the rail grinder, and the progress toward competency based career development. There is also potential for innovative employment practices, which are not yet being implemented. Target track maintenance standards form a good basis for the development of comprehensive asset management planning.

- The impact of resource based budgeting, where the activities are dependent on only QR resources being available, manifests itself as an obvious lack of an integrated strategy. For instance, the emergence of the plan to upgrade the Kinrola and Laleham Branches during the course of this review[1] on account of '26 tonne axle load operation', is inconsistent with the other upgrade strategies on the Blackwater system. These two lines provide a large and consistent proportion of the system tonnage. Extensive timber resleepering on these lines, following the earlier decision not to upgrade, has only just occurred and now all of those sleepers are to be removed with the concrete sleeper upgrade.

- The timing of some major works in the coal systems is premature resulting in the replacement of the assets before they need to be replaced.

- Capital works performed on the coal systems are not selective. The works, whilst being extensive, therefore result in some assets being replaced before their life expiry and others not being treated at all.

- Labour arrangements fall many years behind those of other Australian railway activities. There is an over-complicated award and allowances structure, which is distorting work arrangements while also placing an administrative workload in processing the complicated arrangements.

- Costs are not collected by activity so that it is not readily possible to benchmark activities with other infrastructure maintainers. Therefore, QR is not readily able to ascertain its levels of efficiency. This review has required the detailed piecing together of cost profiles for the activities from raw base data.

- A preliminary set of plans, incomplete in detail and incomplete in scope, is all that is available for the management of the infrastructure asset. This lack of forward planning is resulting in short term expedient work programming, causing sub-optimal decisions on workforce strength requirements, materials requirements and minor upgrades.

[1] After a draft of this review was provided to QR in early 2000

- Many elements of infrastructure maintenance costs are at least 20% higher than they should be and possibly 30% higher than they need be due to .

  - relatively high total wage package for individuals
  - lack of multiskilling
  - lack of competitive tension between the supplier of maintenance services (ISG) and their client (NAG)
  - slightly high manning arrangements
  - premature replacement of assets
  - engineering and operational short-sightedness in structural capacity of the original infrastructure in the coal network
  - tolerance by infrastructure maintainers to operational circumstances which are severely degrading the asset
  - decision making about maintenance and upgrading timing is largely driven by the supply of resources to undertake the work rather than the need for the work to be done.
  - the budgeting process for the coal network is the same as the remainder of QR where the heavy haul operation requires extensive planning and expenditure forecasting.

2 Maintenance and Construction History

2.1 Overview

With the exception of some mine loops and minor spurs, most of the central and northern Bowen basin coal lines have been operational for 15 to 30 years. Their fundamental construction therefore has not benefited from the hindsight gained over that period and is in contrast to the more rigorous engineering standards applied throughout the network today.

In particular, earthwork standards have changed considerably from that time. As well, ballast standards have become more stringent and the overall quality of infrastructure has improved.

2.2 Moura System (Moura Short Line)

The Moura Short Line, from Graham near Gladstone to Moura received its first railings in 1968 even though coal had been previously transported from the Callide and Moura coalfields via Rockhampton for many years . Like all lines built in Queensland at that time, the line was of timber sleeper construction and with relatively light rail (47kg/m). In 1996, the line was relaid with 60 kg/m rail on concrete sleepers. It is now substantially in excellent condition, the District work program for 1999/2000 indicating no major works of any kind.

The line has however been the subject of expansive clay instability. During wet and dry seasons, the formation base is subject to inconsistent settlement causing track geometry problems.

Recent attempts have been made to improve the base condition with the use of lime stabilisation, injected into the formation from specially constructed road/rail trucks. The procedure has shown mixed results and at a cost of approximately $100,000 per kilometre there is careful consideration for its use.

The maintenance resources required for coal operations on the Moura line are now minimal. Most major work in the area will be concentrated on the non-coal Monto Branch, non- coal Biloela branch and in Callemondah yard. The local 17 man Track Gang based at Biloela will be more than adequate to attend to the coal operations. Some of their work is allied to the grain, livestock, and general freight locations of Biloela, Koorngoo, Moura, and Goolara.

2.3 Blackwater (Central Line)

The line to Blackwater dates back to 1877 where it was built using primitive earthworks equipment. Consequently, with the exception of some minor alignment deviations, the line follows a route reflecting those capabilities. Most coal Branch Lines were opened in the late 1960's and early 1970's, being Kinrola, Laleham, and Koorilgah. Later, lines were constructed to Curragh (1983), Gregory (1980), Gordonstone (1992), and Ensham (1997).

The Blackwater system therefore has a long and complicated engineering history only recently stabilized with a program of bridge upgrading and track relaying. Sections of double track have been added as the line tonnage has increased.

Originally, the bridges were designed for the equivalent of the M160 standard, approximately 18 tonnes axle load. During duplication works the M220 standard was adopted (25 tonne axle load) and more recently bridges have been upgraded to M270 standard (30 tonne axle load).

Earthworks improvements have also been progressive. The clay and shale areas have received cutting widening and bank widening treatment. Some selected lime stabilisation has occurred.

Track upgrading during 1997 and 1998 in the Blackwater system resulted in concrete sleepers on 60 kg/m rail through most sections. Many of the timber sleepers recovered have been used in the Laleham and Kinrola branch lines. Much of the rail recovered from the rerailing has not yet found a suitable rerailing location or been sold to scrap. A recent stocktake has attempted to bring those materials into warehouse status.

The Blackwater system has also received substantial turnout upgrading with the use of concrete bearers and swing nose frogs, representing the latest technology available for minimum maintenance and highest reliability.

It is noted that the branches, Laleham, Kinrola and some balloon loops have not received the upgrade treatment. The Laleham Branch receives almost as much tonnage as the Moura Line and more than most portions of the Northern Branches of the Blackwater system. At the present time considerable effort is being exerted by the relatively inefficient local and District resources to resleeper the Laleham branch with timber sleepers, ballast undercut, and re-timber turnouts. The improvements in maintenance productivity made possible by the mainline upgrade will therefore not be able to be fully realised as the remainder continues to require small maintenance teams. QR cites investment priority and other matters as reasons for not upgrading these lines in Attachment B.

It is apparent that the maintenance productivity improvements made possible by the upgrade have not yet matured and the author was unable to solicit any 'human resource plans' for the evolution of the workforce in the Rockhampton District.

It is clear though that it will be possible to reduce local and District gang strengths over the next immediate years with some Track Section Supervisors indicating that such reductions were inevitable given the upgrading work performed. These matters relating to workforce reductions are however not openly spoken of, although 'notional' arrangements do exist for the identification of surplus employees and Government recognition through subsidy for their continued employment.

2.4 Goonyella System

This system was purpose built and received its first railings in 1971 from Goonyella to Hay Point. Many branch lines and loops have been added since that time with most expansion occurring in and around 1983.

According to anecdotal reports, the line was built for a 10-year life. According to those same reports, the standard of earthworks construction was below that required today. Formation problems have been an on-going problem since the start of the project.

In 1982/1984, the Goonyella system expanded, south to German Creek, southwest to Blair Athol, and north to Riverside, on top of the previous mine openings in the 1970's and 1980's, and the system from Hay Point to Coppabella was duplicated.

Duplication of the system, as well as upgrading of the existing timber sleepered line, was performed with 22.5 tonne axle load concrete sleepers and 53kg/m rail. Apart from some minor resleepering with heavier capacity concrete sleepers (28 tonne) and spot rerailing with heavier rail (60kg/m), this was the configuration until the latest relay started in March 1999.

The concrete sleepers laid in 1983 have achieved a 16 year life in the Goonyella system and are destined to be used in loops on the North Coast Line upgrading project Rockhampton to Townsville.

2.5 Newlands System

Coal had been mined at Collinsville and railed to Bowen since 1922. It was not until 1983 that the Collinsville to Newlands section was built that the line received heavy coal tonnages.

In 1983, the line to Collinsville from the coast and the extension to Newlands was laid and upgraded with 53kg/m rail and 22.5 tonne concrete sleepers. This track structure has been in place since and received approximately 150 MGT.

The topographic and formation characteristics of the line are very different north and south of Collinsville. To the north, the line traverses ranges where red soil predominates forming a stable base. The line emerges on the coastal plain where variable foundation support on coastal sediments causes minor formation failure.

To the south of Collinsville, the foundation support traverses expansive clay areas. Despite more modern formation the line is subject to formation movement and subsequent track geometry variability. It is only because the line receives relatively small tonnages that it is in reasonable condition.

The poor track geometry in this section is having an adverse effect on the condition of the rail profile with wear being caused on tangent track due to irregular vehicle tracking. Overall, for the tonnages involved, the line is in good condition.

3 Design Parameters

3.1 Engineering Overview

Many of the work programs underway within the QR coal network are determined by the application of engineering design parameters. The following parameters have been chosen because of their large impact on relay programs, expensive capital programs designed to ensure reliability and absence of failure.

An important characteristic of the Queensland coal systems is that they have been subject to a number of incremental engineering improvements. It is not until recently, where the maximum capacity wagon (104 t, 26 tonne axle load) on narrow gauge has been introduced, that civil infrastructure design has been able to stabilise. Signalling and telecommunications design continues to evolve with some of the largest changes occurring with data communications.

In each of the major components of infrastructure, standards have increased progressively over the history of coal transport as follows

Rail - 94lb/yd, 53kg/m, 60kg/m

Sleepers - timber, concrete 22.5 tonne axle load, concrete 28 tonne axle load

Bridges - M160, M220, M270

Ballast - poor standard, contemporary standard

Signalling - CTC, UTC

Telemetry and telecommunications – open wire, microwave, optical fibre, data packaging

Formation - little attention to capping, rigorous attention to capping

The infrastructure in place today is therefore a composite of these many standards; some applied selectively, some applied as a blanket and some not now applied.

Considerable change has occurred to engineering standards associated with the construction of the formation. Areas of formation exist that are the cause of considerable maintenance effort to the superstructure of the track because the substructure has failed. This is particularly acute with formations built before the mid 1980's such as the Goonyella and Moura systems where upgrading continues to be part of a strategy to mitigate these problems.

Overall however, it is only relatively recently that the coal network has been embraced as 'heavy haul' although some of the solutions currently being employed are still not appropriate to achieving cost efficiency.

The 'heavy haul' philosophy embraces the provision of more permanent solutions to engineering failures, and adequate forward planning to implement these solutions. In particular, since coal contamination and formation failure appear to be at the root of many problems and maintenance expenditure, it is surprising that these root causes are not addressed head on, perhaps by deferring other upgrading work on other components not giving acute concern.

Large expenditures needed to address these root cause problems requires advanced forward planning and detailed investment plans where commitments can be made some years in advance. The current process is characterised by the untimely and yearly budget exigencies relating to the entire Infrastructure Services Group process where consideration is given to all manner of QR services.

3.2 Rail Replacement

The replacement and use of rail is determined by a number of factors in the QR system. Those that specifically apply in the coal network are:

- Structural strength when new and when worn
- Wear characteristics
- Internal integrity

3.2.1 Structural Strength

The Moura, Blackwater, Goonyella and Newlands systems have been subject to various rail improvement strategies. However during the early 1980's, as coal wagon axle loads increased and the wear imposed began to be apparent, the commonly accepted rail size for these types of applications, and the largest Australian produced rail size 53kg/m, was adopted.

This rail size is suitable for 25 tonne axle loads. Limits on the amount of allowable wear, speed and axle load were also established by the various rail systems. These limits were primarily dependent upon curve radius, wheel load and speed. Since that time, a new larger rail size 60kg/m, has become available which will permit higher axle loads at higher speeds and with new limits on tolerable wear.

In 1989, the now head of track design in QR produced a thesis for a Masters degree (Hagaman, 1989) which indicated that the limits for head wear at the time were conservative and new limits were proposed. Those limits were not adopted and the original limits remain. Those considerations extended to 22.5 tonne axle load at 60kmph.

A review of the allowable head wear limits in the light of changes in axle load and speed is currently underway within QR. However, the ongoing replacement of worn 53kg/m and 60kg/m rail occur using the old limits and the extra expense being incurred because of conservative limits is of concern.

Given the large amounts of expenditure involved in rail replacement, a rigorous assessment of the standards in the light of the particular axle load and usage is required for each line. Blanket policy applicable to each circumstance is not warranted given the varying operating conditions, or projected operating conditions on each section of track.

3.2.2 Wear Characteristics

Since the mid 1980's BHP in Australia has been able to produce rail with three different ultimate tensile strength characteristics for the 31&41kg/m, 50&60kg/m and 68kg/m sections. The carbon content of the rail is varied to increase ultimate tensile strength. As well by heat treating the head of the rail, the hardness characteristics of the head is improved. This treatment improves the wear resistance of the rail.

QR has for a number of years been using head hardened rail in tight curves on the coal system. As well, QR have been specifying the use of head hardened rail in the manufacture of their turnouts.

Ultimate tensile strength can also be improved by the addition of certain elements in the steel making process to produce alloy steels, although apart from the heavy haul iron ore railways in Western Australia little if any experience in Australian railways has been gained.

The advantages of enhanced tensile strength has been well known for some time (Esveld,1989), (Cope, 1993), with some estimates of rail wear being a reduction of up to 80%. Since the higher strength of the rail results in less wear, some observers have noted that unless the rail is ground to remove the highly work hardened surface, rolling contact fatigue becomes evident resulting in detrimental surface cracking.

QR has shown great expertise in rail grinding and has established a program using world class standards to ensure the rail surface and rail profile are maintained in optimal condition.

The advantages of head hardened rail extend into the tangent track in addition to the curves because head hardened rail retains its shape for longer periods and greater tonnages.

In the heavy haul railways in Western Australia, the Hunter Valley in NSW and in suburban stations in Sydney, standard practice is to use head hardened rail on all track, tangents included. The small cost premium in the initial investment provides benefits in eliminating corrugations and reducing grinding frequency, and on the heavily used tracks has proven to be economically worthwhile. QR could improve their total rail maintenance costs by adopting head hardened rail on tangents and flat curves.

3.2.3 Rail Internal Integrity

The rail sourced by most Australian railways is from BHP. Prior to the commissioning of the Whyalla rolling mill in the mid-1980's the rail was sourced from the Port Kembla steelworks.

The rail was manufactured using the open hearth method involving the casting of ingots. Ingot casting involves the solidification of the steel and the subsequent reheating of the ingot for rolling into shapes such as into the shape of the rail.

When the ingot is rolled the rail structure mirrors that of the ingot.

Rail has been found to contain a range of discontinuities. Following a disaster involving the Spirit of Progress train in NSW, most rail systems around Australia adopted rail testing designed to reveal the extent of any internal defect or crack. Common practice currently is to use ultrasonic detection methods where a specially fitted vehicle traverses the track and records the site and characteristics of the internal defects. These defects are subsequently removed from track or monitored until they become potentially dangerous.

In the Goonyella system, a particular defect known as a 'vertical split head' has been identified as a potentially dangerous defect and is detected on a regular basis. In 1998, on the North Coast Line, a derailment was caused by a rail break that had its origins in a 'vertical split head', since identified as a 'piped rail'. A 'piped rail' defect is a relatively rare event and involves the presence of a cavity in the centre of the rail.

Other rail defects known as 'transverse defects' have their origins in sites within the rail where stress concentrations cause a 'growth' of a defect by mechanisms of fatigue. Where the defect is left to grow it jeopardises the structural integrity of the rail ultimately leading to a rail break

All Australian railways are aware of these issues and take steps to manage the problem, including regular ultrasonic inspection and rerailing as the defect frequency becomes more severe.

The Whyalla steelworks has adopted the 'continuous casting' approach that results in steels not subject to the casting structures manufactured with ingot steels. All 60kg/m rail made in Australia is sourced from the Whyalla works.

3.3 Concrete Sleeper Replacement

During the early 1980's when concrete sleepers were being first used in Australia in large quantities and when proposed for the Goonyella line, the expected maximum axle load envisaged was approximately 22 tonne. For narrow gauge lines in Australia this axle load was amongst the highest. The wagons using the coal lines at that time had lower axle loads and the sleepers designed allowed for a small increase in load. Consequently concrete sleepers were designed and installed for a design load of 22.5 tonnes with a allowance for occasional overloads to 27 tonnes.

These sleepers are not now adequate for the contemporary coal wagon where the design load is 26 tonnes axle load. QR has estimated that the existing sleepers would need to be replaced within the next 20 years, although the fatigue and stress characteristics are not easily determinable. QR has concluded however that the sleepers are not sustainable into the long term.

In the context of track and sleeper investments made in the early 1980's, it appears QR did not comprehend the trend in heavy haul applications worldwide since other countries and Australia were migrating to heavy wagons at a rapid pace. For instance, the narrow gauge Richards Bay coal line in South Africa was constructed in the late 1970's to accommodate 26t axle loads even though it initially operated at 22 tonne axle load.

QR's latest high capacity coal wagon utilizes all the currently available engineering avenues for narrow gauge capacity and the 26 tonne axle load is believed to be the maximum achievable capacity for coal on narrow gauge. The current infrastructure design incorporates elements suitable for 30 tonne axle load including rail and bridge capacities. The '26 tonne axle load' concrete sleepers also have provision for occasional overloads to 30 tonnes. If wagon designs are improved in the future QR could find itself contemplating another round of sleeper replacement.

3.4 Bridge Strengthening

The current program of bridge strengthening is based on the analysis of bridge capacities and the original design, which was to accommodate 20 tonne axle loads.

The 20 tonne axle load capacity bridges (M160) have been strengthened to accommodate 30 tonne axle loads, a recently introduced standard (M270).

In the period between the original design and the new standard, a number of bridges were constructed at the M220 standard, which is suitable for the 26 tonne axle load wagons.

3.5 Signalling

3.5.1 Design and Historical Influence

Much of the current design and construction relate to the electrification of the Blackwater and Goonyella systems undertaken during 1986 and 1987. As well, the Moura line built in 1968 and the line to Collinsville with its long history combine to ensure the coalfields has a wide variety of signalling equipment of varying type and condition.

There are two main types of signalling system interlocking, relay based and computer based. A variety of manufactures have been used to supply progressive upgrades, and each supplier utilises their own proprietary systems. The suppliers of the signalling systems have been Westinghouse, Siemens, Harmon, Alstom, Union Switch & Signal and ABB.

As well, these interlocking systems are supported by a variety of train detection methods, including DC track circuits, 'frequency' circuits, 'pin point' detectors and axle counters, all of which have been supplied by multiple suppliers.

Finally, telemetry systems and control systems relay the data generated by the field installations to the train controllers in Rockhampton and Mackay, and these systems have also received likewise variety in their establishment and upgrade.

Signalling maintenance resources are also required to maintain operational support equipment such as 'Hot Box Detectors' and 'Dragging Equipment Detectors'. Whilst this task is comparatively small, there is an inconvenience and nuisance factor associated with attendances to failures in the equipment.

3.5.2 Works Initiated by Others

Much of the expense of providing 'maintenance' of signalling systems in the coalfields is being driven from the need to respond to track works and other operational needs, not the maintenance of the signalling per se. Any inefficient track maintenance policy is duplicated into signal maintenance because trackworks require signal maintenance support.

Some QR managers in the Rockhampton area have estimated that up to 50% of their operating expenditure in signalling maintenance is a direct result of the need to respond to track works needs. These needs range from the requirement that electrical track fixtures and other components require disconnecting and reconnecting when the track structure is replaced or maintained. Other needs relate to the addition of new equipment such as with swing nose frogs when a turnout is being upgraded.

The technology used to provide 'maintenance' in these cases invariably is chosen to be compatible with the existing technology, although new versions of the same technology are used wherever possible. The use of existing inventory may also influence installation decisions.

In the last 2 years and due for completion in 1999/2000 a great deal of work has been required by the signalling resources to accommodate the planned change of maximum train speed from 60kmph to 80kmph. This work has involved the re-positioning of signals, track circuits, and interlocking timings to ensure that the system is compatible with the changes to train braking.

3.5.3 New Line Construction

Opportunities do present themselves to introduce new or improved technologies when new lines or spurs are constructed. Recently the construction of the North Moranbah balloon loop provided an opportunity to introduce state of the art signal interlocking and electrical design.

In the past, line duplication has provided other opportunities. The combination of staggered construction times and variation in suppliers has created a very complicated system in which to perform a maintenance function and has resulted in a maintenance regime where:

- Inventories are high and continue to increase.
- Technology competencies expand requiring broader skill levels.
- Pressure on pay rates increases as the number of competencies required to perform a job increases.
- Multiskilling of employees such as signalling and telecommunications becomes more difficult.
- Reliability of the systems decreases due to complicated technology interface arrangements and variability in system design.

In a heavy haul environment, where reliability of service is paramount, the use of such a variety of components is problematical. Although each decision in the past may well have been on the basis of the best value for money at the time for that individual installation, there does not appear to have been the perspective of overall reliability and maintenance outcomes for the long term investment and infrastructure.

The Network Access Group of QR has just begun to quantify maintenance outcomes in their preliminary plans, and this perspective may well alter investment decision making in the future. For the time being, the signalling system maintenance task is bound to be hampered by this plethora of technology and be relatively inefficient.

3.6 Telecommunications

3.6.1 Background

The QR organisational arrangements result in three separate groups dealing with telecommunications issues.

The Telecommunications Group with the Deputy Chief Executive owns the Telecommunications Backbone, being any facility where multiple users have access.

The Network Access Group owns signalling and telecommunications assets that are not part of the Telecommunications Backbone.

The 'Trackside Systems' division within the ISG manages the maintenance of telecommunications facilities and equipment as well as mobile radio. This group has a number of Service Agreements with its customers and includes NAG, the Telecommunications Group, and above rail operators, as well as some external parties who utilise the QR asset. The allocation of costs of maintenance is problematical for Trackside Systems since the many assets are owned by different bodies and interface closely.

Like the signalling systems, the telecommunications systems have a long history of construction and progressive upgrade resulting in a large range in equipment, ages and condition.

The skill base required to keep the variety and age of equipment operational is becoming more difficult and competency arrangements have received a great deal of attention.

The efficacy of maintaining all those skills is questionable as the technology base continues to expand. QR must consider which business it is concerned with and make decisions about those parts that are not fundamental to its existence or else face an expanding requirement for little used skills.

3.6.2 Telecommunications Backbone

This system is currently managed as a separate business activity within QR as there have been opportunities available with the deregulation of telecommunications at the broader industry level.

The assets are the communication facilities where many different 'customers' use the facilities simultaneously. The assets comprise optical fibre routes, microwave (digital and analogue), copper cable, radio towers, and telephone exchanges and aerial wire.

Except for the short lengths of cable from local signalling installations, mobile radios and office equipment, all backbone telecommunications assets are managed by the Telecommunications Group of the Deputy Chief Executive.

3.6.3 Telemetry

Telemetry is used wherever information from a field system is required for use in another location. The information includes signal aspect, interlocking status, dragging equipment detector alarms, stream flood detection alarms, temperature measurement and system status.

The Backbone system is used as well as local devices dealing with the specific processing of the information.

3.6.4 Mobile Radio Communications

Radio communications has comparatively recently received a rationalisation and modernisation. Changes to available radio frequency bands have forced all railway administrations in Australia to upgrade from VHF systems to UHF.

A variety of customers use the facilities available for radio communications. They include train radio systems and maintenance resources mobile communications. Most of the radio traffic occurs as a response to train movements and Train Control is the focus of much of the communication using the TCR system. Mobile to mobile is also a necessary tool in maintenance activities where another system is used. Trunk radio incorporating dial-up facilities is also available.

The handpieces have been supplied from a number of sources, NEC and Nokia currently make up the bulk of the equipment.

The mobile radio network comprises transmitter tower facilities, backbone transmission, terminal facilities, and handheld equipment. All assets except the handheld equipment are managed by the Telecommunications Group while the individual businesses manage the remainder.

3.6.5 Maintenance Philosophy

In a routine sense there is little preventative maintenance that can be performed on telecommunications assets. Minor inspections and tuning of systems occupies a relatively small amount of maintainers' time. Mostly, maintainers adopt the 'fix on fail' approach to telecommunications maintenance, and since signalling systems are designed to be 'failsafe' the consequences of this approach to maintenance are not severe.

3.7 Overhead Power

3.7.1 Construction and History

The construction of the overhead infrastructure was undertaken during the period 1986 to 1987 by a number of contractors on the Goonyella and Blackwater systems. This work established the electric locomotive operation, involving heavier trains with higher train weights.

Citra was the contractor on the Goonyella system whilst EPT constructed the Blackwater system. There were very few design differences and the current maintainers believe the work was completed to a high quality. The systems incorporate a system where the contact wire is kept stretched under constant tension. As well the design of the steel masts used a light lattice configuration.

There has been very little change in the technology and practices used in the overhead line system since the lines were initially constructed. Minor product enhancements have been introduced as the opportunities have arisen and these have been related to improvements in reliability of individual components. A modern replacement would probably incorporate prestressed concrete mast design.

3.7.2 Product Improvements

The work plans available for the next few years indicate the autotransformers will require replacement or at least significant upgrade as their oil based cooling systems and electrical integrity are showing signs of failure. A small number of transformers have failed while other transformers show signs in their oil of impending problems.

Whilst most of the unscheduled routine maintenance is associated with track works, adjustment of alignment, isolations or new works, and derailments, the technology in place has given little problem and maintenance resources have not had to be specifically adjusted on account of design or technology issues.

A number of minor issues have arisen including the on-going effort to find better section insulators.

Control system technology has received upgrades over the life of the project and the system recently installed incorporates computer controlled remote operation from Rockhampton. Software improvements continue to be made to the systems but there are no major upgrades scheduled. Y2k compliance over the past year has taken a significant amount of work.

4 Train Operations

4.1 Introduction

Train operations affect the efficiency of infrastructure maintenance and the level of maintenance required in a number of ways. The arrangements negotiated between the infrastructure maintainer and the train operator are therefore important in the infrastructure maintenance programme of works and the way in which those works are undertaken.

The elements of train operation impacting the efficiency of infrastructure maintenance are:

- Access to the infrastructure
- Condition of the rollingstock
- Speed of trains

These will be dealt with separately below.

4.2 Access to the Infrastructure

4.2.1 Planning the Access

As a matter of course, the train operations sections (train control) in Rockhampton and Mackay plan their train schedules on a 3 month, 1 month and 1 week basis. Whilst a formal 'master' schedule is not recognised as such, the number of trainsets, the cycle time to the mines and return, and the number of crews available, constrain the operations to a well known pattern.

The Track District Engineer meets with train control on a 2 weekly basis to discuss previously identified track access and refinements to arrangements already planned. Train control is also able to alert the District Engineer about forthcoming mine closedowns or planned tonnages. Other infrastructure areas in QR have a similar process, although many of the works in which they are involved, result from works planned for the maintenance of the track.

4.2.2 Daily Arrangements

On a daily basis, local track gangs negotiate with train control to confirm previous arrangements or to make alternate arrangements if train operations have changed.

In general, the total number of trains run does not vary markedly from the plan. However, variations in mine destination occur regularly with trains diverted because of production problems or other mine related issues. This results in access to the infrastructure closer to the port being more predictable than toward the mines. This variation is not particularly serious because the train density closer to the mines is lower than in other sections of the track and work teams can often work around the changes.

On the Goonyella system, the author discussed the issue of access with train control at Mackay. It was indicated that provided ‘possessions’ were required on a single section basis, which is between adjacent crossovers on the double track, there was no problem in providing continuous access. Provided the track sections were not adjacent, it was indicated that up to three sections from the port to Coppabella could have work occurring simultaneously. This requirement was rare.

The TLM currently operating on that line occupies a section of track over a 24 hour period. This arrangement has occurred during the record tonnages of Autumn and Winter 1999.

4.2.3 Access Requirements

With the exception of the rail grinding activities and emergencies, access to the infrastructure is required by QR only during daylight hours. Access restrictions therefore have not forced QR to seek other access arrangements and the density of trains is therefore low enough to accommodate a comfortable level of access. However, whilst QR does not currently seek after-hours access, various recommendations in this report suggest that greater use be made of extended or double shifts to improve utilisation of high value equipment.

The North Coast line between Rockhampton and Gladstone is the most heavily used with approximately 19,000 trains per year on the double track section, including the tilt train. That is, approximately 50 trains per day or one train every half hour on average. Bi-directional signalling on this line and others greatly assists access.

4.2.4 Conclusion

Whilst access to the infrastructure is not freely available, the infrastructure maintainers are able to plan their work with the knowledge that with appropriate planning, the infrastructure will be available. The author found no instances where the infrastructure maintainers were prevented from access over lengthy periods, which resulted in planned works not being able to be performed. This situation contrasts with the arrangements in the Hunter Valley where train densities are greater and access to the infrastructure severely restricts track maintenance activities.

As the current regime for access to the infrastructure is invariably on a daytime basis only, except for rail grinding activities, the actual time available for infrastructure maintenance is greatly in excess of the requirement. The utilisation of major equipment is therefore poor and costly. Opportunities for improving maintenance capital utilisation, such as in tamping machines, therefore present themselves.

Access to the infrastructure therefore plays no part in restricting maintenance efficiency and potentially plays a significant part in improving equipment utilisation by using out-of-hours periods with higher capacity machines.

4.3 Condition of the Rollingstock

The cost of infrastructure maintenance can be heavily influenced by the condition of rollingstock. The infrastructure has been designed for certain forces and the rollingstock can exert forces well above those design parameters if they are not well maintained or if they contain design flaws.

The areas of rollingstock design and maintenance that can affect forces applied to the infrastructure and therefore the maintenance required include:

- Wheel Transverse Profile

QR has undertaken extensive research to optimise wheel and rail profiles and the work has been widely recognised as being close to or at 'best practice'.

- Wheel Out-of-Round

Flat spots on the wheel occur when braking causes the wheel to skid and a flat section is worn into the wheel. These wheel flats cause high dynamic loading that can cause damage to concrete sleepers and impose high forces on ballast and sub-grade. Out-of-round wheels can be developed when the wheels are machined for maintenance. Rollingstock inspection and maintenance practices include procedures to eliminate these problems at the time of inspection. This can however be many days after the damage has been propagated.

QR is in the process of installing wheel impact detectors on the coal network in order to limit damage caused by defective wheels. As yet, QR have not been able to identify any particular incident that caused massive damage from out of round or skidded wheels, however gradual deterioration to the infrastructure is known to occur due to these causes.

- Dragging Equipment

Where brake equipment or a derailed wheel drags along the track, it is now prudent for high density operations to install detectors on the track for these incidents. QR has an extensive network of dragging equipment detectors (DEDs) on their coal network for this purpose. Rollingstock inspection and maintenance practices include procedures to eliminate these problems.

- Faulty Wheel Bearings

A major cause for concern in QR's coal network is the frequency of the failure of wheel bearings, their subsequent collapse and the resulting damage inflicted on the track. In the past 5 years there have been axle/bearing related derailments on the coal systems as follows: Blackwater-14, Goonyella-25, Moura-2, Newlands-3.

These derailments have caused long lengths of track to be damaged, overhead masts pushed over and signalling equipment damage costing millions of dollars. Some of the track currently being relayed on the Goonyella system is that damaged by these derailments. Damage can occur requiring immediate track replacement in some cases, and in others, the asset life has been reduced requiring early replacement. On top of the early replacement cost, the section of track involved can require increased maintenance whilst those components remain in track.

Cracked sleepers and deformed rail lead to other track maintenance problems as well. Dragging equipment detectors have been instrumental in limiting the extent of damage once the wheel has derailed Hot box detectors have been instrumental in detecting a failed bearing before it has caused a wheel to derail. As well, wagon bearings are regularly inspected and changed out if necessary. A program to improve bearing performance by replacing bearings with higher capacity units was completed recently. Failure of wheel bearings has been a significant issue affecting the efficiency of infrastructure maintenance.

- Pantograph Faults

Electric locomotive pantographs are constructed with a graphite insert section and contacts with the overhead contact wire. The maintenance of the graphite insert is important to ensure the pantograph does not exert undue forces on the contact wire. Where the graphite insert breaks the pantograph is instrumental in damaging the contact wire and in some cases pulling the wire and breaking its anchors.

Recent technology in Europe has seen the introduction of a detection mechanism on the pantograph so that where the graphite insert is broken, the pantograph automatically collapses preventing any damage to the contact wire. QR is actively exploring the technology, however false pantograph collapses occur and disrupt services. The relatively rare event of a legitimate failure does not yet justify the installation of the device because of the high number of false failures.

This type of incident has not been prevalent in QR and does not represent a significant problem to infrastructure maintenance efficiency.

- Sparks from Locomotives and Wagons

A significant amount of local gang time is required for the annual burning of fire breaks along the length of the railway. The burn-off is thought to be required for a number of purposes including the prevention of a fire resulting from the sparks emanating from diesel locomotives and heavily braked wagons where sparks fly into the undergrowth.

Most supervisors are aware of a recent payout by QR for alleged damage incurred on a pastoralist's property. For most track gangs, approximately 100 man weeks is devoted to this activity every year. As well, a grader is required to grade a firebreak along the boundary fence. This also serves the purpose of maintaining an access track.

The actual extent of fire caused by railway operations has not been factually established and the current practice of burning-off is, in part, a traditional activity from the times when dirty exhausted locomotives and poor braking controls resulted in common fire occurrences. A review of the need to carry out burning off in certain areas could be worthwhile in establishing a more targeted approach to this issue. For instance, in Western Australia the planting of low scrub has kept the grass load down and improved fire management because hotter fires are needed before fire spreads.

- Locomotive Wheel Slip

On the Newlands and Moura lines, both diesel hauled operations, a significant amount of damage is caused by locomotives wheel slip on steep grades. The locomotive wheels spin and wear/melt the top surface of the rail. This in turn creates an impact point, which subsequently causes deterioration in track geometry and sleeper life.

Locomotives are fitted with sand storage and the sand is pumped onto the rail immediately in front of the wheel to improve adhesion and prevent wheel slip. As well, the locomotives are fitted with a wheel slip reduction facility, which however is only effective in preventing large-scale wheel slip.

Newer locomotives, particularly those fitted with AC traction, have more sophisticated wheel slip detection mechanisms.

4.4 Speed of Trains

4.4.1 Impact Loading

Various methods exist to compute the extra impact brought about by speed. Work by the American Railway Engineering Association (AREA) and the European Union Internationale des Chemins de Fer (UIC) organisations, as well as individual researchers, indicate that there is a linear or square relationship of impact to speed. Therefore any increase in speed creates large increases in impact, which result in increased maintenance effort.

The Code of Practice for Railways: Rollingstock (Draft October 1999) identifies discrete discontinuities such as at dipped welds as being the cause of high frequency impact forces that increase non-linearly with speed. The overhead system similarly suffers from discontinuities in its surface such as at section insulators.

There is no doubt that increases in speed will result in higher loading to the track and the overhead systems. As well, high frequency impacts will increase with speed at discrete discontinuities.

Overall, increasing train speed will result in faster degradation of infrastructure components and increased maintenance cost on a time basis and on a per tonne basis. Any proposition to increase train speeds should be accommodated with a proper evaluation of the benefits obtainable in other quarters such as rollingstock utilisation, and approached with utmost caution having regard to infrastructure costs and maintenance.

The Coal & Minerals Group engaged a railroad consultant from the USA to review the best way of catering for the rapidly increasing coal tonnages. QR correspondence received by the QCA in October 1999 quoted as follows:

'His analysis of rollingstock numbers required improved reliability of locomotives and wagons, reduced operational delays in train running, as well as increased maximum coal train speeds and bigger wagons. ….. A cost benefit analysis was done in order to justify the investments required and some additional track maintenance costs were part of that analysis.' (QR Correspondence 29th October 1999).

These operational changes suggested have had a large bearing on recent capital programs and will continue to be the source of intensified maintenance activities. The increase in track forces creates track degradation requiring increased maintenance attention and provides the environment for increased opportunity for other related detrimental effects such as coal contamination.

4.4.2 Coal Contamination

Coal contamination has been identified as occurring from four primary sources. They are:

- Dislodgment of coal captured during unloading operations, mainly when the wagon bogie ploughs through the coal not taken away by the unloading bin.
- Dislodgment of coal on the top of the wagon caused by overloading of the wagon above its sustainable retention profile.
- Leakage of coal from doors during transit.
- Wind blown coal from the top of the wagon during transit.

The dislodgment of coal is particularly noticeable around track discontinuities such as turnouts and sharp curves where the track geometry creates large vehicle movement.

The leakage of coal from the doors of the wagons has been largely overcome in recent times with application of improved door mechanisms.

Particularly for the finer coals, the wind blown coal from the top of the wagon is a noticeable problem.

The coal contamination is so severe on the Goonyella system that there appeared to be no effective loading protocols and the use of surfactants to keep wind blown coal at bay was absent.

Site inspection concluded that the condition of the ballast was very poor and had occurred through coal contamination, formation failure contamination and its degradation in shape. The future ballast undercutting program proposed in QR's 10 year plan, where an equivalent length of more than the total length of the system would be treated in that period, also attests to the ballast's poor condition.

4.5 Loading and Unloading

As well as having a large influence on the rail system capacity and operational efficiency, the way in which trains are loaded and unload can have a bearing on track maintenance efficiency in the following ways.

- Overloading can lead to excessive axle loads and spillage en-route. This is highly evident on the Goonyella system and leads to excessive track re-surfacing, ballast replacement and formation drainage damage.
- During unloading, if the coal is not being extracted from the unloading bins at the same or higher rate than is being discharged from the train, coal can build up under the wagon and be 'ploughed' by the wagon equipment. The coal is captured by the wagon and falls off during transit. This occurs almost without exception. As well, in severe cases, the wagon derails due to the build up of coal.

  In all unloading with transverse bottom dump narrow gauge wagons, coal is deposited on the rail head and adheres to the wheels. During transit the coal is compacted and causes impacts on the rail, damaging both the wheel and the rail. Only 'bomb bay' doors can alleviate this situation on narrow gauge.

QR's response (Attachment B) to these observations during the course of this study was as follows:

'The Coal Division are in the process of installing Coal Loader Profilers and Overload Removal Systems at those mine loadouts which have clamshell coal loaders (giving poor control of coal flow into wagons) to assist in reducing the extent of this problem.' (QR correspondence 29th October 1999).

This correspondence also identifies the introduction of Kwik-Drop doors for automation of coal loading as reducing the extent of unplanned door openings along the track and coal 'ploughing' at the unloading pits. It is unclear how the ploughing effect can be reduced by the Kwik-Drop doors, given that the effect is caused by unloading occurring at a more rapid rate than the conveyors are able to take away. Train speed during unloading determines the Kwik-Drop door unloading rate.

5 Current Work Programme Assessment

5.1 General Observations

5.1.1 Budget Structure and the 10 Year Plan

The Network Access generated 10 year maintenance plan, the subject of this review, is a plan detailing work activities and their expenditures. The plan has tended to concentrate on major project work and although called a 'maintenance plan' also contains items that may be classified as 'capital expenditure' for accounting purposes. This plan sits alongside the Network Development Plan, which is a plan concerned with projects that will further develop the network for improvements in functionality, such as expansions or quality improvement of below rail services. The Network Development Plan is often referred to as the 'capital plan'. However the Maintenance Plan and the Network Development Plan both include activities that may for accounting purposes be classified as capital expenditure or recurrent expenditure.

On the other hand, the ISG budget process is a responsibility based budget, allocating budgets to the various 'levels' of management for accountability purposes.

Therefore the activity expenditures generated by Network Access are not directly measurable from the chart of accounts. Instead a work order process is used to account for large jobs. This process has only recently been implemented and at the time of this review could not be relied upon for accurate information.

As well, ISG have developed a unit rate for major activities which when applied to the activity quantities in the Network Access 10 year plan should, in theory, match the expenditures estimated and at the end of the year reconcile with the actual expenditures incurred by ISG. This process similarly at the time of this review was still being refined and its accuracy could not be relied upon.

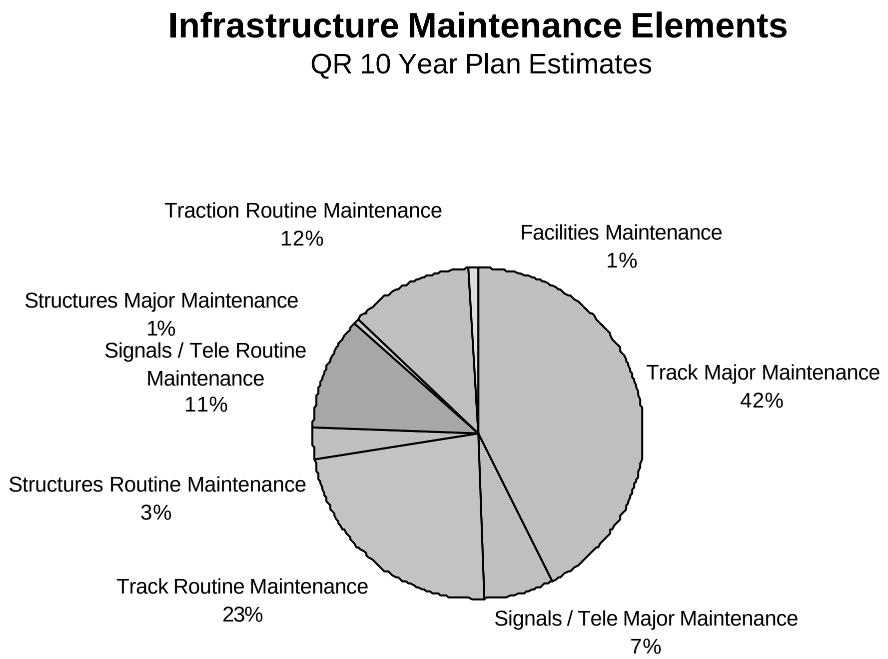
Hence the comparison between actual contractor unit rates and QR's own internal rates has been problematical given that QR's unit rates do not include an average ISG 'management fee' of 16.7% on direct costs. Contractors' rates are all inclusive.

Therefore, for comparison purposes, this review has adopted a strategy where for major maintenance[2] activities involving a high percentage of machinery costs, the costs direct identified by QR plus the management fee[3] have been compared with the contractors' costs. For the other costs, mainly routine maintenance, a blanket assumption has been made incorporating 15% management fee for track related costs and 25% for trackside systems costs. The higher management fee for trackside systems recognises the increased design and commissioning costs associated with those activities.

[2] The term 'major maintenance' refers to QR's construct in their 10-year maintenance plan. Some of those activities are dominated by manual work methods and for the purposes of efficiency comparisons and the application of efficiency improvements have been amalgamated with routine maintenance.
[3] Network Access also adds a management fee associated with the management of the ISG contract but this has been separately accounted for in other parts of the consideration of reference tariffs.

Figure 5.1 indicates the elements of the 10 year maintenance plan into major categories and their QR estimated expenditure weighting. Track Major Maintenance and Routine Maintenance dominate expenditure. In addition, given that much of the signals and traction power expenditure is driven by track maintenance work, the importance of track maintenance is paramount.

Figure 5.1 Elements of Infrastructure Maintenance



5.1.2 Budget Timing

In late June 1999, the Districts had not yet received notification of their budgets for the 1999/2000 year. There was little concern expressed about this fact as a 'rough idea' of the main elements of the budget were either known or assumed.

Most decisions therefore about work requirements were made on the basis of the most likely outcome. Essentially, this consisted of a slight downgrading of the budget submission placed earlier in the year. The district strategy on budgeting was a familiar and well-worn path. That is, to submit a budget which was likely to be the best imaginable outcome in the hope that the final allocation continued to make life comfortable but not extravagant.

Some decisions taken during the later half of 1998/99 in relation to turnout maintenance did reflect an anticipated outcome of the 1999/2000 budget. Those being related to a yearly and continued request for turnout upgrading of some mainline turnouts which needed some attention soon. That decision resulted in turnout timber being installed. However, the budget outcome for 1999/2000 could have been the allocation of monies to enable the turnout upgrade, in which case the temporary maintenance would have been redundant.

For 'Operational Systems' the activities in the budget relate in part to major or minor projects undertaken to increase the strength of the track structure. Some of these projects have not been capitalised and have been expensed forcing the signalling expenditure to increase. Expenditure budgets have often been estimated on the basis of providing an 'allowance' for these types of works, although at budget time each project has not been fully scoped. The methods are ones that mirror the cash accounting approach where distorted decision making results in under-estimation of asset worth and expenditure profiles are based on funding sources rather than need.

An inspection of an indicative 'Operational Systems' draft budget for the 1999/2000 budget year in July 1999 revealed allowances for every project on the track works 'plan'. A review concluded that the 'plan' was not practically achievable even if monies were available for all the works. The resources allocation plan could not sustain the works plan.

These preliminary budgets were under review at the time at a number of levels in the process and will culminate in the eventual agreement by Network Access. This 'bottom up' budgeting process is consistent with good budgeting formulation and promotes ownership at all levels. Unfortunately though, this process was just underway in July 1999, already into the budget year.

The uncertainty about yearly maintenance scopes based on the availability of monies is inappropriate in the context of the operation of a heavy haul railway. In order to optimise expenditure the maintenance planners and priority decision makers need certainty about the viability of their programmes before the programs begin.

Sub-optimal decisions will be made where field staff is unsure about the availability of materials for works. Costly 'temporary' arrangements, for example on turnouts, will be used to maintain the asset integrity if funding for the permanent works is not known. As well, commitment and ownership to expenditure budgets is unlikely where staff is not provided with advanced knowledge of their responsibilities.

5.1.3 Track Laying Machine Program Timing and Planning

The Track Laying Machine (TLM) is currently working in the Goonyella system replacing ballast, sleepers and rail. The justification for the work program was formulated in September 1998, for work to begin in March 1999. Final approval for the task was given in the later half of 1998. Some $20.7m had already been approved as part of the Coal Fleet Upgrade Project.

Although the TLM can work independently, the track possessions negotiated for this type of work assists other District resources to undertake other works. The project scope for the TLM includes specific work to be undertaken by District resources. As well, some District resources are undertaking complimentary ballast undercutting and other rehabilitative work.

It is difficult to imagine how a District can manage its resources given the unknowns of large upgrading works, their timing and their scope. No doubt, the District knew of the desire to upgrade and the conceptual programming occurred some time in advance.

However, many decisions would be required in advance of the work, some years in advance in order to decide whether to maintain or to wait for the upgrade. These decisions could only now be seen in the light of being sub-optimal, because the exact timing of the upgrade could not have been known at the time. Some decisions to maintain would now have proved wasteful and other decisions to wait would have resulted in an unnecessary degradation of the assets.

5.1.4 Goonyella Relay Project 1999

The first element, and the one that is identified as the primary reason for the relay, is that of rail replacement.

The replacement of rail on the Goonyella system is substantiated by the assertion that the rail will need to be replaced in 3 to 5 years. A major determining factor in the decision to rerail was the incidence of VSH (vertical split head) type defects in the rail. As well, there is some concern that the 53kg/m rail is structurally inadequate for 26 tonne axle loads. Replacement of rail for these reasons questions the current life expectation of the asset which for the purposes of deducing a reference tariff is estimated at 50 years.

The project submission indicates that a derailment on the main North Coast Line was caused by a VSH defect and this incident has raised the risk associated with the Goonyella coal operations. In fact, the defect was a 'piped rail'. It is common within QR to label any defect internal to the head of the rail and longitudinal in character as VSH.

A 'piped rail' defect is a large defect associated with a cavity in the interior of the rail. Its size is much greater than defects caused by smaller discontinuities. Therefore, 'piped rail' defects are quite detrimental because there is a real possibility that they could fail catastrophically over a short period.

This behaviour contrasts with defects caused through the smaller discontinuities, which are known to be slow in growing and therefore more manageable in their consequences. The defects detected on the coal system have been typically small in nature, where clusters of them have resulted in a measurable discontinuity.

QR has recently commissioned a report into the smaller VSH defects in order to determine how they might be managed within QR procedures. A preliminary conclusion from the study is that these types of defects are unlikely to fail catastrophically and that the time frames necessary for defect removal can be managed so that priorities and other timely measures can be taken. These conclusions are not new in the Australian rail context.

The record of derailments on the Goonyella system indicates none caused by VSH in the past 5 years. In fact, the greatest incidence of VSH has now passed following a breakthrough in the technology of detection some 2 years ago. It is highly likely that the defect incidence has now stabilized and is now dropping after many of the rails that were subject to these discontinuities have been removed.

The derailment prone threat is unquantified and a risk analysis has not been performed to indicate the relative merits of wholesale rerailing. In fact, the incidence of a VSH has a very small chance of causing a derailment, probably less than that of a man made defect in a defective weld. Regular monitoring and visual inspection would provide adequate management of the problem.

Although the problems caused by the cumulative tonnage on the 53kg/m rail flags the need for a rigorous management of the rail asset towards the end of its useful life, the wholesale replacement of the rail is unwarranted at this time.

The VSH problem has facilitated the replacement of rail planned for the North Coast Line upgrade through the process of ‘cascading’ the rail to lesser onerous tasks. It is estimated that the rail is being prematurely replaced by approximately 5 years, which on most of the track being rerailed represents approximately 300 million gross tonnes of traffic.

Another element of the relay program occurring on the Goonyella system is the replacement of 22.5 tonne axle load sleepers with 28 tonne axle load sleepers. This decision is based on the need to ensure the sleepers are structurally adequate for the progressive implementation of 26 tonne axle load wagons, the increasing tonnages and an increased speed of train operation from 60 kmph to 80 kmph.

The 22.5 tonne concrete sleepers were placed in track in 1983 when the duplication of the system was carried out. At that time the sleepers could accommodate the low capacity 80 tonne gross wagons. The sleepers will support limited 27.5 tonne overload.

The replacement will ensure that the sleepers don’t fail in fatigue. According to the project justification, the sleepers will need to be replaced during the next 20 years although the actual fatigue life has been difficult to quantify. For the purposes of the justification however, the benefit due to resleepering had been ignored.

The complete financial case for the project currently underway on the Goonyella system was not available during this review. The sleepers recovered will be used on the North Coast Line upgrade due to begin in early 2000.

Whilst replacement of the sleepers appears to be inevitable in the face of the increase in axle loading, and the replacement program will necessarily extend over a number of years, the current timing is premature. A targeted program, addressing high loading areas firstly, such as curves, in the face of an estimated 20 year remaining life, should be considered as an alternative to current en-mass replacement.

The third major element of the relay project is the replacement of contaminated ballast. The Track Laying Machine is able to plough the ballast aside and the Ballast Cleaning Machine (BCM) subsequently excavates it and places it to the side of the track. New ballast is then laid.

Whilst the BCM is capable of cleaning ballast by sieving and extracting appropriately sized material for reuse, this option is not being used for this project. QR's experience is that the coal and mud contamination cannot be adequately cleaned from the ballast. Also, cleaning of ballast for re-use slows the productivity of the machine as it must travel at a slower speed while working.

Another reason stated for the combined ballast, rail, and sleeper replacement approach is that the fastenings on the old concrete sleepers do not lend themselves to easy rail replacement. These old fastenings require the ballast to be removed from beneath rail prior to unclipping, whereas the alternative chosen is above the rail. In the light of projected 'frequent' (5 to 20 years) rail replacement, it is reasoned that it would be more productive to work with an above rail fastening.

In summary, the Goonyella relay currently underway is poorly targeted, extravagant in some areas and under-resourced in other areas. Essentially the program should have consisted of a greater emphasis on sub-grade repair, targeted rail replacement and targeted sleeper replacement instead of the 'catch-all' approach to replacing everything in order to bring the entire system to the same standard.

Since the TLM is committed to the North Coast Line upgrade for the next 3 years, various timing scenarios for asset replacement works on the coal systems would not be available. These circumstances along with the objectives of engineering standardisation appear to be the primary drivers in the timing of the works, not the engineering condition of the components. The inability to outsource some or all of the works limits the flexibility required when specific timing and scope targeting is planned.

5.1.5 Maintenance and Capital Programs

In late June 1999, the author requested QR's latest asset management plans (AMP), so typical of contemporary asset management techniques.

Two plans were provided, both preliminary drafts, containing background information and general directions. A plan called the Network Development Plan addressed major developments and upgrades, which were seen as being essential for the continued growth and health of the network. At the time this plan contained little expenditure detail and could only be called a conceptual ‘capital’ plan. Since that time a more detailed plan has been developed along with more detailed maintenance plans and internal contracts between ISG and NAG. The three documents, two plans and a contract now make up the extent of forward planning and asset management on the systems. There is no ‘asset management plan’ as such.

A Maintenance Plan was also made available. Again, this plan was a preliminary draft with background, some project timing and few expenditure details. The plan included maintenance standard targets for each line system that represented one of the best quantifications of maintenance standards available in Australia. The emphasis however in the plan was projects of a capital nature. That is, projects which extended the life of the asset or improved its functionality. The plan had no details of the resources required to maintain the asset on a day to day basis with routine or preventative maintenance. Whilst the maintenance plan has been redrafted a number of times the detail remains in the internal contract arrangements between ISG and NAG.

5.1.6 Conclusion

Cultures and strategy applicable to a much larger organisation distort the coal infrastructure strategy and culture. A heavy haul operation requires robust forward planning in order to avoid costly sub-optimal maintenance decisions and this is not evident in QR heavy haul. Specifically, the budget process for the heavy haul should consist of firm rolling expenditure commitments over a 5 year planning horizon. Optimal strategies with respect to replacement, maintain or upgrade can then be planned with confidence and day to day maintenance would not be dependent on the final outcome of last minute budget decisions.

Whilst many maintenance practices display heavy haul characters, such as heavy rail, concrete sleepers and inspection regimes, the operation of the infrastructure maintenance in the coal network suffers from being part of the much larger network where different objectives drive the process of budgeting and planning decisions.

The uncertainty about identity is summarised with the following question “Is the coal network heavy haul operation demanding high levels of predictability and robust forward planning, or is it part of a generalised maintenance regime relying on yearly Government budgets, unpredictability and making do on unprofitable lines?”

5.2 Routine and Preventative Track Maintenance

Resources based in the local area and programmed and controlled from that local centre perform maintenance of a minor nature. The resources are grouped into gangs of approximately 10 to 15 staff under the direction of a TSS (track section supervisor).

The structure and capabilities of these resources has evolved from a period when track gangs had access to very limited mechanical resources. In those days, gangs travelled by rail and were therefore greatly restricted in their coverage.

A 14-staff track gang will typically manage 100 kilometres of track. The gang resources are varied to suit particular track configuration, condition, or special circumstances.

In the main, resources in the central Queensland coal systems area perform work associated with the coal task although the recent introduction of the Tilt Train has forced some new focus on the North Coast Line. As well, the Moura and Blackwater systems operate other than coal traffic on some lines. It has been necessary where applicable to allocate resources to the coal network in order to examine comparative statistics.

Typical work for the local track gang includes:

Track geometry correction
Fencing repairs
Burning off fire breaks
Track component repair and changeout (remove and replace)
Assist large production gangs
Safeworking assistance for third parties near railway lines
Minor construction
Turnout installation
Removing dead animals
Responding to signalling failures when track caused
Minor resleepering

The pattern of work in the coal systems over the past 5 years has been orientated to upgrading tasks and the work of the local track gangs has been punctuated by large commitments to assist in these works. As yet the Blackwater gangs have not adjusted in size or work emphasis despite the upgrades that have occurred.

5.3 Major Track Program Maintenance by District Resources

The 'major program maintenance' label (MPM) has not been adopted in QR and its use here simply mirrors common nomenclature in most other rail systems in Australia for comparative purposes.

District 'production' resources are responsible for activities of a mechanised nature and those that require large track possessions. The District resources are not directly involved with the large relaying or upgrading programmes although they often make use of the opportunity to perform complimentary work with those head office resources.

The District 'Production' resources that most often perform the type of work classified here as MPM are those resources performing all other work except for 'local gang' or 'relay' types. The structure of these resources is that a 'Roadmaster' and 'Bridgemaster' are the team leaders and they supervise a resource available to the entire District.

In the case of the Moura and Blackwater systems, the Rockhampton District covers that area. In the case of the Goonyella system, the Mackay District covers that area although more specific resources are allocated to that 'closed' system. In the case of the Newlands system, resources from Mackay are made available.

Typical work for the Roadmaster and Bridgemaster resources includes:

Culvert repair and extensions
Bridge repair and strengthening
Bridge walkway installation
Thermit (rail) welding associated with rail defect removal
Thermit welding for new construction
Rail surface repair
Earthworks maintenance, drain cleaning
Graded firebreak construction
Ultrasonic testing of welds and other isolated anomalies
Weed spraying
Bridge examination
Tractor slashing
Track resurfacing
Turnout replacement
Lubricator (curve lubricant applicator) maintenance and filling

For the Rockhampton District one might ask the question 'what else is there to do on a system that has recently received attention from the TLM where substantial upgrading was undertaken'?

The answer lies in a number of cultural issues. The upgrades were never designed to be all-encompassing but focused on particular problem areas. It is apparent they were never intended to eliminate jobs in order to operate most efficiently. As well, the only resource available at the time, being the TLM, was required on other parts of the network subsequently.

Thus the upgrade work was never completed for the entire District and has resulted in resources still being required. Minor branch lines and other major lines such as the Laleham branch still require substantial work.

The decision not to upgrade these Branch lines was made on the basis of the costs being 'disproportionate to the benefits…compared to the investment on the main trunk route' (QR Correspondence 29th October 1999, Attachment B). Also, there was a perceived commercial risk of unexpected market changes coupled with the fact that some of the Branch line length is privately owned.

This argument is weakened by decisions to upgrade Branches to the north of Blackwater and the Moura line, and that unlike many timber sleepers, concrete sleepers are largely recoverable for use elsewhere if the need arose. During the course of 1999/2000 QR have refined their capital programs and included the concrete resleepering of the Laleham and Kinrola Branches.

The failure to consolidate on capital improvement at the time of the other work will have proven to be an expensive strategy as the Laleham branch was timber resleepered in 1999 and the concrete resleepering is planned for 2002/03.. It was 'convenient' to have resources on tap for derailments and other events, but in the meantime, their productivity dropped performing unnecessary work.

This strategy of consolidating on upgrading work to achieve economies in maintenance contrasts with strategies involving like for like components, such as on the Goonyella system where one can be more targeted with replacement works. This is because maintenance activities are not as dependent on the differential of track structure, a concrete sleepered track being similar whether the sleepers are of 22.5 tonne design or of 27 tonne design.

This fundamental philosophy is crucial in the assessment of whether QR is performing efficient track maintenance. In order to make accurate comparisons with other railways it is necessary to understand longer-term plans for resource strengths and work programs. The longer term plans became available during 2000 and were progressively refined for inspection by QCA up until April 2000.

The work programs for both District based 'production' teams and head office controlled resources appear to be largely influenced by the resources available at the particular time. This strategy inevitably leads to decisions that are sub-optimal on timing and where assets are either maintained above their optimal level or they are left to degrade.

The timing of the North Coast Line upgrade from Rockhampton to Townsville is a case in point. This timing is determining the work scope for the current TLM program in the Goonyella system. As of 6th July 1999, the work scope for the TLM's involvement on the Goonyella system was still under review. Either the work needs to be done or it doesn't.

5.4 Resurfacing (Tamping)

5.4.1 Background

The workload for District resources in resurfacing is determined by a variety of work scopes occurring in any one year. At various times the resurfacing resources have supplemented major upgrade works, but in the main the resources are programmed to attend to maintenance tamping following TSS inspections and Track Recording Car measurements.

The major source of workload since concrete sleepers were installed has been the removal of track geometry defects associated with ballast being fouled by coal and formation instability, both combining in certain areas to create vertically unstable track.

The District controls the resurfacing resources except that the Projects and Plant Division of ISG procure the machinery and supply engineering services to support the field resources.

The composition of the machines and resources and their method of operation used in the coalfields is therefore a mixture of the pragmatism of the District management and of engineering judgement from Head Office.

5.4.2 Work Programme

The work program in any single year is determined reactively with 'notional' understandings in the District that certain locations will be targeted because of a history of poor track or other special circumstance.

For the financial year 1998/99, 1,117 kilometres of track was tamped by the three main gangs working in the coal systems. They were gang nos. 20 (Blackwater), 23 Sarina, and 8 Gladstone. These gangs also perform work on non-coal parts of the network, but allocate most of their time to coal. Other resurfacing gangs work from time to time in the coal systems but also attend to the North Coast Line. Some locations were tamped on a number of occasions during the year.

The total number of kilometres of track in the coal systems, excluding loops, is approximately 1800 kilometres. Notwithstanding the influence of capital works occurring on both the Blackwater and Goonyella systems over the past year, the resurfacing performance represents an average resurfacing frequency of approximately 1.5 years. Some areas of track are resurfaced more frequently and others less.

The track geometry for the coal systems indicates a steadily improving trend since the end of 1997, which is at a quality better than the expected best quality. Since track geometry on heavy haul lines can deteriorate quickly due to the reinforcing effect of dynamic loading, particularly in susceptible formation areas, there is a need to ensure a good quality of track geometry. However, compared to tamping frequency cycles on other heavy haul lines in Australia the frequency is excessive and a 2 year cycle is a more appropriate benchmark.

Tamping cycles on the BHP Iron Ore railway, Hamersley Iron railway, Robe River railway and Hunter Valley coal railways, all with comparable tonnages at much higher axle loads, exhibit a resurfacing frequency of 2 to 3 years. Targeted capital works on formation problems and a reduction in coal contamination would be methods to obviate the need for such a short tamping cycle.

One of the more significant changes to the resurfacing work program in the last year has been the need to resurface the Rockhampton to Gladstone North Coast Line section, where Blackwater system coal trains operate, for the operation of the Tilt Train. This activity is particularly inefficient because the machines are required to undertake the work at short notice and the tamping is localised to very short areas. Travelling of the machines to these selective areas produce long periods of unproductive work. This activity impacts the efficiency of the use of the resurfacing resources on the coal lines.

5.5 Goonyella Track Laying Machine Program

The track laying machine (TLM) is a large specialised piece of machinery designed to lay new track and to relay existing track with new components. It often is accompanied by a ballast cleaner, although the machines perform very different functions.

The TLM is operated and supported by a team of approximately one hundred staff, tamping machines, ballast regulators, earthworks equipment, trucks and sundry medium sized support equipment. There is only one TLM in the state and its movements are controlled centrally from the QR Brisbane head office. Other machines that perform similar but inferior functions are available on a state-wide basis, controlled from head office.

During 1999 the TLM was working on the Goonyella system replacing ballast, sleepers and rail. The program, which includes work undertaken by District resources as well as the TLM consist, extends over 138km track. 100 km of rail is being replaced, 123 km of concrete sleepers are being replaced and 50,000 cubic metres of ballast is being renewed.

During the execution of the works it became apparent that there were some sleepers with 28 tonne axle load capacity that were originally thought to be of 22 tonne axle load capacity. As well, some areas thought to be 53 kg/m rail were surveyed more accurately and found to be 60 kg/m. Thus there appeared to be an opportunity to reduce the scope of the works of the project.

However, the scope was subsequently increased so that the quantum of money approved was used to carry out these extra works. These consisted of formation repair and lime injection treatment.The author believes that, rather than wholesale replacement of rail and sleepers as per the original scope, a more selective treatment of failed formation areas and methods to reduce coal contamination would be a better allocation of resources. That is, treating the root cause of many of the problems as well as treating the symptoms. In any case, a more exhaustive analysis of options could have revealed other strategies.

The project justification outlines a number of issues and benefits of the program as follows.

5.5.1 'UP' Track Focus

The project justification focuses on the 'UP' track of the dual mainline as it is claimed most loaded trains use this track. This track is the right hand track in a traditional left hand running sense. This situation has arisen because the track configuration at the port is such that if a loaded train operated on the left hand side from the mine, then it would need to negotiate a cross-over near the port. It is therefore convenient in most cases to operate on the 'wrong' side for 100 kms prior to this cross-over. The signalling system is designed to accommodate bi-directional running and the practice is well established.

On interviewing train controllers, some suggested that they ran trains on both tracks in order to distribute the wear. Others suggested 'UP' track running was their preferred course.

The 'UP' track is the most recent construction, being the new track when duplication was performed in 1983.

Asset lives could be prolonged if the usage on both tracks was equal, enabling long term asset planning. Simple procedural solutions could ensure equal use. In order to ensure equal traffic, a re-configuration of the tracks near the port may assist, but this would be a last resort after other simpler procedural matters. A concentration of maintenance resources on the cross-over section would be money well spent if it could delay wholesale asset replacement by even a short period of time.

5.5.2 Rail Replacement

The project justification indicates that rail replacement would be necessary in 3 to 5 years if it were not performed now. Increased axle load, train speed and tonnage are thought to exacerbate the rail characteristics.

The project justification in totality and the replacement of the rail in particular relies heavily on the risk associated with retaining the existing rail in track. The VSH type of defect was stated as being the cause of a derailment on the North Coast Line in recent times. As the Goonyella system has found to contain VSH defects, the implication was that a derailment of the type of the North Coast Line could not be tolerated. The author received advice from the QR rail testing specialists, in fact the derailment on the North Coast Line was caused by a 'piped rail', and classified as a VSH.

The assertion that the rail will need to be replaced, en mass, in 3 to 5 years has no foundation. Certainly all tangent track is exhibiting little wear and most curves are being replaced as and when the need arises. The rail grinding being performed is doing an excellent job of prolonging rail life.

Other strategies for addressing the VSH 'threat' could include more frequent and dedicated ultrasonic inspection. These measures are extreme and are probably not warranted but would be far more cost effective than replacing all rail. Selective rail replacement for curves is currently being undertaken and will continue to be a legitimate asset management strategy.

It is concluded that most of the rail replacement is being performed prematurely by 5 years. The rail will be recovered to be used on the North Coast Mainline upgrade between Rockhampton and Townsville.

5.5.3 Sleeper Replacement

The project justification indicates that the concrete sleepers currently in track were designed for 22 tonne axle loads with authorised peak loading up to 27.5 tonnes. It is planned to replace 70 kms of these concrete sleepers on the 'UP' track and on to the Norwich single line from Coppabella.

The justification indicates that sleepers will need to be replaced in 20 years time if they are not replaced now. This represents a shortening of their expected life from 50 years to 36 years. The current program will see these sleepers removed from track after 16 years and be reused in the North Coast Line upgrade.

Replacement of the remaining 'DOWN' track and other section sleepers will occur at a later time.

Essentially the strategy is to begin the replacement process early, before the sleepers fail en mass. The replacements will occur in the most highly trafficked section first. This basic strategy is sound, albeit the process of replacement is beginning very early.

5.5.4 Ballast Replacement

The ballast replacement program covers 50 kms, 50,000 cubic metres of ballast replacement, performed by the ISG's specialised ballast cleaner/undercutter.

The ballast cleaner, has for this work, been stripped of its cleaning function because it was assessed that attempting to clean the ballast would be a waste of time and that the productivity of the machine would be compromised. Wholesale replacement is therefore occurring.

Cleaning mud and coal contaminated ballast has many problems because the particles retain a skin of the lubricants which would reduce the effectiveness of the process. The only cleaning process effective in these circumstances is washing, which is expensive and not readily mechanised for on-track applications. As well, the shape of the ballast particle is also degraded.

There is no doubt that the combination of coal contamination and the formation quality has led to deterioration in track geometry and ballast structural failure. Ballast replacement is warranted. In this program however some aspects are of concern.

Firstly, the slope of the undercutting is flat on tangents and equal to the cant of the curve on curves. This is detrimental to the drainage of the track and mud contamination problems will probably arise in a short period. Undercutting should occur to leave a formation top slope away from the track.

Secondly, no attempt is being made to re-establish a good quality capping layer on a general scale by the use of sand or geotextile. District resources are treating selective poor areas. However, the action of the undercutter will be to break a compacted surface and replace it with loose new ballast. This could have a detrimental effect.

Thirdly, the source of the coal contamination will continue to occur. The refurbishment of the structure of the ballast should have as an integral part of the strategy, a path for reducing or eliminating this contamination. Otherwise this task of ballast replacement will be required on a regular basis.. This task will represent a doubling in cost of what could be expected to be reasonable maintenance costs. Rail Access Corporation in the Hunter Valley of NSW is yet to complete a full ballast clean in that area where only selected parts have been treated in its entire history and BHP Iron Ore has only completed one ballast cleaning operation during the project's 1500 million gross tonne history.

Fourthly, there has been no attempt to increase ballast depth. The standard maximum ballast depth used on the QR system is 250 mm and this depth has been used on the system for some time. However, with the combination of narrow gauge structure, faster speeds, higher axle loads, formation failure and contaminated ballast experience, it is clear there is a case for a deeper ballast depth. It is understood this aspect is receiving some consideration, but will be too late for implementation on this project. There are a considerable number of complications with increasing ballast depth including the readjustment of overhead wiring.

5.6 Rail Grinding

The rail grinding program for the coal lines has been well planned and standards have been developed for maintenance frequencies and treatment.

Maintenance return periods for the various systems have been developed as follows:

- Moura, every 6 months to attend to curves with radius less than 1000m, every 24 months for other track.
- Blackwater, every 3 months for curves less than 1000m, every 12 months for all other track.
- Goonyella, every 3 months for curves less than 1000m, every 12 months for all other track.
- Newlands, every 12 months for curves less than 1000m, every 36 months for all other track.

Branches from these systems have reduced frequencies according to their tonnage.

The machine teams provide regular feedback, with rail assessments performed before and after grinding so that return frequencies can be further refined.

The actual pass kilometres on a section or curve are varied to suit the condition of the section. In most instances the larger machine is performing 2 passes on tangents and 3 passes on curves. Consideration has been given to adopting the 'one pass' strategy adopted by many North American railroads. The logistics of the Queensland system and its varying needs preclude wholesale adoption of this strategy.

The current rail grinding program is dominated by the need to implement rail profiles on the newly rerailed Mt Isa section, as well as the heavy on-going need on the coal lines.

Observations made on site indicate the rail grinding effort has retained excellent rail surface condition, which has assisted rail wear, corrugation control and wheel impact sites. The instances of rail surface irregularities causing wheel impact, and sleeper and ballast degradation were very rare. On the Newlands line, instances of wheel burns were common on the steeply graded portion east of Collinsville. As well, the rail profile west of Collinsville in areas where the track passes over expansive soils, were also sites which could benefit from an increased frequency of grinding. Local personnel recalled the grinder had not visited their area for a considerable length of time.

5.7 Trackside Systems Signalling and Telecommunications Maintenance

Signalling and telecommunications maintenance supports the infrastructure delivering field and train control based safeworking equipment, the signalling, cable and radio systems. The engineering workforce used radio systems are also maintained. As well, QR's administrative telecommunications based infrastructure is also maintained.

The technical variety, age and complexity of the system is large and is a highly influencing factor in the maintenance resources dedicated to this task. In particular, as the history of the use of these systems covers many years, new specialist skills were required from time to time and segmentations and demarcations developed within the workforce.

The following table details the asset base on which the maintenance is carried out. Detailed costing is not performed in relation to the individual components as the current accounting system within QR is not activity based.

Components	Blackwater System	Goonyella System	Newlands System	Moura System	Total
No of CTC Stations	53	38	10	12	113
Interlockings					
VPI	0	0	0	10	10
Westrace	6	5	0	0	11
Microlok	4	1	0	1	6
Relay	43	32	10	1	86
Level Crossings					
Flashing Lights	16	8	8	6	38
Boom Gates	17	4	0	0	21
Dragging Equipment Detectors (DED)	74	57	14	15	160
Elecrtical & Hydraulic Points	404	278	29	27	738
Electric Release Points	66	70	0	17	153
Electrical Signals	1325	791	126	163	2405
Track Circuits	1695	1194	168	232	3289
Axle Counters	23	30	0	18	71
Alternators	53	38	10	12	113
Location Cases/Housings	1090	733	Not avail	100	1923
Electronic Weighbridges	7	11	2	3	23
Telemetry	Optical Fibre	Optical Fibre	Pole Line	Micowave and radio	
Total	**4876**	**3290**	**377**	**617**	**9160**

The maintenance functions for this type of equipment falls into two main categories. Firstly, preventative maintenance is aimed at ensuring reliability and consists mainly of inspection and monitoring functions. Secondly, where faults do occur due to the equipment itself or other factors, there is a rapid troubleshooting and repair function. Other parties can also determine activities, especially track based projects requiring support or where damaged occurs due to other activities..

The signalling system is essentially a track infrastructure based system, so that any reconfiguration of the track infrastructure requires the participation of signalling expertise. Some more recent train safeworking systems on the market are heavily dependent on radio communications and rely less on the track infrastructure and these no doubt will form the direction for future system design.

Standards for performing work and work procedures are well documented and considerable precedent within the rail industry exists for work procedures. A review is currently being undertaken of these procedures.

The most revealing aspect of the maintenance required in this discipline is the wide variety of equipment requiring maintenance. As new technologies develop QR is faced with an ever increasing complex task of maintaining differently aged and complex equipment. QR will need to address whether it is reasonable and efficient for the organisation to posses all the skills required where there exist other organisations that specialise in these areas such as telecommunications.

5.8 Trackside Systems Overhead Traction Power Maintenance

The overhead traction power maintenance function supports the infrastructure necessary to deliver the traction power for the electric locomotives operating on the Blackwater and Goonyella systems.

The components of the system that require maintenance are the overhead wires and structures over the track itself, the power feeders that parallel the track, and the substations where the electricity authority's power is transformed for distribution to the railway system.

Two distinct technological functions have led to distinct work activities on the system. Firstly, there is the maintenance associated with the overhead lines. This workforce is characterised by line technician skills where the tasks involve being in the train corridor often at height. Secondly, there is the maintenance associated with the high voltage transformers in the substation environment.

Inspections dominate the work activities of both groups. In the overhead line area, other groups generate a significant percentage of work. Where trackworks involving machinery is involved there is often a need to electrically isolate that section of infrastructure. This involves rigorous safety procedures. The time between the activities of isolation and re-connection is unproductive unless specific activities are required to be performed on the electrical overhead traction system in the near vicinity.

The substation workforce is also interrupted in its regular inspection regime by trackworks but to a lesser degree. Replacement of equipment and new construction form a part of the total workload.

In the past few years the continual opening of new mines has seen both workforces become involved in new construction and where necessary they are supplemented by construction teams from Rockhampton.

6 Activity Efficiencies

6.1 General Observations

6.1.1 Employment Practices

QR's employment practices have over the last few years been considerably modernised within the context of Government employment.

Employment status with QR is multi-level and there is the potential use of employment structures that could considerably improve the efficiency from labour.

The various employment status levels include:

- Casual employment, through an agency or separately.

Construction gang groups because of the transitory and spasmodic nature of their work favour this type of employment. The construction teams prefer to hire locally for the time that they are in that community. In recent months, the groups have been restricted on the use of this type of employment as there has been pressure from outside QR to recruit on a permanent basis. This has and will add labour cost inefficiencies into QR's total costs.

- Fixed term employment.

This type of employment is suited to semi-permanent jobs where there is currently a temporary need to recruit and that need could extend into the future. This type of employment is favoured by District and Construction groups because it allows a proper assessment of the need for a permanent position and of the employee's potential to fulfil the requirement. The extension of a project work scope can be uncertain at various times, and this type of employment option provides that flexibility. Of the 135 staff employed in civil infrastructure maintenance on the Goonyella system, 11 were fixed term employees.

- Subsidiary EBA agreements.

These agreements complement the industrial award to suit particular circumstances of a work scope. They are particularly suited to work where track possession availability falls outside normal working hours or where shift arrangements are required to suit particular working conditions. Of the 4000 employees in the Infrastructure Services Group a total of 200 were working under a subsidiary agreement. Of the total number of ISG employees working in the central Queensland coal network, 500, a total of 50 were working under a subsidiary agreement and relate to the operation of the TLM.

- Permanent employment.

This category of employment status represents by far the greatest number of employees. A permanent employee can be made surplus to requirement. Then they are eligible for voluntarily relocation to another position within QR or to another Government position.

Despite the opportunity for the flexibility in workforce arrangements QR policy has been to decrease the number of fixed term and casual appointments and the existing employees in these categories have been made permanent.

6.1.2 Employment Training and Competencies

The civil infrastructure area of the ISG group has adopted a competency framework for the recruitment, training, wage rates and promotion of its level 6 & 7 (wages) staff. The competency framework is being extended into the supervisory levels as well.

The adoption of this framework is at the forefront of this type of initiative in Australia and represents 'best practice'. Whether or not this initiative translates into appropriate infrastructure maintenance costs however is a different matter, but the foundation for a competent workforce is an important part of the overall equation.

A significant issue for some supervisors in the coal network is the imposition of a maximum number of competencies in a particular gang. This means that even if a gang member wishes to improve their competency or if a member already has a competency, there is a limit to the application of that competency since the gang member will not be paid for the use of the competency. This practice limits the flexibility with which a supervisor can allocate tasks, with predetermined minimum group sizes resulting from the restricted number of competencies at the supervisor's disposal.

To date, the operational services (signals and communications) organisation has not adopted a competency based system although a large initiative to multi-skill and to bring disparate technical skills together is underway. This is the primary reason why the operational services personnel are not organised at the District level in the same way as the civil organisation. For the number of staff involved a regional approach to multi-skill and amalgamate the signals and communications areas is being attempted. Later, an amalgamation of skills with the electric overhead and transmission staff has been flagged as a potential strategy.

6.1.3 Labour Pay Rates

The industrial arrangements expressed in the awards are characterised by a complicated and highly modified set of conditions, many the remnants of an old technology and highly demarcated working practices. Along with base pay rates, there are also many allowance categories making payroll functions complex and specific activity costing and cost driver analysis impossible.

The major concern associated with this level of complexity as well as the inflated administrative function to support the system, is the continued reinforcement of work demarcations. While there are different pay rates for many different work activities, jobs continue to be demarcated.

There is in QR however, an increasing trend through competency training and amalgamation of job function to simplify these arrangements and promote efficiency through multi-skilling. The drift to these new arrangements is laborious and time consuming and in the meantime propagates inefficiency.

When these arrangements are contrasted with modern enterprise agreements, such as that in use in NSW with Barclay Mowlem, the elements of inflexibility become apparent in the QR system. This inflexibility and low productivity is caused through skill demarcation reinforced by pay demarcation and working time rigidity.

Modern Enterprise Agreements openly recognise the competitive environment in which the company must survive and the employees benefit with that survival. The Enterprise Agreements are easy to understand, setting out in language and sequence the way in which the remuneration and conditions are constructed. There is no need for the parties to employ legal advocates to interpret these arrangements. It is an open and transparent process.

The particular strengths of the Enterprise Agreements over the traditional awards include the provision for productivity bonuses, project to project working time and remuneration flexibility, obligations of both parties clearly stated, and a highly consultative environment. This contrasts with a rigid remuneration system based on the traditional notion that whatever the circumstances of the work the same conditions must apply.

Close examination of the systems used in QR indicates that although some avenues exist for the construction of 'subsidiary agreements' for specific circumstances, these avenues are rarely progressed because of the difficulty in constructing economical arrangements. The productivity of machinery and manpower is therefore restricted and the overall cost of the activity is inflated. This is particularly evidenced in resurfacing activities but also has relevance in electrical isolations where the 'normal' hours of work in one part of the infrastructure workforce is different from another resulting in large amounts of 'overtime' being worked.

6.1.4 Use of Equipment

QR is well equipped for infrastructure maintenance since it has a leading position in Australia for the most modern track maintenance machinery.

QR however, has a tendency to retain older less productive pieces of equipment. In the case of resurfacing machinery, equipment capable of producing only a fraction of the output of more modern machinery has been retained. District management indicates that flexibility offered by retention of the old equipment is advantageous. However with a relatively predictable tonnage and train task, and a relatively new track construction, this added flexibility for the coal task is unwarranted. The cost of this added flexibility should not be borne by the coal task.

The retention of this older equipment for the sake of flexibility has propagated inefficient operations and this is evidenced by the relatively high unit cost of production. QR's own estimates indicate a difference of 50% in the unit costs of production between the older and newer equipment representing the lower production rate of the older equipment and therefore higher unit rates..

As well, the use of track maintenance equipment has been confined to daytime operation to coincide with the normal rates of pay for the workforce. This has restricted equipment utilisation and built in constraints in productivity. Until more modern pay arrangements are constructed, the equipment utilisation will be confined to approximately 30%. This particularly important because the major maintenance work which constitutes about 40% of the total infrastructure maintenance expenditure is capital equipment intensive.

In a few cases, special agreements called supplementary agreements have been put in place to permit the use of the equipment after normal hours. In the metropolitan area, where access to the track is severely limited, it has been a matter of necessity that has forced the arrangements.

In the coal network, there are opportunities to utilise high production machinery in wider windows than the daytime hours alone.

6.1.5 Skill Demarcations

The QR civil infrastructure area has undergone a great deal of restructuring in recent years following the mechanisation of many jobs, the upgrading of the track and the ready access to motor vehicles.

There still remains quite a deal of specialist activities within all 'discipline' areas and there are plans to break down these barriers over time using competency frameworks and multi-skilling.

The disaggregation of skills is the single biggest barrier to improved productivity in infrastructure maintenance. The following disciplines are currently retained separately:

- Thermit welding.

Specific personnel specialise in this activity. Some Track Supervisors have expressed a desire to have that skill in their own teams rather than having to rely on District resources. However, there are concerns about retaining a level of competence in the welding in teams that are only required to perform the task occasionally. Whilst there is no single right answer to this issue some maintenance contractors have evaluated the circumstances and introduced the practice where the conditions relating to quality and need suggest it is efficient to do so. The implied blanket policy position adopted within QR is not appropriate and significant benefit could be derived in appropriate circumstances.

- Mechanical signal maintenance.

This activity is concerned with the maintenance of the apparatus of a mechanical nature in the signalling area. It stems from the time when signalling equipment was not electrically operated. Apart from the small number of non-electrically controlled locations in the coal network, there are also interfaces within the electrically controlled sites. It is therefore not unrealistic for an 'electrical technician' and a 'mechanical technician' to visit the same site at the same time to attend to a repair or inspection. Only small pockets of this type of demarcation exist elsewhere and there are plans for multi-skilling in QR to improve productivity in this area.

- Track Machine Fitter and Operators.

With the few exceptions of where a former fitter has been trained as a machine operator, the skills of operating and maintaining track machinery are separated. The difference in pay rates is one barrier to multi-skilling as is the retention of jobs in the specific categories. All track-machine contracting organisations in Australia employ fitter operators where the operator can perform minor to medium level maintenance.

- Telecommunications maintenance.

It is well recognised by QR, and is being addressed, that the technologies of signalling and telecommunications have an interface and are merging. In the current situation, it is highly likely that a fault first reported as a signalling fault is in fact a telecommunications fault. The response to the fault is from two persons, one after the other. This response is untimely and highly inefficient. The system encourages this response, awarding both employees with call-out pay. An amalgamated technician able to attend to both signalling and telecommunications faults operates in the Pilbara of Western Australia and in South Australia where recent contracts have induced innovation and advanced skill training.

- Overhead line and sub-station maintenance.

Many aspects of traction overhead maintenance employees' time are unproductive given the demands on their time by trackwork related causes. An 'isolation' for track maintenance will involve activity at the start and end of the day and disrupts other routine tasks. As well, overhead linesman and substation employees are involved. QR recognises the inefficiency and has informally discussed means to provide track maintenance employees with the necessary skills to effect isolations. This strategy has been described as a 'sensitive' issue because of fears of downsizing and the plans have been muted. In Victoria, suburban trackwork employees have been provided with skills to effect overhead line inspection to a limited degree.

6.2 Routine and Preventative Track Maintenance

The efficiency with which this task is carried out is dependent upon a number of factors, which for the coal network will be individually commented upon.

6.2.1 Labour terms of employment

In the main, the labour in local track gangs is of a permanent full time basis. On this basis, the QR labour rate is higher than an equivalent private contractor because award provisions are more generous than the equivalent private sector arrangements.

In the infrastructure area these arrangements typically include many allowance provisions for all manner of circumstances and include allowances for items such as; acid (battery), working in the rain, wet places, height, tunnels, standby, travelling, tool, narrow excavations, dangerous material, and pneumatic jack hammer. The structure of these provisions is outdated compared with contemporary practices elsewhere. They typically add 10% to 40% to the cost of performing the maintenance. As well, these provisions create a large payroll workload, which ultimately incurs higher overhead costs.

For direct labour costs QR compares unfavourably with the private sector in the areas of superannuation, where QR's prevailing rate is 12.75% compared to 7% to 9%, and with allowances that can be as large as 35%. More modern registered agreements such as those in the Pilbara of Western Australia incorporate these allowances into aggregated rates where productivity bonuses also apply.

Base rate of pay comparisons between contractors and QR are difficult to make because the contractors' work classifications are wider and more skills are incorporated into a particular level. Even with this breadth of classification contractors' base rates are no greater than QR's. For instance, the Barclay Mowlem base rate for track workers in Western Australia with broad skill levels, including supervisory tasks are the same as QR's base track worker.

As well, ISG's management fee amounting to an average 16.7% over all maintenance activities, including those concerned with the purchase of materials, makes the total QR cost base uncompetitive.

6.2.2 Location and Work Content

The accessibility to track and the condition of the access roads have a large influence on the productivity of track gangs. In the central Queensland coalfields, whilst some areas are inaccessible, on balance there should be no premium applicable compared to other regions of Australia.

6.2.3 Organisational Policies

The QR organisation is subject to greater expectation from community concerns than a private contractor may be. This emphasis can sometimes inhibit free movement to address maintenance concerns in a rational manner, thereby building inefficiencies in the task.

This issue is particularly important around town areas. A major concern for cost accuracy is the correct allocation of cost to the applicable line sections and then to the applicable business units. The Moura system has a number of branches, yards and facilities that are not involved in the coal task. These branches serve towns and other mixed community needs.

The activities that exhibit a high impact on community needs and consume a large part of local gang resources are:

- Fencing and animal removal
- Firebreak construction and burning off

These activities form a strong interface with the local community and especially adjoining landholders. The activities relate to land management and it is not surprising that there are many complaints about the railway's performance, some of which are misplaced.

Essentially, these tasks are an inefficient way for maintenance personnel to spend their time. As well, they are probably not particularly well skilled at the discipline of land management. The time they spend on the task is not easily shown as being 'productive' as far as the operation of the trains are concerned. Other methods of achieving the same result should be explored including outsourcing to the land-owner or to specialists.

6.2.4 Gang Equipment

Work teams in Central Queensland are well equipped. The small tools and transport for local gangs, and the track machinery, earthmoving plant, tool and transport for the District Production gangs are all up to the standard of teams on the best railways in Australia.

Notwithstanding the potential to multi-skill teams as previously reported, and the need that generates for equipment, there is currently no impediment to efficient working of the teams. Potential exists to improve efficiency with resurfacing machinery by disposing of the oldest machinery and utilising the more modern equipment on an extended shift or multiple shift basis.

6.2.5 Skill Levels

QR's infrastructure maintenance workgroups, across all disciplines, have adapted to varying degrees, the framework of national competency standards. Of all railways in Australia, QR could rightly claim pre-eminence in this area.

The competency framework establishes a regime of skill needs identification, training and employee promotion on the basis of competencies acquired against the background of the competencies required. There is a certain administrative effort in establishing and administering the framework but the proponents of the system believe the quality and efficiency benefits outweigh the costs. To the author's knowledge, this is yet to be quantifiably established, however there is generally no argument with the scheme's objectives.

In the broader context however, the competency framework is required to interface with other aspects of an administration such as the employee relations processes. In particular, the competency framework is a generation ahead of the pay structure which has been slightly modified to accommodate the competency framework. This modification has been the amalgamation of bands of pay scale to match the competency framework. This has led to small inequities where some employees are being paid at a different rate for the same work.

Also some gangs complain that there is an artificial restriction placed on the number of employees permitted in a gang with particular skills. This has led to inefficiencies where certain work cannot be undertaken if a single employee is not at work.

Overall, QR's infrastructure maintenance employee skills are heading in the right direction albeit with the burden of an outdated pay structure and under the enormous weight of a complicated administrative process. In the signalling and telecommunications areas, where multi-skilling is part of the main agenda at present, the competency based framework will assist with its introduction, but there will be considerable effort to transition the pay scales and structures in the consultative manner QR is adopting.

6.2.6 Track Structure

The structure of the track influences the work required to be performed in a very direct way. Over the past 5 years, most of the coalfields' tracks have been upgraded to a very high standard with concrete sleepers, modern turnouts, improved drainage and heavy rail.

In a routine sense, there is now comparatively little to be maintained by way of the track structure itself by the local and District gangs. With an adequate resurfacing program, and appropriate rail replacement the main task of the routine maintenance is to carry out inspections. The single most burdensome tasks relate to the condition of the ballast because of contamination and the condition of the formation due to inadequate construction standards.

On the other hand, much of the non-track related work remains. Tasks such as fencing, vegetation control, level crossing maintenance and yard maintenance continue, not having the benefit of the upgrading programs performed on the track.

6.2.7 QR's 10 Year Plan

The 10 year maintenance plan, the subject of this review, identifies the individual track maintenance routine maintenance activities without a corresponding scope or expenditure estimate except in the aggregate. Nevertheless the type of work corresponds with the activities the local gang resources would be expected to perform and align with the observations in this report.

6.3 Major Program Maintenance by District Resources

Within each district resource group, specialist resources concentrate on particular activities. In view of a costing system that only collects information on an administrative level, it is therefore impossible to accurately measure the costs on an activity basis.

In a similar manner to Local Track Gangs, the District Resources' response to the track upgrading that has occurred in the district is one of slow evolution of quantity and type of skills. There should be much less work for district gangs to have to perform now that the track in the district has been substantially upgraded. However changes to resource levels are occurring only very slowly. Some evolution is occurring as the effects of removal of work take place. For instance, the No 4 Production gang at Rockhampton was recently made redundant and it is expected that the gang will merge with the No 8 gang over time as staff are not replaced.

This evolutionary strategy contrasts with the contracting methodology where only those resources required are retained and the workforce is more flexible in its location of work. In practice, the sharp rationality of contracting assists personnel with employment planning and the natural turnover of personnel within these workgroups accommodates these changes.

6.3.1 QR's 10 Year Plan

QR's 10 year maintenance plan identifies two categories of work, major works and routine maintenance. Routine maintenance is largely performed by the local track gangs and consideration has already been given to those resources. Major works are performed by a number of groups, district resources being one of those groups.

Major maintenance activity is also supplemented by ISG (head office based) teams where work involves the use of specialist machinery.

For the purposes of reviewing the 10 year plan, this task has considered the scope of the activities proposed and the efficiency with which that activity can be accomplished.

The use of district resources for major maintenance as well as ISG head office based resources were not separately identified in the 10 year plan as it is an activity based plan only.

Where the activities in the 'major maintenance'[4] section of the plan have been considered as being mostly labour based[5], those activities were compared on the same basis as the routine maintenance portion of the plan. That is, there were no direct comparisons with contractors' rates but efficiencies were identifiable relating mainly to labour deployment and practices.

[4] As defined in the contect of QR's 10 year plan.
[5] As agreed with Network Access

The other major maintenance activities were directly compared to contractors' rates. The contractors' rates were 'all-up'[6] rates, whilst the QR rates were direct rates (including on-costs) and were added the 16.7% ISG management fee.

The matters associated with major maintenance are dealt with in the following sections.

6.4 Resurfacing (Tamping)

6.4.1 Costing

The costing system with in QR is not oriented to tracking costs on activities. However, cost centres exist to Level 5 in the organisation, which corresponds to Roadmaster, TSS level. Therefore some activities can be traced to cost centre level. These relate primarily to large construction gang type works.

The resurfacing within the District falls under the responsibility of the Roadmaster, effectively a senior TSS, who also controls earthworks, 'thermit' welding, rail lubrication, and other activities where resources are required to operate over the entire District. Therefore, individual resurfacing costs are not easily traced.

The Projects and Plant Division of ISG is currently undertaking work to be able to collect all costs associated with resurfacing and other activities so that appropriate comparisons and benchmarking can occur for the plant under 'their' control. In previous years, to 1997, the Plant section collected some of the major costs associated with resurfacing and produced reports indicating cost trends. However, this activity ceased with recent QR restructuring.

As a result of the author's queries and because budgets for the 1999/2000 year were being formulated, the Plant section produced a costing model for the three main resurfacing groups working in the coal systems, groups 23,20, and 8.

The models were constructed using a combination of actual costs incurred and estimates from known variables. The elements of the cost model were:

- Ownership and Operating costs. This included capital interest, amortisation (purchase cost minus salvage value) over 15 years, fuel, maintenance and consumables for the two units of plant in the gang, the tamping machine and the ballast regulator. Since maintenance costs are not collected on a per machine basis an estimate was made for each type of machine.
- Labour costs. This is District labour at a rate made up of base wages multiplied by an on-cost allowance, plus an overtime allowance (factored onto the base times on-cost). In another part of the infrastructure costing methodology, other estimates currently being produced for 'standard' (charge out) rate purposes, indicate that including employment on-costs and District and Corporate overheads, a different overhead allowance is made. For the purposes of this comparison the 'charge out' approach has been ignored and the more conservative estimate for the factor has been adopted.
- Support vehicles. This is a monthly hire rate plus fuel plus maintenance cost.

[6] Including return of capital and profit.

- Miscellaneous costs. This includes accommodation, safety clothing, and minor consumables.

Costs, now considered as conservatively low, were formulated for the following machinery:

- High capacity continuous action tamper and regulator.
- Modern, half life expired, medium capacity tamper and regulator.
- Life expired old technology tamper and regulator.

On top of these direct costs QR also adds a management fee for the provision of services by the ISG organisation including contract management, employee relations and resource co-ordination. This management fee equates to 16.7% of the direct costs.

6.4.2 Labour Levels

The resurfacing teams were composed of between 8 (high capacity machine) and 5 (low capacity machine) staff. This manning is generally one person higher than with contract resources. As well, it was noted that some of the machine operators were multi-skilled as fitter/operators and this was an increasing trend. However the use of fitter/operators in their dual role is rare because staff fulfilling the old single-skilled roles is available and need to be utilised. In the private sector, staff are most often multi-skilled and it is now rare for there not to be a multi-skilled operator/fitter.

6.4.3 Machine Utilisation

A recent study across all of QR has quantified the levels of machine utilisation on a corridor by corridor basis.

The study concluded that the percentage of time the resurfacing machines were tamping compared to the total time the machines were attended, was between 30% and 40%.

The highest levels of utilisation on medium to high density trafficked main lines were recorded around Brisbane, East of Coppabella on the Goonyella system. The Brisbane area benefits from after hours working whilst the double track on the Goonyella system permits better occupancy. Single line sections in general, and particularly those single line sections on the North Coast Line exhibited as low as 28% utilisation.

The coal system generally exhibited better utilisation than most other mainline sections. Any cost comparisons on a cost per km basis are therefore likely to marginally favour the coal lines in terms of efficiency. Unfortunately, only the costs on a 'generalised' basis are available.

The conclusion that machine utilisation for all machines across all lines falls within a small band suggests that the extended use of higher production machines is a strategy that would improve production and efficiency. However, resurfacing machines are worked single shifts only, regardless of their production rate and their capital cost.

Prima facie, higher production machines should be used in favour of the older lower capacity machines, notwithstanding the requirement for maintenance machines to be available for urgent work on a particular section. However, suitable monitoring of the track geometry condition should preclude emergency work sufficient to warrant the retention of a complete resurfacing machine group, comprising a tamping machine and ballast regulator machine.

It is noted that the particular construction of the labour award arrangements is a large disincentive to adopt innovative work practices. In the Brisbane area, where after hours work is the only feasible alternative, a supplementary agreement based on the existing award structure is used. Since the supplementary agreement is based on the existing award provisions where overtime rates apply to normal out-of hours working, the cost of those provisions is high. The practice has not been attempted elsewhere.

6.4.4 Other Cost Components

The most difficult issue to resolve about the content of cost elements is that a number of different sections within QR contribute to the overall cost and management structure of resurfacing and other activities.

For example, the 'yearly maintenance and consumable budget' for resurfacing gang 23 is designed to include all internal and external costs directly related to the operation of the machine. There are no records to validate this estimate because costs are collected on a functional basis across all of QR. For instance, the mechanical support provided is costed for the function of mechanical support for all machines and vehicles and not against particular machines. Roadmaster consumables are recorded across all activities under their control.

The 'overhead allowance' is the most disturbing aspect of cost because, for the coal system, it is probable that the complexities of the other parts of the QR business are over-complicating an otherwise simple business.

Costs that have not been allocated in the rates above include Corporate Overheads, Regional and District overheads. Therefore the estimate for 'overhead allowance' currently used in QR's unit cost referred to in 6.4.1, will increase. As well, the ISG management fee of 16.7% on top of these direct costs will further increase the unit costs.

Contractor on-costs and overheads in the resurfacing business contribute no more than 50% of the direct labour charge. That is, an 'overhead allowance' of 1.5 times and a margin of 10% will bring contractors' costs below those 'incomplete' costs of QR's. Therefore it can be concluded that contractor prices for resurfacing could be confidently estimated as being approximately 25% lower than QR's full costs.

6.5 Track Laying Machine Program

QR's recent practice has been to construct a proper scoping document for the works undertaken by the TLM. This discipline provides an opportunity for a comparative situation where contractors' costs can be more directly compared if the need arises.

At this stage the sophistication of the documentation is being developed but it is providing a better quality check on the operations and assisting field operators better plan their work. This strategy fits with the 'internal contractor' strategy being propagated throughout the organisation.

Whilst the efficiency of the actual work performed can be controlled and be continuously improved, the main issue relating to the operation of the TLM is the determination of the need for the work itself. Earlier conclusions in this document refer to the prematurely and incorrectly based timing and scope of the work on the Goonyella relay.

It was earlier concluded that

- the reason for the replacement of the rail was based on misleading information in that vertical split head defect rates had not increased and that the rail responsible for a derailment on the North Coast Line was a 'piped' rail and not the VSH type defect found on the Goonyella system. The rail defect trend was manageable.
- the timing of the replacement of concrete sleepers was based on the convenience of the changeout program while the TLM was replacing rail, and that the fastening system of the current sleepers was not conducive to fast rail changeout, and that they would need replacement over the next 20 years anyway.
- apart from cutting widening to improve drainage, there was little attention to formation problems.
- ballast depths would remain the same despite overwhelming evidence that the current ballast depth was not adequate to cope with coal contamination, poor formation and heavy loads with increasing speeds.
- there is no complimentary strategy to address the largest single cost driver of track maintenance in the coal systems, that being coal contamination.
- the availability and therefore the scope of the TLM was closely tied with the requirement to perform upgrading work on the North Coast Line to coincide with planned operation of a tilt train from Townsville to Brisbane.

In terms therefore of effectiveness, the operation of the TLM is under doubt as to its effective deployment in the coal systems. There appears to be an over-riding requirement for the TLM to fit in with the requirements of the total QR system where objectives are often counterproductive to optimising the TLM's contribution in the coal systems.

The premature timing of the work on the Goonyella system, as previously referred to, is symptomatic of a system where the coal system managers knew that the TLM would be unavailable for some time on account of the North Coast Line upgrade. When resources are not available at the time they are needed there is a tendency to 'make sure' the track will retain its quality into the unknown future for as long as possible. These extra costs are hidden behind a system that cannot consider alternative supply models because it operates on a resource based budget.

This report concludes that the replacement of some rail and the concrete sleepers is premature, and that more attention should be paid to earthwork formation issues and reducing coal contamination.

Based on the author's observations of the condition of the rail, the ultrasonic flaw detection records, the derailment history, predicted tonnages and the fatigue life estimates of the concrete sleepers, the indicated timing of rail and concrete sleeper replacement is in 3 to 5 years time, which clashes with planned timing for the North Coast Line upgrade.

6.6 Rail Grinding

Rail grinding is performed in QR, across the entire system, with two machines. Firstly there is an old 'Loram' machine, of relatively low capacity but performing specialised turnout grinding as well as mainline grinding. Secondly, a recently acquired, high capacity, 'Speno' machine performs mainline grinding.

The grinding team is composed of 23 staff across the two machines. The higher capacity machine works a double shift, with a third shift providing maintenance and any other spare capacity grinding. The lower capacity machine works single shift. Both machines work more night time work where track possessions are more available and there is a lower risk of fires started by the grinding. The rail grinding operation stands out with effective equipment utilization and is a real strength of the track maintenance effort.

The Network Access Group will purchase grinding services from the Plant and Projects section of ISG.

This 'price' is made up of:

- Operating labour
- 'On-costs' including leave, workers compensation, payroll tax, allowances (tool etc)
- Consumables including fuel, grinding stones, minor spare parts, accommodation
- Depreciation, at the rate of 10% of the capital purchase price
- Corporate overheads on a staff number distribution basis
- Internal expenses such as motor vehicle rental, engineering assistance, workshop services
- Return on asset, based on 10% on the depreciated asset value to cover the equivalent cost of interest and sundry other matters

The rates are constant across all lines in Queensland. This treatment would tend to disadvantage coal lines because possession availability in the Brisbane metropolitan area and the North Coast Line is generally lower, requiring a greater elapsed time to perform similar work. The train densities on these lines severely restrict access. Grinding rates for the coal lines could be 10% lower than for other areas.

The rates fall within a competitive range with private sector rates. The budget structure separates the operational expenditure and the overheads, including capital charges associated with the works.

The slightly higher rate could be the result of slightly higher labour costs in QR and some on-costs including payroll tax for large organisations, allowances discrepancies and other sundry Government labour characteristics as detailed in section 5.1.

However the single largest factor associated with a difference in rates is the burden of the 16.7% ISG management fee. For a self contained operation like the rail grinder the application of the management fee is unwarranted.

The predicament for ISG is that if self contained operations like the rail grinder are not allocated this proportion of the management fee, other activities will be further burdened with disproportionately high management fees. Overall ISG must spread this fee across all of its activities.

It would be uncommon for a private contractor to be provided with a 10 year contract, so the provision of 10% depreciation in the QR costs is a low depreciation rate for the purposes of comparison. As well, the private sector rate takes into account a business risk margin whereas the QR rate provides for a 'Return on Asset' which is nominally a charge for capital interest. The QR costs are therefore on the upper side of the competitive range with the private sector.

6.7 Timber Resleepering

In the Central Queensland coal systems there are two activities involving resleepering.

Timber resleepering is occurring in the Blackwater system on branch lines, which were not concrete resleepered during the upgrade in the last few years. This resleepering is being performed by a District 'production' gang and assisted by the local Blackwater gang. The resleepering operation includes partial timber sleeper replacement with recycled timber sleepers resulting from the concrete resleepering upgrades. During the course of this review it was revealed that QR now plan to concrete sleeper these lines in the near future.

Since costs are not being collected on an activity basis it is not possible to directly compare costs of that operation with commensurate contracting costs.

The no.8 production gang from Rockhampton, who were performing the work contains about 17 personnel and at times were supplemented by the Blackwater local gangs (East & West combined) numbering approximately 14. The resleepering included approximately 7000 sleepers over a period extending from July 1999 to October 1999. The work constituted an upgrade from a smaller size timber sleeper and wide sleeper spacing to a deeper sleeper spaced more closely. Whilst this work was the gang's main task over this period, other jobs coinciding with possession windows were also undertaken such as turnout insertion on other parts of the network.

Although the production gang used mechanical resleepering machines to perform the work, the most efficient machinery to perform respacing and insertion of deeper sleepers is the TLM or mechanised panel replacement. There are equipment capital cost implications with these methods particularly if this rare type of work is to be performed with in-house resources.

The consequences of being locked into a workforce structure and equipment ownership constrain the number of available solutions and the opportunities for outsourcing. Inevitably, the particular methods and vague scope of work is unable to be benchmarked against other service providers. Contracting out of the work would require discipline in work scoping and conditions.

This particular example reinforces the need for QR to evaluate the needs for upgrading and other works without the influence of the factors associated with the availability of in-house resources. The upgrading of the line to concrete sleepers has been previously included in long term plans but has been continually pushed out in time. As previously concluded, since the Laleham Branch carries significant tonnages commensurate with the Moura Line, and the remainder of the Blackwater system was upgraded, the concrete resleepering of it appeared to warrant completion despite the fact that part of the line is privately owned. Attachment B details QR's response to this anomaly.

6.8 Rerailing

District production gangs as well as the TLM perform rerailing. The District gangs replace curve worn rail as the need arises and comments have previously been made in 3.2 with regard to the design parameters used in the determination of replacement criteria.

The TLM is currently involved in the Goonyella system upgrade. There is no doubt that using the TLM for large rerailing tasks is a method with potential for very low unit costs. However in the case of the upgrade, the need for the work is of much greater concern and has been previously commented upon in 6.5.

6.9 Track Geometry Measurement

QR is able to boast it is an industry leader in track geometry measurement. It has a finely tuned program of inspection, produces management reports including trend analysis and information for resurfacing programming.

There is insufficient comparative data to conclude whether the task is being run efficiently or not, except to observe that the machine involved is world state of the art, there is a proper program of inspection, and the information generated is widely used and useful.

6.10 Ultrasonic Rail Inspection

Ultrasonic rail inspection is performed by contract, one of the few tasks outsourced by QR. The ultrasonic equipment used by the contractor is similar to that used by all other railways in Australia.

There is a well defined program of inspection frequency based on time intervals and linked to tonnage levels on the various lines. Small refinements could be made to the program to take into account rail condition and configuration, to ensure for instance, that the 53kg/m rail on the Goonyella system, with its 'VSH problem' was adequately managed to mitigate any risks associated with catastrophic failure probability.

This refinement may have given sufficient confidence to QR to defer the need to rerail the Goonyella on a massive scale in order to avoid the perceived risks associated with the VSH problem referred to earlier in 5.1.4.

6.11 Trackside Systems Signalling Maintenance

6.11.1 Labour Arrangements

The current organisational structure associated with Trackside Systems reflects a desire by QR to multiskill its signalling and telecommunications workforces in order to be able to supply a more 'integrated' service.

In particular, at present there is a demarcation of skills between the two disciplines, signalling and communications, and results in inefficiencies with respect to fault finding and repair, and to productive volumes of work during the day.

Typically, a signalling 'fault' as depicted by a train control system is not specific about the location of the actual physical fault. The physical fault could lie with the signals and their interlocking and operation, or with the telemetry linking various systems together. The direction of technology improvement in this area is toward integrating the electronics of the signal interlocking and the telemetry associated with the transmission of the data. This principle applies to activities where both functions are performed during normal maintenance.

This demarcation issue is however common in Australian railway systems and all parties are exploring the opportunities for productivity improvement.

As well, QR is attempting to multi-skill the 'mechanical' signalling functions and the 'electrical' signalling functions for similar reasons. Mechanical signalling functions include the skills associated with mechanical equipment design, installation and maintenance. As mechanical systems become more rare, the volume of work available becomes less and productivity lower.

Westrail and ARTC have multi-skilled to a level where the distinction between 'mechanical' and electrical' trades in the signalling area is unrecognisable.

QR is utilizing its competency based training and workforce development approach and show some early successes. Its approach however is evolutionary in the sense that it will use voluntary processes and natural attrition to achieve the transition over time.

6.11.2 Work Activity Drivers

Signalling maintenance activities contrast with track maintenance activities in the sense that many other infrastructure activities strongly influence the level of activity. The level of traffic on the route bears little relationship to the level of signalling maintenance. In particular, track activities have a direct bearing on the level of signalling activities.

Track maintenance activities have already been commented upon and in general is concluded that works occur prematurely and unfocussed. These activities cause signalling resources to be deployed in a support role, which distracts those resources from routine maintenance and incur large expense because of the necessity to work out of hours.

Although not formalised it has been estimated by QR District personnel that up to one half of the signalling maintenance budget may be related to providing this support role.

In addition, routine signalling maintenance is undertaken and is governed by a well documented set of standard procedures and instructions.

The Operational Systems section, dealing with signalling and communications, is currently embarked on a review of these maintenance standards and procedures with a process known as the FMEA (Failure Mode Effect Analysis) analysis. This process details the effect of certain failures, their frequency, consequences and any mitigating strategies to effectively root out any redundant procedures and to enhance existing ones where needed.

It has been estimated by QR managers that this process is expected to reduce the resources required for routine maintenance by approximately 15% as well as ensuring the resources used are focussing on the important aspects of safety and reliability. The result of the process is to redefine inspection intervals and scope of work to be performed on the multitude of components of the signalling asset.

In conjunction with the FMEA process the multi-skilling initiative is also likely to result in a reduction in employees, the overall effect not known.

A major issue for signalling maintenance costs is their allocation to specific businesses and line sections if and when that is required. An estimate by QR district managers of the proportion of time spent by the Rockhampton Operational Systems employees covering the Moura, Blackwater, Goonyella and Newlands systems revealed that approximately 77% was devoted to the coal network from a total of 238 employees. As well, many activities performed on signalling systems occur in common assets that support field based systems from a variety of locations. This is especially true for the telecommunications assets.

6.11.3 Indirect Costs

The main issue associated with efficiency of the work programmed relates to the relatively high cost of on-costs and overheads associated with QR's structure. In the Trackside Systems area a ratio of approximately 14% indirect to direct is very high with some corridors showing better results than others. As well, the ISG management fee adds another 16.7% to the total cost.

The possible integration of work activities and simplification therefore of reporting structure will have a positive effect on the competitiveness of the area. This evolution is evidenced by the absence in the structure of the 'Regional' layer of management and where the Manager has been charged specifically with an integration of skills, albeit from the head office position.

6.12 Trackside Systems Telecommunications Maintenance

Observations have been previously made in 6.1.5 and 5.7 regarding the plans to remove trade demarcations from the workforce.

It has also been noted that the telecommunications assets are of differing ages and capabilities and that new technology in this area continues to make equipment redundant.

Apart from the issue of providing a workforce with adequate skills for both the old technology and the new technology maintenance, the challenges associated with getting best value for money in the dynamically changing environment are enormous. One therefore has to question whether QR would be better served by using the resources available in the wider industry sector. It is recognised however that there are some elements of the telecommunications work function that interfaces with the signalling function. As well, it is planned to integrate these functions as far as possible to avoid duplicated resources attending the same site.

Other parts of the telecommunications function such as backbone network maintenance, IT network maintenance and office equipment have many capable suppliers and maintainers in the private sector. There is little reason why QR could not use these services in order to focus on the more critical elements of the signalling/communications functions.

6.13 Trackside Systems Overhead Traction Power Maintenance

The general thrust in the Trackside Systems area to multi-skill and to maintain to an FMEA approach will also apply to the Traction Power section. Since the costs and workforce is smaller than other areas of Trackside Systems, the priority for reform is lower than the other areas.

In overhead traction power maintenance the issues to be addressed in terms of potential efficiency improvements include:

- Merging job and skill functions between the linesman and sub-station technicians.

  The traditional boundary and demarcation in this area relates to the fact that the sub-station maintainers are mostly qualified tradesmen whilst the linesmen are mostly unqualified. The recent adoption of a competency based training system opens the potential for bridging the training gap. In terms of status, the tradesmen will be concerned with performing de-skilled work whilst the linesmen will be eager to learn new skills and be paid for those higher skills.

  Also to consider about merging the job functions, is the opportunity for actually using the multi-skilling. Where work groups do not have the opportunity to use skills there is little purpose in training and refreshing. Thus the work methods need examination and inspections and other maintenance works need reprogramming to ensure the skills can actually be used.

- Permitting other infrastructure groups to perform functions.

  Many groups of infrastructure personnel work in the vicinity of the overhead traction infrastructure. It is often because of track maintenance that the overhead traction power system requires electrical isolation, requiring staff from the 'overhead traction' area to attend to that procedure.

  Where simple and routine functions are involved it may be possible to permit suitably trained staff to perform those functions rather than incur the cost of specially providing highly trained persons. At the present time, the isolation procedures at the start and the end of a day's track works requires the services of a highly trained overhead traction employee. That employee may not have any other meaningful work to perform in that vicinity and a full day's pay is incurred for a few minutes work.

  In Mackay, the overhead traction employee's normal working day starts at a different time to track maintenance employees, so overtime is incurred as well as the inherent inefficiency. In Westrail, the two contractors, Alstom for signals and John Holland for track have reached agreement about these interface issues and the lines of demarcation are becoming blurred as staff understand that their jobs are not in jeopardy and that innovative working arrangements lead to competitiveness.

- Specific product improvement

  There are a number of components for which improvements in design, reliability and longevity are sought. QR has been active in the trialing of section insulators that form a discontinuity in the catenary and are therefore the source of catenary damage. As well, the autotransformers in use at the sub-stations are showing signs of age degradation and various methods to increase their life are being tested.

7 Efficient Costs

7.1 Summary

The derivation of efficient costs has been made by using the existing 1999/2000 budget and modifying the individual components of those costs on the basis of industry or contractor benchmarks or inappropriate practices employed by QR and applying those rates to QR’s 10 year maintenance plan. This review has also taken account of the ISG management fee and comparisons are made between defined major maintenance works and contractors’ rates incorporating this fee.

This analysis has not been able to include the effects of capital interest charges on the costs of QR, however where direct contractor benchmarks have been used these are all-inclusive of those capital charges. Therefore, any comparison made has erred on the conservative side as far as the contractors are concerned and any reductions in costs foreshadowed are likely to be greater.

The construct of an alternate model for the performance of maintenance in the coal system underpins the financial conclusions and modifications made to the existing budgets. The alternate model proposed by this review consists of the following elements and presupposes a competitive environment with private industry.

a) Targeted capital works, reducing the rail and sleeper quantities by extracting a longer life from the assets. Compared to the current regime this will not increase maintenance costs since there is a surplus of maintenance capacity and assets are being replaced unnecessarily.

   Whilst reducing the overall capital works, the remainder should be targeted to improving formation condition by reducing coal contamination, replacing sections of damaged formation, lime stabilisation and drainage improvement as concluded in 6.5.

b) Improved track machine utilisation by using higher capacity machines on extended or double shifts. QR’s own costs detailed in 6.4.1 indicate the improvements in production available with the more modern machinery.

c) Rationalisation of employee awards to eliminate penalty payments for out-of hours work, elimination of allowances no longer commensurate with contemporary regional working, and superannuation arrangements. The differences in rates and flexibility detailed in 6.2.1 and operable in the private sector highlight the changes to traditional arrangements.

d) Multi-skilling, particularly in the Trackside Systems workforce to permit interchangeability of work function detailed in 6.12, 6.13 and 6.14.

e) Increased quotas in gang competencies. Any perceived deficiencies will restrict gang productivity.

f) Arrangements to ensure surplus personnel are relocated to other areas immediately upon completion of upgrade programs. Evidence of the lag in response is indicated in 2.3 and 5.2

g) Budget planning to commitment level for at least 3 years into the future or at least for the period for which revenue streams are known.

h) Progressively increase ballast depth to a standard of 300mm below the bottom of the sleeper, which is in accord with standards expressed in NSW and WA.

i) Alignment of local track levels to a benchmark of 15 kilometres per man. This is in accord with practice in the Hunter Valley of NSW, BHPIO and Westrail.

j) Alignment of District, Regional and Head Office indirect costs so that combined they are no greater than 12% (1 in 8) of the direct costs. This benchmark is derived by taking one supervisor for each 10 staff, assuming 50% of the supervisor’s time is direct in nature (such as ordering material and arranging cooperation with other external parties) plus regional and head office overheads. For the purpose of this analysis a 6% district/regional and 6% head office split has been assumed.

k) Other measures that will improve the performance of ISG in the delivery of its services include:

   i) contract arrangements with NAG that provide incentives for improvement to increase contractual tension without producing an adversarial relationship.
   ii) separation of functions associated with the maintenance of the coal systems, such as budgetary processes, to ensure the heavy haul imperatives are not mixed with other QR business needs.
   iii) cost allocation and recording aligned to activities would provide ISG with information to be able to benchmark with other administrations.
   iv) joint economic evaluation with operators concerning planned operational changes may result in different decisions being made affecting infrastructure maintenance and construction.

Taking into account the observations made in previous sections, as well as benchmarked industry costs,the detailed elements of cost comparisons are as follows.

7.2 Local Track Gangs

Costs have been modified on the basis of a number of elements. They relate to the number of personnel in the gangs, the wages and conditions under which those individuals are employed and the circumstances of their working including operational factors. Employee costs average approximately 60% of all costs incurred in these groups.

The number of personnel in the gang is in turn related to the work volume, its appropriateness, and the productivity of those individuals. The factors observed to detract from high productivity included:

- Gangs in the process of rationalisation after upgrading do so through natural attrition and other long processes. There is also a delay between the time the upgrading is complete and the actual completion of the rationalisation.
- The number of multi-competence individuals in a gang is restricted to a pre-determined level, reducing flexibility in the formation of tasks.
- A high reliance of burning off in the management of the perceived risk of fire.
- Benchmark data for similar tasks at 15 kilometres per person.
- The high levels of coal contamination[7] and rapid asset degradation.

Gang employee counts have therefore been adjusted to 15 kilometres of mainline track per person from the current 11.9, which includes loops, turnouts, and yards. Wages and conditions have been adjusted for standard levels of superannuation, a reduction in location and working allowances from 10% to 5%, and application of contemporary employment conditions.

In total, adjustments to local gang expenditure amounts to approximately 35% reduction of the staff costs, that is approximately 22% of total costs. Say 20%. This conservative estimate is based on a restructured award or industrial agreement system as is common amongst maintenance contractors around Australia and with details previously referred.

7.3 District Track Gangs

Costs for Roadmaster and Bridgemaster gangs have been modified on the basis of a number of elements. They relate to the wages and conditions of the staff, the equivalent rates for resurfacing tasks applicable from contractors and the circumstances of their working including operational factors.

The particular factors identified as being inappropriate and identified include:

- In resurfacing teams, the low level of operator/fitter multi-skilling in place leading to approximately one extra gang member in comparison to contractors. It is noted that this discrepancy is being addressed.

- The use of relatively inefficient machinery where existing higher capacity machinery may be used on a more intensive basis by the use of double shifts or extended shifts

- The high levels of coal contamination resulting in a higher frequency of resurfacing and ballast deterioration.

- Responses by track machines to Tilt Train matters that interrupt efficient working on the coal systems. Costs arising from the disruption are hidden but effect the efficiency of work performed on the coal systems.

[7] While coal contamination is not directly controllable by ISG, the relationship between NAG and its contractor (ISG) should be such that ISG will be attempting to improve the cost effectiveness of maintenance by providing data to indicate the effect of the contamination on costs. NAG then have the responsibility for the conditions created by operators.

- Deteriorated sub-grade conditions.

Labour costs for these District gangs are approximately 50% of the total gang costs. Allowances for these groups are high, averaging 15% of the total wages costs and have been adjusted to 10% on the basis of contemporary award structures. Superannuation has also been adjusted.

In section 6.4 of this report specific cost comparisons were made for resurfacing costs. Without the impact of District and Regional overheads the analysis concluded that contractors could provide equivalent services at between 15% and 20% cost reductions. When combined with the ISG management fee burden the reduction in cost is higher. The contractors made these estimates after being briefed about the environment and circumstances present on the coal systems.

Taking into account the continued use of outdated equipment and unextended hours working the estimate for the reduction in costs for District gangs is estimated to be between 20% and 25%. This estimate ignores the observation that the high return frequency for resurfacing of every 1.5 years is detrimental to ballast life and could probably be redressed with targeted formation restoration. This deterioration to ballast resulting from more frequent tamping occurs in addition to the deterioration through contamination and therefore imposes a multiple burden on the life of the ballast Overall a reduction of 25% is estimated.

7.4 Rail Grinding

A direct comparison has been made in this analysis with estimates from the contracting industry. However, it should be noted that the depreciation treatment of capital might have bearing on the actual reductions in cost, as a typical depreciation period for the contractors is less than 10 years where the depreciation period used for most large machines in QR is 10 years.

The reasons for any differences in rates between QR and a contractor could be:

- QR's machine was purchased from a contractor. The purchase price was probably a 'retail' price whereas an operating contractor would have a machine available at their cost value. The 'retail' price reflects the contractors' costs and risk associated with infrequent sales. Whereas, when the contractor supplies both the grinding service and the machine, the regularity of revenue through a maintenance contract is favourably reflected through the actual manufacturing costs of the machine.
- Contractors, who also build their machines, are more likely to have access to information of the design which enables operation closer to the design limit in terms of both power output and maintenance requirements.
- Contractors, who also build their machines, and with detailed design access, are able to troubleshoot more effectively and efficiently.
- Contractors are less likely to deviate from the scope of work to perform tasks just because the machine is available.

Costs for rail grinding have been modified as a 14.3% reduction primarily on account of the high ISG management fee.

7.5 Facilities Maintenance

Facilities maintenance is concerned with the upkeep of infrastructure related to both the operation of trains as well as the maintenance of the train running infrastructure itself. For this reason, some facilities maintenance tasks will have a direct bearing on the efficiency of the costs of maintaining the train running infrastructure, whilst some activities will be specific to the train operator.

On the basis that the staff related costs amount to approximately 55% of the total budget, and that infrastructure maintenance staff rationalisations previously foreshadowed would result in a lesser workload, the estimated reductions amount to 21%, say 20%, which is the same as for the more generalised routine maintenance estimates made previously.

7.6 Infrastructure Services

This activity comprises many discrete functions providing a support role to the field operations as well as the Regional Manager North's office support. Whilst it has been considered a direct cost in this analysis, many of the functions are support role functions, such as drawing office activities. The considerable role of support fitters to the resurfacing teams in the region as well as workshop functions has provided evidence that the overall role is critical to the operation of field personnel.

The total costs associated with labour amount to approximately 65% of the total budget. It is noted that the 'allowances' budget amounts to 17% of the labour salaries and wages and is therefore significantly higher than any other expenditure group. This reflects the field support role provided by the area, where some allowances in the calculation of 'standard costs' have been estimated at 40% of the base labour rate. The average overtime as a ratio over normal hours is also higher than any other group at 16%.

Taking into account the high allowance rate, superannuation and contemporary award potential for aggregated wages, the modification to the budget is estimated at a reduction of 35% of labour costs, or 23% of total costs and for consistency have been estimated at 20%, similar to the routine maintenance component.

7.7 Operational Systems Local Gangs

The Operational Systems budgets are characterised by a high proportion, at 85%, of the total budget being staff related expenses. As well, the budget for allowances is approximately 20% of total salaries and wages and overtime accounts for approximately 40% of base wages.

This high overtime component is typical of industrial awards responding in the traditional way to construction work or call-outs for defect repair. The construction or upgrading work has recently been instigated for track and train operations related purposes.

Contemporary industrial awards have migrated to aggregate wage arrangements essentially, where a higher rate of pay is guaranteed in return for more flexible working hour arrangements. Some site and job specific arrangements are in place for track construction teams but the practice is very rarely used elsewhere in QR. Unfortunately, traditional award responses to call-outs imply rewards for failure of the systems. This is the main reason why most of Australia's rail systems have now converted their wages structure in the signal and communications disciplines to an outcome based structure.

Modifications have been made to the Operational Systems local gang budgets in response to labour only changes. Specifically, advice was provided that multi-skilling plans for the mechanical technicians; electrical technicians and communications technicians would most likely result in a 15% reduction in staff numbers. As well, utilisation of contemporary awards would reduce the amount of overtime as a percentage of base wages from 40% to 20%, albeit with a slightly higher base rate of pay. A total of 30% reduction in staff costs is estimated to operate on 85% of the budget. That is, 25.5%, say 25% reduction is estimated in the total local gang budgets.

7.8 Operational Systems District and Construction Teams

The teams associated with District wide services include the construction teams and Network Services, the communications specialists. The construction team's maintenance or recurrent expenditure budget is small in comparison to its capital works budget and large settlements apply. However characteristically, large overtime proportions and allowances appear further emphasizing the outdated traditional award response to this type of work.

The network services budget of 22% overtime and 16% allowances is not as high as other Operational Services areas but is still significant and could be addressed through contemporary award structures. In combination with multi-skilling in the communications and signalling disciplines, and with the application of more flexible pay structures it is estimated that these teams could reduce their staff related costs by 25% of the 85% staff proportion of total costs. That is approximately 20% of costs.

7.9 Overhead Maintenance Teams

For the purposes of this analysis all components of overhead maintenance have been classified as Direct costs because a large section of the Manager's budget is concerned with field components not specifically allocated to a particular field supervisor. This treatment will only slightly distort the Direct to Indirect analysis.

The Overhead line maintenance budgets are characterised by high staff cost proportion of total costs at approximately 50%. Allowances for these teams are relatively low at 15%.

Modifications have been made to these budgets to reflect planned multi-skilling of the sub-station function with the overhead line functions although it is recognised there is only limited scope in these areas. As well, contemporary award structures could reduce overtime and allowance payments whilst guaranteeing staff more consistent higher base wages. In total it is estimated that a 20% reduction in staff related costs could occur amounting to overall 10% reduction in the budgets.

7.10 ISG Administration and Projects and Plant

The ISG administration area includes such functions as Employee Relations, Works Planning, Budgeting and Accounting and Business Services, and could generally described as being the Group General Manager himself and support for the Group General Manager Infrastructure Services.

This small area in itself has not received any direct attention. However when combined with Projects and Plant below and previous District and Regional Indirect costs, has been benchmarked against the total of 8% of Indirect costs. For the Head Office functions 3% is remaining after the 5% allowance was allocated to the District and Regional areas as previously detailed.

The Projects and Plant area involves itself with plant and major projects including capital works. Some of its functions have already been separately costed and have previously been identified as Rail Grinding, Track Recording and Non-Destructive Testing. However many other support functions are also provided.

For the purposes of a comparative analysis, the depreciation held by these budgets for the plant used by the Districts at Roadmaster level have been allocated to that District level. This allocation has been done by observing the average plant usage on the coal lines in comparison with the balance of the network. 36% of the Plant and Projects depreciation budget (except for the GM's depreciation) has been allocated in this way to the Districts in the coalfields.

The ISG management fee of 16.7% spread across all activities is obviously inappropriate when a comparison with contractor delivered services is made. For this review, most major maintenance activities where contractor services can be sourced and where their activities are somewhat self-sufficient, the management fee concept has been incorporated into the contractors' cost. The management of the contractor would occur directly through Network Access for which suitable allowances have been made in their own cost estimates and which are detailed in other considerations for the purposes of the reference tariff.

For major maintenance activities involving a high proportion of labour and for routine maintenance works a management fee of 15% has been applied for track based activities and 25% for trackside systems based activities. These fee levels recognise the different support functions required for the two types of activity and are commensurate with other Australian railways.

8 Longer Term Maintenance

8.1 Introduction

Whilst the preceding analysis has been focussed on the practices and efficiencies used at the present time (July 1999), these observations have been applied to the 10 year maintenance plan proposed by Network Access for the purposes of compiling the reference tariff applicable to each mine cluster.

8.2 Expenses Detailed

The expenditures shown in the Maintenance Plan are those that will be specifically expensed on a particular coal system. Other costs, such as regional administration, technical services support or head office overheads have not been shown. These costs are planned by QR to be allocated, on a basis not yet clear[8]. However, the author is aware that the QCA plan allocate these costs in a manner that will enable them to determine appropriate reference tariffs.

8.3 Plan Details

The QR 10 year Maintenance Plan provided lists activities in two main categories, Major Maintenance and Routine Maintenance. These two categories have been used for each discipline, Track, Structures, Trackside Systems (Signaling and Overhead Traction Power) and Facilities Maintenance.

The Plan indicates activity description, units of work, quantity of work, unit cost and activity cost for each year over a 10 year period, starting with the 1999/2000 year.

According to Network Access, there is an accurate correlation between the actual 1999/2000 'cash' budget and the first year of the plan. This review has also concluded that there is a correlation but that the correlation relates only to direct costs and cannot be verified for ISG management fee and other 'regional' or 'network' costs.

The detail of the activities listed against each discipline in the plan varies greatly. The Major Maintenance activities in Track are detailed, showing individual functions, albeit of a project nature. All other disciplines and categories are completely absent of detail, indicating the 'Track' background of the managers within Network Access and the relatively incomplete knowledge of the other discipline areas.

Therefore the correlation between the existing actual cash budgets and the Plan figures is somewhat vague. In particular, the identification of budget areas for the resources that would normally be involved in routine maintenance, but will assist planned project works, is not well defined. In the absence of more detail of the routine works it is not possible to accurately identify cost allocations.

[8] It is planned that these 'indirect' costs will not form part of the explicit factors to be taken into account for access pricing, but will be comprehended in the striking of a rate between upper and lower bounds.

8.4 10 Year Maintenance Plan Review

Network Access has provided a 10 year maintenance plan in spreadsheet form in the detail and scope explained earlier. In two rounds of consultation, NAG were asked to clarify and explain some of the expenditures. Resulting from those explanations and from the reviewers’ own evaluations, new estimates of reasonable costs have been made.

The specific variations from the Network Access plan are detailed below.

8.4.1 Moura Maintenance Plan

This review has resulted in the modification of QR’s 10 year estimates and the reasons for those deviations are as follows:

- Year 99/00 has not been scope or efficiency adjusted so that a direct reconciliation could be made with the actual ‘cash’ budget.
- Resleepering quantities have taken into account the actual length of coal traffic track under Network Access control.
- Resurfacing frequency has been reduced so that all coal lines in the system are resurfaced each 26 MGT on average. Many line sections in the system receive small tonnages. This return frequency is approximately 50% more often than allowances made for other systems, recognising the poor formation conditions in the system.
- The mainline grinding frequency has been adjusted to better reflect the actual tonnages over each line section and the general ‘policy’ of QR to grind on a 50MGT basis. The adjusted frequency is a compromise between these two criteria. QR’s own guidelines for return frequency expressed as a map (‘6 months return for curves less than 1000m radius, 24 months tangent’ and ‘24 months all track’) and the 50 MGT criteria are grossly dissimilar for many of the line sections.
- The ballast undercutting program has been adjusted to more targeted areas and has considered the likely tonnage over the line. In the latter part of the plan when the ballast undercutting is proposed, QR expects to operate with coal from Theodore, essentially replacing lost tonnage from Moura. However QR’s own tonnage forecasts used for the purposes of developing reference tariffs plateau after 2005 and do not coincide with the assumptions made in the maintenance plan. The Moura to Earlsfield section will continue to operate at approximately 8MGT. Combined with the formation improvement plans a more modest ballast undercutting program is proposed.
- Project ballast requirements have accordingly been adjusted.
- Maintenance ballast requirements have been adjusted to take account of the actual tonnages expected, and the planned major works.

- Major track reconditioning has been removed at QR's suggestion.

- Labour efficiencies in both routine maintenance and major maintenance activities have been applied in accord with the estimates deduced in this report.

- The ISG management fee has been reduced to coincide with the estimates provided in contractors' advice for unit rates as well as taking into account the proportion of material purchases and their appropriate 'management fee'. The adjustment to the management fee amounts to approximately one half of ISG's estimates.

8.4.2 Blackwater Maintenance Plan

This review has resulted in the modification of QR's 10 year estimates and the reasons for those deviations are as follows:

- Year 99/00 has not been scope or efficiency adjusted so that a direct reconciliation can be made with the actual 'cash' budget quoted earlier.

- Major track reconditioning has been removed at QR's suggestion.

- Resleepering quantities have taken into account the actual length of coal traffic track under Network Access control.

- Rail grinding of turnouts has taken into account the actual tonnages to be experienced over all line sections and the policy of a return frequency of 50MGT.

- Labour efficiencies in both routine maintenance and major maintenance activities have been applied in accord with the estimates deduced in this report.

- The ISG management fee has been reduced to coincide with the estimates provided in contractors' advice for unit rates as well as taking into account the proportion of material purchases and their appropriate 'management fee'. The adjustment to the management fee amounts to approximately one half of ISG's estimates.

8.4.3 Goonyella Maintenance Plan

This review has resulted in the modification of QR's 10 year estimates and the reasons for those deviations are as follows:

- Year 99/00 has not been scope or efficiency adjusted so that a direct reconciliation can be made with the actual 'cash' budget quoted earlier.

- Major track reconditioning has been removed at QR's suggestion.

- The resurfacing of turnouts is halved on advice from QR.

- The rail grinding of turnouts is placed on a 3 year return frequency on advice from QR.

- Ballast undercutting scope has been reduced to match actual tonnage on line sections, and reductions in spillage brought about by the modified loading practices planned by QR.

- Labour efficiencies in both routine maintenance and major maintenance activities have been applied in accord with the estimates deduced in this report.

- The ISG management fee has been reduced to coincide with the estimates provided in contractors' advice for unit rates as well as taking into account the proportion of material purchases and their appropriate 'management fee'. The adjustment to the management fee amounts to approximately one half of ISG's estimates.

8.4.4 Newlands Maintenance Plan

This review has resulted in the modification of QR's 10 year estimates and the reasons for those deviations are as follows:

- Year 99/00 has not been scope or efficiency adjusted so that a direct reconciliation can be made with the actual 'cash' budget quoted earlier.

- Major track reconditioning has been removed at QR's suggestion.

- The frequency for resurfacing has been reduced from 20MGT to 35MGT in line with other comparable coal systems and takes into account actual tonnages on line sections.

- Ballast undercutting has been reduced to the equivalent of the Moura system which is also plagued with formation problems. The formation repairs earmarked will assist.

- Labour efficiencies in both routine maintenance and major maintenance activities have been applied in accord with the estimates deduced in this report.

- The ISG management fee has been reduced to coincide with the estimates provided in contractors' advice for unit rates as well as taking into account the proportion of material purchases and their appropriate 'management fee'. The adjustment to the management fee amounts to approximately one half of ISG's estimates.

8.5 Summary of Adjustments to QR's 10 Year Plan

The previous sections have detailed the various elements of the maintenance plans and the impact various efficiency improvements will make on those elements.

In total, over the 10 year period, the average adjustment to those various elements in a QR annual budget estimate of approximately $75 million amount to:

- Approximately $5.8m relates to scope changes. A large portion of this adjustment relates to the degraded state of the ballast, which requires such extensive maintenance on the Goonyella system. A more usual program on a system of this length would suggest an average of 30 kilometres per year. The extra expenditure proposed by QR over this benchmark amounts to $4.7m per year and could be interpreted as the extra resources required because of the degraded state of the asset. This amount was subsequently adjusted by way of asset value by the QCA to reflect the condition of the asset.

- Approximately $5m has been adjusted from the 'management fee' to reflect reasonable charges attributable to this activity by contractors. This adjustment also takes into account the high proportion of material costs in major maintenance activities that will only attract materials handling fees.

- An efficiency adjustment relating primarily to labour deployment, machine utilisation and labour rates amounts, to 10% across all of the activities combined, after the impact of the management fee adjustment. Some activities attract a larger efficiency adjustment than others. For instance, after the management fee has been accounted for, major track maintenance attracts an efficiency adjustment of 2.5%, while routine maintenance attracts an adjustment of 18%.

- In addition, in order to compare contractor's rates with QR's the VERS component of maintenance budgets was also adjusted.

- In total, the review concludes that the reduction in maintenance plan expenditure would be approximately $11.5m per annum in the first year of the plan ramping up to $13 after three years. This is approximately 15% reduction with a further reduction on account of the elimination of the VERS component.

9 Institutional Factors

During the observation and analysis stages of this study it was apparent that the way in which the QR organisation is structured and information and policy are implemented, cause inherent inefficiencies and create ineffective solutions.

The systems within QR constrain good decision making particularly as it relates to the heavy haul operations of Central Queensland.

Itemised below are those factors that lead to the inefficiencies. The factors have not been quantified in their effect on efficiency and effectiveness but have been previously mentioned in the report and quantified to the extent of the overall efficiency performances, particularly in section 7 dealing with costs.

1. Short term planning horizons for heavy haul maintenance.

The work planning and budgeting systems and timing for infrastructure maintenance work for the Central Queensland coal systems is exactly the same as for the whole of the QR system. The business imperatives and decision making timeframes necessary to run the coal systems are very different to those of say the metropolitan system. In particular, since infrastructure degradation can occur so quickly on the coal lines it is important that local management has a firm understanding of approved expenditures well in advance. Short term maintenance can be balanced with long term permanent solutions and risks associated with deferring maintenance can be taken with the comfort that expenditure for permanent solutions will be available.

2. Maintenance planning information generated by NAG is difficult to reconcile with ISG expenditure accounts.

The costing system for maintenance is based on administrative work group costing. With some rare exceptions, where work groups perform specialist activities, it is not possible to trace costs of particular activities. In other rare cases, specific work orders are generated to capture the cost but these generally relate to capital works or private sidings where expenditure is accountable to other bodies. The collection of activity based costs would permit the analysis of efficiency for the purposes of fine tuning work group performance and the quantification of output performances.

3. QR has adopted a conservative approach to the management of the rail asset.

Despite research by QR themselves and comparable operations by other railways in Australia, the head wear limits for the replacement of rail currently used by QR are conservative leading to premature rail replacement. In particular, the head wear limits in place for the Newlands and Moura lines where 22 tonne axle loads predominate are very conservative.

On the Goonyella system the replacement of the 53kg/m rail en masse is premature.

4. QR continues to expand its own skill requirements despite specialist expertise available.

The variety of signalling products in use is creating a plethora of inventory and required skills to the overall detriment of the reliability of the system. There is no evidence that any consideration other than initial purchase price has influenced acquisitions whereas continuity of technology and backup service may well present benefits in total system costs including ongoing maintenance.

As the number of products grows, particularly in the communications area, QR will be faced with a decision to become a full industry player.

5. Coal contamination is an example of the lack of rigour in decision making and results from the integration of the railway where one party remains dominant.

Coal contamination of the ballast and formation contributes up to 50% of the cost of infrastructure maintenance taking into account the necessity for extra resurfacing, spot maintenance, corrective response and capital upgrading programs. This ongoing problem has been allowed to continue despite millions of dollars being spent on corrective solutions. The integrated nature of the above rail operations and infrastructure maintenance has prevented serious consideration of the issues and the absence of any contractual system has led to the absence of any commercial tension to solve the problem.

6. Decisions to increase speed have had large cost implications.

Strategies involving the increase of speeds, indicated as a strategy to improve cycle times, have been implemented at a large cost and involving asset upgrading. The investment program was an integrated program involving improved loading and unloading times, improved reliability of locomotives and wagons, increased maximum trains speeds and bigger wagons. However, as well as involving infrastructure upgrade costs, the extra maintenance costs are having a dramatic effect on the unit maintenance costs and the activities are causing serious disruption to the operation of trains.

7. The maintenance plan and budgets are resourced based rather than needs based.

The schedule associated with the TLM appears to be largely dictated by its availability rather than by need. That is, upgrading work is dependent on resource availability rather than the need to carry out the works and this artificial constraint has been the result of a policy to prevent contract maintenance and upgrading. Upgrading work for the Goonyella system currently underway had been planned to occur well before its current timing but the TLM had not been available. On the other hand, while the current work was underway, and it was discovered that some sleepers did not need replacement, the TLM's work program was extended because the machine was available prior to its planned working on the North Coast Line upgrade.

8. Employee relations policies prevent open transmission of plans and work program consequences.

The QR employee relations policies that include location based security of employment engender insecurity and apathy to changed circumstances. In particular, where upgrading occurs to improve infrastructure and reduce maintenance, resizing of the workforce occurs through natural attrition and the creation of inefficient practices. The Blackwater gangs are in the process of amalgamation through natural attrition, creating uncertainty in the workforce. The District based gangs at Rockhampton continue to operate but with long term objectives to amalgamate after natural attrition creating uncertainty and lacking human resource planning.

9. There is an absence of contractual tension between NAG and ISG.

Within the context of Network Access being the purchaser of services from ISG there is effectively no mechanism to ensure ISG is providing value for money apart from the examination of major work programs by Network Access. There are no performance targets for productivity set or negotiated by Network Access and the Service Agreement with ISG is toothless in that the estimates provided in the Agreement use notional unit costs bearing no direct relationship with actual costs for a particular region or line sector. Network Access will at the end of the day pay ISG whatever it has cost.

10 References

A number of works on design and maintenance of infrastructure were referenced during the study. Together with information received from QR and various contractors the references formed the basis on which certain conclusions have been drawn and recommendations made. The published references were:

Ebersohn (1995), "Substructure Influence on Track Maintenance Requirements", Willem 1995.

Maree J.S. (1989), "Evaluation of Track Structure Problems on the Coal Line", Fourth International Heavy Haul Conference, Brisbane pp 446-451, September.

Esveld C. (1989), "Modern Railway Track".

Arnold D. Kerr (1975), "Railroad Track Mechanics & Technology", Proceedings of a Symposium, Princeton University 1975.

Doyle N.F. (1980), "Railway Track Design – A Review of Current Practice", BTE Occasional Paper 35, Australian Government Publishing Service.

Hagaman B.R.(1989), Optimisation of 1067mm Gauge Railway Track Under Static and Dynamic Loading", Master of Engineering Thesis, Queensland University of Technology.

11 Attachment A

Certain items required clarification by QR during the study and the following letter was forwarded for QR’s reply.

RMS

RAIL MANAGEMENT SERVICES Pty Ltd ACN 077 089 813
Suite 3, 9 Church St
L.P.O. Box 2321
Licensed Post Office Hawthorn 3122
Victoria

14 Oct 99

Tel 0412 164 391

Mr Glen Mullins
Infrastructure Asset Manager
Network Access Group
Queensland Rail
Floor 21, 127 Creek St
Brisbane 4000

Dear Glen,

Re: Efficiency of QR’s Infrastructure Maintenance Review for QCA

In order to finalise my report to the QCA and for the QCA to subsequently release the draft for QR’s comment, there are some gaps in some of the historical and technical data about maintenance and operating strategies which have a direct bearing on the efficiency of current day practice. I have formulated some questions below that would assist in filling in the gaps.

I have received excellent cooperation from all of the QR contacts you have supplied to me on the verbal level and I would normally continue to do so if I thought the questions below could be answered simply. However I thought it best to approach you in writing with these questions because they are probably more complicated in their answers and there is a need to be more precise in their framing.

Please do not hesitate to contact me if there is a need to discuss the issues before your response.

1. In the concrete sleepering upgrade of the Blackwater system, was any consideration given to concrete sleepering of the Laleham Branch? It is noted that the Branch receives almost as much tonnage as the Moura Line and certainly more than some northern parts of the Blackwater system.
2. For the project generally referred to as the ‘80kmph’ upgrade, where the speed limit for all systems is proposed to be lifted from 60kmph to 80kmph, were there considerations given to achieving the same benefits by other means, such as improving the terminal operations, or upgrading only those sections where most benefit could be gained? In the same project, were the increases in operating costs, particularly infrastructure maintenance, evaluated against the benefits?
3. In relation to head hardened rail, have cost benefit studies been conducted to determine the circumstances in which its use is superior to standard carbon rail? What were the conclusions of that analysis?

4. Has a risk analysis of Vertical Split Head rail defects on the coal systems been done to determine what options are available for their management? What were the conclusions of that analysis?
5. Have any investigations been conducted into methods to reduce the impact of coal spillage? It was reported to me during a site visit that the coal operations group had encouraged the mines to load the wagons to the maximum possible degree in order to improve the capacity of the system. Was any analysis performed as to the benefits and costs of a policy which inevitably led to coal spillage?
6. Re there any plans to repair formation problems on the coal lines other than by way of lime stabilisation which, it is understood, has had variable success? Have there been any other successful methods and were they experimental in nature or part of a longer term justified program?
7. Have considerations been given to increasing ballast depth on the coal lines and what were the results of that consideration?

Please do not hesitate to contact me to discuss these issues if required or to clarify the questions. Could an interim reply be made available by 30th October please.

Martin Baggott
General Manager

12 Attachment B

Items requiring QR's clarification in Attachment A received the following response and is reproduced below.

08/12 '99 09:48 FAX 61 7 3235 3439 QR NETWORK ACCESS 002

61 7 3235 3439 Copied P. Ellerby.

Network Access
Network Infrastructure & Business Systems

NA/I99 (3964)

FILE COPY

GPO Box 1429
Brisbane Qld 4001
Floor 21 Indus House
127 Creek Street
Brisbane Qld 4000
Telephone
07 3235 2489
Facsimile
07 3235 3439
E-Mail
glen.mullins@qr.com.au

Mr Martin Baggott
General Manager
Rail Management Services
Suite 3, 9 Church Street
HAWTHORN VIC 3122

NETWORK ACCESS
QUEENSLAND RAIL

Dear Martin

EFFICIENCY OF QR'S INFRASTRUCTURE MAINTENANCE

Reference is made to your letter of 15 October regarding the above. You requested advice on Seven (7) specific issues. Please find below our comments on each of these.

1. CONCRETE SLEEPERING UPGRADES

It was considered that the costs of concrete sleepering the Laleham Branch (and also the nearby Kinrola Branch) and upgrading signalling and turnouts to allow the introduction of 80km/hr coal trains were disproportionate to the benefits to be gained as compared to the investment on the main trunk route. Short lengths of haul at the slower speed did not dramatically affect rollingstock requirements. There was also perceived to be a greater commercial risk, with single mine spurs, of the traffic ceasing due to unexpected marketplace changes or other factors (note Koorilgah closure and Gordonstone disruptions).

The Laleham Branch was also complicated by the fact that the track beyond Koorilgah is owned by South Blackwater Mining Company, and their level of commitment to upgrading had been sufficient to only provide 150mm timber sleepers to replace the original 100mm sleepers allowing heavier wagons (but not higher train speeds) to be introduced. Also, significant lengths of the private railway were to be undermined by the longwall operation and had to be periodically rehabilitated which was thought to be easier with the lighter track structure.

In terms of the tonnage comparisons made, I think that Laleham has built up substantially over recent years with the development of its longwall operation. Also, the Gregory Line and the link to the Goonyella System by the "northern parts of the Blackwater System" were originally constructed in 47kg/m rail and various sections of 150 and 100mm timber sleepers for freight train and limited 1980's coal train operations. This track standard required upgrading for the introduction of 104 tonne wagons and the increasing cross system coal traffic.

2. INCREASED COAL TRAIN SPEEDS

QR's then Coal & Minerals Group engaged a railroad consultant from the USA to review the best way of catering for the rapidly increasing coal tonnages being projected, rather than just buying more and more trains. His analysis of rollingstock numbers required improved terminal loading and unloading times, improved reliability of locomotives and wagons, reduced operational delays in train running, as well as increased maximum coal train speeds and bigger wagons.

All of these aspects have been addressed in different ways. Through put studies have been made of Jilalan and Callemondah and respective investment programs put in place. A major investment in coal wagon fleet upgrading to higher capacity wagons has also been pursued.

The higher coal train speed project was not a "stand alone" project. It required integration with other capital investments to achieve its outcomes, particularly the concrete sleeper relays of the trunk corridors and the associated ballast renewal. The installation of wheel impact detectors was also a key requirement in terms of minimising track damage from the higher speed/heavier axle load trains.

As indicated under 1, some short branch lines were not included in the higher train speed project because their contribution to improved turnaround times were not justifiable compared with the costs involved. The investment was also staged with respect to corridors (and even within corridors to some extent) to provide the maximum benefits as early as possible.

A cost benefit analysis was done in order to justify the investments required and some additional track maintenance costs were part of that analysis.

3. HEAD HARDENED RAIL

Cost benefit studies have been conducted into the use of head hardened rail and a set of standards are available for its recommended use. In general terms it is not recommended for curves of greater than 600m or tangent track.

4. VERTICAL SPLIT HEAD RAIL DEFECTS

Management of Vertical Split Head and other rail defects on the coal network is in accordance with QR Standards which are developed by our technical advisers in line with prudent risk management. There is little of the susceptible pre-1980 53kg/m or 47kg/m rail left on the coal network (mainly Saraji to Peak Downs).

Specific non-destructive testing techniques have been developed to locate VSH defects and identification terms have been redefined.

5. COAL SPILLAGE IMPACT

Coal fouling of the ballast has always been a problem on the coal network. This has been due to coal falling off the tops of wagons, being dropped by defective doors opening during transit, and being shaken off bogies which have "plowed" through coal overflow at the bottom discharge unloading pits.

There are essentially two types of coal loaders in the system. The older (original Utah now BHP) clamshell style which tend to load irregularly and the flood loading style that have been the more recent installation. It is only the former that are likely to have been significantly affected by the incentive scheme.

The amount of coal falling off the tops of wagons has probably been increased by the incentive scheme C&M introduced to minimise underloading, but I am not aware of any studies to confirm/quantify this or to analyse the costs/benefits. However, the Coal Division are in the process of installing Coal Load Profilers and Overload Removal Systems at those mine loadouts which have clamshell coal loaders (giving poor control of coal flow into wagons) to assist in reducing the extent of this problem.

In regard to coal spillage due to unplanned door openings along the track and coal "plowing" at the unloading pits, the introduction of Kwik-Drop doors for automation of coal unloading has dramatically reduced the extent of these sources of coal fouling of track.

6. FORMATION REHABILITATION

QR has used various techniques for treatment of formation problems over the years. These have included "french" drainage, lime piling, geofabric, capping layers, and deep formation rebuilds. Only the latter has been effective in the long term in most cases, and this has only been possible for isolated defects due to cost and disruption to traffic. It is not an economic solution for extensive lengths of deep reactive clay subgrades.

Lime slurry pressure injection options were initially trialled along with a number of formation rebuild alternatives on the Moura Short Line before the current process was selected for improving reactive clay subgrade performance. LSPI does not provide a "one treatment" solution at all problem sites, but has indicatively a 70% success rate with a single treatment, 95% with two treatments and is probably the wrong solution if more than three treatments are required. It is also not yet clear just how long lasting the improvement effect on the subgrade material will last, and the balance of the Moura Short Line (about 25 kilometres) which might benefit from the process will not be treated until the existing work shows the achievement of medium term benefits.

There is also difficulty to date in determining whether or not the process (including the specific slurry mix) which seems appropriate for the Moura Short Line subgrade material will be suitable for the expansive clays found in other areas of the coal network. Some limited work has been carried out in coal traffic areas on the North Coast Line and the Central Line, and on the Goonyella System. Isolated sections of failed formation on non-expansive subgrades on the Goonyella System continue to be repaired by total formation rebuild.

7. BALLAST DEPTH

Extensive research and development has been undertaken into the performance of ballast in recent years. This has included the development of an improved ballast specification, the assessment of ballast performance and degradation and consideration of maintenance equipment and practices.

Ballast depth on the coal systems was reviewed in 1992 in connection with the increase in axle load to 25t. This indicated that an increase in depth to 300mm could be warranted. However analysis showed that formation bearing pressures are within allowable design range for both 250mm and 300mm and implementation of 300mm ballast depth to existing tracks would involve considerable costs in adjusting overhead traction wire heights, additional ballast and some formation lowering works.

The issue of ballast depth on the Goonyella system is again being reviewed and a report will be finalised shortly.

I trust that this information satisfies your enquiries.

Yours sincerely

G R Mullins

Glen Mullins
General Manager
Network Infrastructure & Business Systems

29 November 1999