Report

October 2018

Report for – Rother Valley Railway
Track Reinstatement between Northbridge Street and Junction Road
Air Quality Statement – Level Crossings and Rolling Stock Emissions
T2073.3
Final

Document version control

Version	Date	Author	Reviewed by	Reviewed and approved by
0.1	11/09/18	Alaric Lester	Richard Lane	Peter George
0.2	24/09/18	Alaric Lester	Richard Lane	Peter George
0.3	25/09/18	Alaric Lester	Richard Lane	Peter George
0.4	15/10/18	Alaric Lester	Richard Lane	Mark Skelton

Report for:	**David Gillett** Rother Valley Railway Ltd.
Main contributors:	**Alaric Lester, Marko Ristic-Smith, Richard Lane, Elena Recio Palanca**
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Contents

Appendices

1.0 Executive Summary

Temple Group Limited has reviewed air quality issues associated with the Transport and Works Act Order application for the Rother Valley Railway extension to Robertsbridge, on behalf of Rother Valley Railway Ltd. Nitrogen dioxide, fine particulate matter and sulphur dioxide were all considered.

Pollution levels in the area are low and typical of rural areas. Even along the A21, kerbside measured nitrogen dioxide levels are within national standards. The highest recently-measured annual nitrogen dioxide concentration at the A21 is 30.6 µg/m^3. In nearby Northiam, the corresponding measured concentration is 23.5 µg/m^3. This compares with the national objective level of 40 µg/m^3, which is met across much of Sussex and Kent, with the exception of some built-up areas near busy roads.

Calculated emissions impacts from proposed level crossings associated with the Rother Valley Railway extension give predicted increases in nitrogen oxides and fine particulate matter (PM_{10}) of up to 5.6% and 2.3% respectively. Given the low baseline pollution levels, the small increase in emissions and the distance of the nearest receptors to where vehicles will be queuing, changes in pollution levels at these receptors are likely to be negligible.

Emissions from steam and diesel engines on the extension have been estimated. A qualitative assessment of potential impacts from engine emissions has concluded that additional emissions from engines will be well below the level at which significant effects might occur.

2.0 Introduction

Rother Valley Railway Ltd (RVR) instructed Temple Group to look at air quality issues associated with the Transport and Works Act Order application for the Rother Valley Railway extension to Robertsbridge. It is understood that a number of stakeholders have objected to the proposals on the grounds of air quality impacts related to traffic queues at the proposed level crossings and general air quality impacts from diesel and steam emissions from locomotives.

This report considers the following:

- baseline air quality conditions;
- a desktop review previously-identified air quality issues associated with heritage railways;
- consideration of the potential impact of traffic queues on emissions and air quality at the three proposed level crossing associated with the extension; and
- consideration of the likely impacts on emissions and air quality from heritage railway diesel and steam engines associated with the extension.

3.0 Baseline Conditions

3.1 Pollutants of Concern

The pollutants of potential concern for the proposed extension are nitrogen dioxide (NO_2), fine particulate matter (PM_{10} and $PM_{2.5}$) and sulphur dioxide (SO_2). Road vehicles are the main sources of NO_2, PM_{10} and $PM_{2.5}$ in the area. Diesel and steam engines emit NO_2 and PM_{10}; they also emit SO_2.

National objectives for NO_2, PM_{10}, $PM_{2.5}$ and SO_2 are in **Table 2.1** below.

Table 2.1: National air quality standards and objectives relevant to Rother Valley Railway

Pollutant	Air quality objective levels	Measured as
NO_2	200 µg/m^3, not to be exceeded more than 18 times per year	1-hour mean
	40 µg/m^3	Annual mean
PM_{10}	50 µg/m^3, not to be exceeded more than 35 times per year	24-hour mean
	40 µg/m^3	Annual mean
$PM_{2.5}$	25 µg/m^3	Annual mean
	Target of 15% reduction in concentrations at urban background	Annual mean
SO_2	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean
	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean

When considering NO_2 emissions, nitrogen oxides (NO_x) are usually calculated. NO_x converts to NO_2 in the atmosphere. The relationship between NO_x and NO_2 is not linear, but the majority of NO_x is likely to convert to NO_2 in the relatively rural setting of the RVR.

3.2 Receptors

3.2.1 A21

There are no relevant receptors near the proposed level crossing on the A21. The nearest residential properties are around 150 m to the north, close to the roundabout at the junction of the A21, Northbridge Street and Church Lane. Two properties are approx. 15 m from the A21.

3.2.2 Northbridge Street

The nearest property to the proposed level crossing is around 50 m to the north and approximately 2 m from the kerbside. There are other properties further away from the proposed level crossing.

3.2.3 B2244

Udiam Cottages are on the B2244, approximately 180 m south of the proposed level crossing and 2 m from the kerb.

Udiam Farm is more than 100 m east of the B2244 and pollution levels there will not be influenced measurably by changes in traffic on the B2244.

3.2.4 Ecology

The land immediately adjacent to the proposed level crossings is mainly open arable and pasture farm land with small pockets of deciduous woodland. The closest designated ecological site is Wellhead Wood Ancient Woodland approx. 130 m to the south of the proposed track alignment.

3.3 Local Authority Review and Assessment Information

Rother District Council (RDC) publishes air quality review and assessment information periodically, as part of its statutory air quality duties. Air quality in Rother district is generally good. Road traffic is the main source of pollution near the proposed extension, with the A21 being a major route. There are currently no areas in Rother where members of the public are exposed to pollution levels in excess of national air quality objectives[1].

3.3.1 Monitoring

Continuous monitoring is undertaken at two sites within the District of Rother. One of these sites is located on De La Warr Road in Bexhill-on-Sea (RY2). It is located approximately 17 km south of the proposed scheme and monitors NO_2 and PM_{10}. **Table 2.2** shows NO_2 and PM_{10} monitoring results from this kerbside monitoring site. The NO_2 annual mean, NO_2 one-hour, PM_{10} annual mean and PM_{10} 24-hour measurements were all within national objectives between 2012 and 2016. Although in a different setting from the RVR, this is the only PM_{10} monitoring station within the borough.

Table 2.2 Monitoring results for RY2 monitoring location

Year	Annual mean NO_2 (µg/m^3) [2]	No of 1-hour exceedances NO_2[3]	Annual mean PM_{10} (µg/m^3) [4]	No of 24-hour exceedances PM_{10} [5]
2012	27.5	0	20.8	8 (37)
2013	26.0	0	25.2	7
2014	22.5	0 (105)	19.0	0 (30)
2015	19.8	0 (100)	24.3	2 (33)
2016	25.2	0	18.1	0 (27)
Objective	**40.0**	**18**	**40.0**	**35**

– Source: Rother District Council. Air Quality Annual Status Report (ASR), 2017.

There are two kerbside NO_2 diffusion tube monitoring locations relatively close to the proposed scheme site. Diffusion tube DT2 is approximately 77 m south of Northiam station, on the existing KESR line. Diffusion tube DT9 is on the A21, approximately 250 m north of the proposed A21 level crossing of the RVR.

[1] Rother District Council (October 2017), 2017 Air Quality Annual Status Report (ASR)

[2] Data capture less than 75%, annual mean NO_2 concentrations have been annualised (in brackets, where available).

[3] Data capture less than 85%. 99.8th percentile of one-hour mean NO_2 concentrations (µg/m^3) included in brackets (where available). A 99.8th percentile concentration (in brackets) below 200 µg/m^3 indicates compliance with the one-hour objective.

[4] Data capture less than 75%, annual mean PM_{10} concentrations have been annualised (in brackets, where available).

[5] Data capture less than 85%. 90.4th percentile of 24-hour mean PM_{10} concentrations (µg/m^3) included in brackets (where available). A 90.4th percentile concentration (in brackets) below 50 µg/m^3 indicates compliance with the 24-hour objective.

The results of NO_2 diffusion tube monitoring at locations nearest to the site are shown in **Table 2.3**. The results indicate that NO_2 concentrations are within the annual mean objective level.

Table 2.3 Annual mean NO_2 concentrations at diffusion tube sites (μg/m^3)

Site name	Location	Site type	2012	2013	2014	2015	2016
DT2	North of Northiam	Kerbside	19.4	18.2	20.8	18.4	23.5
DT9	A21 Robertsbridge	Kerbside	23.9	16.1	26.6	22.1	30.6
Objective			**40.0**				

– Source: Rother District Council. Air Quality Annual Status Reports (ASR), 2016 and 2017

3.4 Defra Background Mapping

Background concentrations of NO_2, PM_{10} and SO_2 were obtained from the Defra background maps[6] for the 1 km x 1 km grid squares along the proposed route of the RVR line. Background NO_2, PM_{10} and SO_2 concentrations for 2021, the opening year of the development, are shown in **Table 2.4**.

Table 2.4 Defra annual mean background pollutant concentrations along the Proposed route of the RVR line (μg/m^3)

Grid square	2021 NO_2	2021 NO_x	2021 PM_{10}	2021 $PM_{2.5}$	2021 SO_2
573500, 123500	**6.7**	**8.7**	11.9	8.1	3.8
573500, 124500	6.3	8.2	11.4	7.6	3.8
574500, 123500	6.4	8.3	12.3	8.1	3.7
574500, 124500	6.5	8.4	11.9	7.9	3.8
575500, 123500	6.0	7.7	11.3	7.6	3.7
575500, 124500	6.0	7.7	11.7	7.8	3.7
576500, 123500	5.9	7.6	11.3	7.5	3.7
576500, 124500	5.9	7.6	12.0	7.9	3.8
577500, 123500	6.0	7.8	12.6	8.2	3.8
577500, 124500	6.0	7.7	**12.7**	8.3	3.8
578500, 123500	6.0	7.8	12.2	8.1	3.8
578500, 124500	6.1	7.9	12.7	**8.4**	**3.9**
Objective	**40**	**-**	**40**	**-**	**-**

There is little air quality monitoring in the vicinity. The nearest NO_2 monitoring site is a kerbside site on the A21 in Robertsbridge. Measured annual mean NO_2 concentrations here have been no more than 30.6 μg/m^3 in recent years[1], within the national air quality annual mean objective level of 40 μg/m^3.

3.5 Overall Baseline

Overall, pollution levels in the area are low and typical of rural areas. Even along the A21, measured NO_2 levels at the kerbside site are within the national annual mean objective level.

[6] Defra Background mapping data for local authorities – 2015 https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015.

4.0 Desktop Review of Heritage Railways

4.1 Heritage Railway EIAs

No specific air quality issues have been identified in a desktop review of recent heritage railway EIAs.

4.2 Air Quality Management Areas

It is rare for heritage railways to be associated with air quality problems. There is one air quality management area (AQMA) in the UK associated with heritage railways: the Great Central Railway (GCR) AQMA in Charnwood borough. Charnwood Borough Council's 2006 Air Quality Action Plan[7] states:

"Air quality problems in the vicinity of the GCR are associated with emissions from the engineering shed when the steam locomotives are 'fired up' each day in order to bring them into operational service. The process takes around 3 hours during which time the dispersion characteristic of the plume is poor due to low temperatures and below-optimum combustion. The nearest properties are within 20 metres.

"Monitoring of air quality near to the sheds allied with modelling of the emissions has concluded that approximately 70 residential properties may be subject to more than 35 incidents per year when they are exposed to more than 266 mg/m^3 of sulphur dioxide for 15 minutes. The nature of the activities at the GCR mean that receptors are not subject to chronic, long-term exposure. The problem is exclusively due to occasional, short-term exposure to high levels of SO_2 when the operations at the engine sheds and weather combine to prevent adequate dispersion of the emissions."

There are several unusual factors contributing to the air quality issue in this AQMA, including the presence of receptors within 20 m of where steam locomotives are fired up each day and the use of full-size steam engines on the Great Central Railway. This railway is not considered representative of operations at the Rother Valley Railway.

4.3 Other Rail-related Air Quality Issues

There has been concern about diesel emissions associated with the Great Western Mainline. A 2014 study[8] for Ealing and Islington Councils found that, although then-current GLA modelling indicated that diesel trains on the Paddington mainline may be responsible for breaches of the NO_2 annual mean objective, real-world measurements did not support the modelled predictions and a clear signal from diesel trains was difficult to detect. A 2015 study[9] showed that, while train stations are not required to comply with national air quality standards, pollution levels at the station were often higher than on the Marylebone Road. However, the Great Western mainline is a busy line, with large numbers of high-power diesel engines. Given the difference in scale between the Great Western mainline and RVR, it is not anticipated that the issues associated with the Great Western mainline will be applicable to RVR.

[7] Charnwood Borough Council (September 2006), Local Air Quality Management – Final Action Plan

[8] Fuller et al. (2014), Air Pollution Emissions from Diesel Trains in London,

[9] Uven Chong et al (2015), Environ. Res. Lett. 10 094012

5.0 Potential Air Quality Impacts from Proposed Level Crossings

5.1 Proposed Crossings

Three level crossings are proposed, as described in the 2011 Rother Valley Railway Proposed Level Crossings Traffic Impact Study[10]:

- Crossing 1, on Northbridge Street, approximately 300 m south-west of the roundabout at the junction of the A21, Northbridge Street and Church Lane;
- Crossing 2, on the A21 Robertsbridge Bypass, approximately 140 m south of the roundabout; and
- Crossing 3, on the B2244 Junction Road, approximately 6 km south of Hawkhurst.

The 2011 Traffic Impact Study looked at the impacts of the proposed level crossings on traffic. It made predictions of likely queue lengths during crossing closures for typical weekday, Saturday and Sunday traffic situations in spring/ autumn and in summer. In addition, it considered likely queue lengths for the May Day and August bank holidays.

5.2 Potential Emissions Impacts from Proposed Level Crossings

5.2.1 Calculation of Emissions

Emissions of NO_x and PM_{10} were calculated for the year 2021, using information from the Traffic Impact Study[10] and vehicle emissions factors from Defra. A more detailed description of the emissions calculation method is provided in Appendix B. $PM_{2.5}$ emissions have not been calculated explicitly, since these follow similar trends to and are included within PM_{10} emissions.

5.2.2 Results

Tables 4.1 and **4.2** show calculated increases in NO_x and PM_{10} emissions as a result of the proposed level crossings. The increase in NO_x ranges from 1.6 to 5.6 %. The increase in PM_{10} ranges from 0.7 to 2.3 %. These additional emissions from queues are relevant only close to the proposed level crossings, where the traffic queues form before vehicles accelerate away.

Table 4.1: Calculated NO_x emissions per unit distance in 2021

Road	Baseline NOx (kg/ km/ annum)	Additional NOx from queues (kg/ km/ annum)	Increase in NOx as a result of proposed level crossing closures (%)
A21	2,247.0	126.5	5.6%
Northbridge St	275.6	4.4	1.6%
B2244	292.4	13.7	4.7%

[10] Mott MacDonald (October 2011), *Rother Valley Railway: Proposed Level Crossings Traffic Impact Study*

Table 4.2: Calculated PM_{10} emissions per unit distance in 2021

Road	Baseline PM_{10} (kg/ km/ annum)	Additional PM_{10} from queues (kg/ km/ annum)	Increase in PM_{10} as a result of proposed level crossing closures (%)
A21	190.48	4.39	2.3%
Northbridge St	21.51	0.16	0.7%
B2244	26.03	0.47	1.8%

5.3 Potential Air Quality Impacts of Proposed Level Crossings

The predicted increases in emissions arising from the level crossing will lead to increases in air pollution levels in the immediate vicinity of the crossings. This section considers qualitatively the likely magnitude of change in NO_2 and PM_{10} levels.

Best-practice guidance on assessing air quality for planning[11], produced by Environmental Protection UK and the Institute of Air Quality Management, indicates that changes in pollution levels in areas with low concentrations are likely to be negligible if they are 5 % or less. This guidance has been considered in this qualitative assessment.

Pollution levels are known to fall steeply with distance from roads. Concentrations at kerbside locations (less than 1 m from the kerb) are highest, with a steep drop in concentrations to around 20 m from the kerb. Concentrations fall more slowly after this; at around 50 m, road contributions are very small; by 200 m, it would be hard to differentiate between pollutant contributions from roads and from general background levels. Distances of receptors from kerbsides have also been considered in this qualitative assessment.

5.3.1 A21

According to the Traffic Impact Study[10], average length of traffic queues for level crossing closures in 2021 are predicted to be in the range 46-66 m, with the exception of bank holidays, where they range from 73-196 m. Maximum queues in 2021 range from 53 to 82 m in general, with a much longer maximum queue of 1,217 m during the May bank holiday.

Residential receptors close to the A21 are more than 100 m to the north of the proposed level crossing and the small calculated increases in emissions would not, therefore, be close enough to impact upon these receptors for the vast majority of the time. The extended queues on the May Day Bank Holiday would have a negligible impact on annual mean pollution concentrations at these receptors and there is no realistic risk that short-term national objectives would be breached.

5.3.2 Northbridge Street

The small increases in NO_x and PM_{10} associated with level crossing closures are likely to lead to negligible increases in NO_2 and PM_{10} levels in the immediate vicinity of the proposed level crossing. In addition, according to the Traffic Impact Study, maximum queues from barrier closures in 2021 will be 12 m. The nearest residential receptors will be around 40 m from the queues and it

[11] Moorcroft and Barrowcliffe. et al. (2017) Land-use Planning & Development Control: Planning for Air Quality. v1.2. Institute of Air Quality Management, London.

is, therefore, highly likely that changes in pollution levels relevant to air quality objectives will not be discernible at these receptors.

5.3.3 B2244

As for Northbridge Street, the small increases in NO_x and PM_{10} associated with level crossing closures are likely to lead to negligible increases in NO_2 and PM_{10} levels in the immediate vicinity of the proposed level crossing. The nearest residential receptors are some distance from the predicted queues associated with level crossing closures. It is highly likely that there will be no discernible increase in pollution levels at these receptors.

6.0 Potential Impacts from Heritage Railway Steam and Diesel Engines

6.1 Receptors Near the Proposed Extension

Receptors are shown in Appendix A. No receptor is within 20 m of the proposed line.

There are dwellings near the proposed line close to the B2244, in Salehurst and in Robertsbridge. Most of these are more than 50 m from the line. In Robertsbridge, where trains will be stationary at the station, the nearest receptors are more than 50 m away. An engine shed is also proposed at Robertsbridge Junction station; the nearest dwellings are more than 150 m from it.

There is one dwelling on Northbridge Street within around 22 m of the line. Close to the B2244, Udiam Farm is approximately 24 m from the railway.

Wellhead Woodland is around 130 m to the south of the proposed track alignment.

6.2 Emissions from Locomotives on the Proposed Extension

Emissions of SO_2 and NO_x have been estimated for both steam and diesel engines on the proposed extension, based on 2017 fuel use provided by RVR and 2016 emissions factors (the latest available) from Defra[12]. These represent conservative over-estimates, since no account has been taken of the fact that a substantial proportion of fuel in the 2017 fuel-use data was used in firing up steam locomotives.

Based on previous fuel use, an estimated additional 525 kg of SO_2 and 206 kg NO_x will be emitted per annum, per kilometre of track. In the absence of emissions factors for PM_{10} for steam locomotives, PM_{10} emissions have not been estimated.

A summary of engine emissions calculations is presented in Appendix C.

6.3 Potential Impacts from Engine Emissions

It is estimated that engines will be fired up from the shed at Robertsbridge Junction up to 100 times per year. Since the shed is over 150 m from the nearest dwelling, emissions from firing up are expected to have a negligible impact.

When trains are moving, emissions from engines are well dispersed, since pollutants are released above the engines and the movement of the train quickly dilutes emissions. In the professional opinion of the author, estimated emissions are well below a level at which substantial changes in pollution levels at receptors would be likely, both in respect of long-term and short-term standards.

At the station in Robertsbridge, although engines may be stationary for some time, emissions whilst stationary will be lower than when moving, and receptors are more than 50 m from the railway.

Overall, given the quantum of emissions and location of receptors, it is considered that the additional emissions from engines will be well below the level at which significant effects might occur.

[12] National Atmospheric Emissions Inventory UK emissions data selector http://naei.beis.gov.uk/data/data-selector?view=air-pollutants

7.0 Conclusions

The desktop review has identified that there is one AQMA in England associated with heritage railways. This heritage railway is unusual in that it operates mainline steam locomotives and that there are receptors within 20 m of where locomotives are fired up. It is not considered representative of operations at the Rother Valley Railway. Heritage railways in general are unlikely to lead to air pollution levels that breach national standards, since they operate limited services compared to national rail services.

The assessment of potential air quality impacts from the proposed level crossings has shown that increases in NO_x emissions will be a maximum of 5.6 % close to the proposed A21 level crossing and less elsewhere. Increases in PM_{10} emissions will be a maximum of 2.3 % close to the proposed A21 level crossing and lower elsewhere. Potential changes in pollution levels at receptors close to the A21, Northbridge Street and B224 are likely to be negligible in all cases.

A conservative over-estimate of rail engine emissions has calculated that 525 kg of SO_2 and 206 kg of NO_x will be emitted per annum, per kilometre of track. In the professional opinion of the author, these additional emissions will be well below the level at which significant effects might occur.

Appendix A – Receptors Near Proposed Railway Extension

Project: Rother Valley Railway
Client: Rother Valley Railway Ltd

Sensitive receptors within the Proposed Rother Valley Railway

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Temple Group Ltd., The Woolyard, 52 Bermondsey Street
London SE1 3UD
Tel. 020 7394 3700

Legend
- Sensitive receptor
- Proposed level crossing
- Proposed railway route
- Wellhead Woodland

Appendix B – Method for Calculating Changes in Road Vehicle Emissions

Emissions per unit length of each road considered were calculated without the proposed level crossings in place, using traffic flow data from DfT[13] and the Railway Proposed Level Crossings Traffic Impact Study. DfT's Tempro model[14] was used to adjust the data to the assessment year of 2021. Growth factors were calculated for each of the roads assessed and were applied to the baseline traffic data (2010). Emissions factors were taken from Defra's Emissions Factors Toolkit (EFT)[15]. The EFT allows calculations of emissions from road vehicles along road links, given traffic flow, composition and average-speed inputs. Vehicles typically have lower emission rates per unit distance at around 50 km/h, and higher emission rates at low and high speeds.

Queuing vehicles have lower average speeds and, hence, higher emissions. Vehicles emit additional pollutants while queuing and when accelerating away from queues. Deceleration when joining a queue is not likely to generate additional emissions.

The EFT, as a speed-based tool, contains a database of vehicle emissions (in g/km/s). It does not contain emissions factors for average speeds below 5 km/h. As a pessimistic assumption, it has been assumed that vehicles queuing and vehicles accelerating away will have an emission rate corresponding to that of vehicles at 5 km/h. Additional emissions associated with queuing have been calculated for the year 2021 using this assumption.

Average queue lengths were taken from the Traffic Impact Study[10]. A number of additional assumptions were taken from the Traffic Impact Study[10], including:

- an average vehicle length of 5.75 m;
- an average crossing closure time of 51 s;
- a saturation flow rate (rate at which vehicles cross the railway line after a closure) of 30 vehicles per minute.

Additional emissions per level crossing closure were calculated based on average queue length for the following day types:

- spring/ autumn weekday
- spring/ autumn Saturday
- spring/ autumn Sunday
- May Day Bank Holiday
- summer weekday
- summer Saturday

[13] https://www.dft.gov.uk/traffic-counts/

[14] https://www.gov.uk/government/publications/tempro-downloads

[15] Defra Emissions Factors Toolkit Version 8.0.1. Available from https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

- summer Sunday
- August bank holiday

The total additional emissions per annum on each link were calculated from the 2018 train timetable provided by RVR, by multiplying the number of train trips on each day type by the calculated emissions per crossing closure for the relevant day type.

The May Day Bank Holiday is an exceptional traffic event on the A21, with large numbers of vehicles heading towards and away from Hastings. As a highly pessimistic assumption, it has been assumed that level crossings on each May bank holiday will lead to slow-moving traffic for an additional six hours. This is pessimistic, since there is already a substantial amount of queuing on the A21 on May Day and since the late May bank holiday is not associated with such high levels of traffic.

The Traffic Impact Study[10] provided only limited information on queue lengths along Northbridge Street. It has been assumed that the spring/ autumn weekday queue lengths are representative, on average, of queue lengths at other times.

Appendix C – Engine Emissions Calculations

Engine type	Steam locomotive		Diesel traction engine	
Fuel type	Coal		Diesel	
Sulphur content	0.74%		0.001%	
Annual fuel usage	571	tonnes	9,120	litres
Current annual miles	17,628.88	miles	3,855.92	miles
Average fuel use per mile	0.032390033	tonnes/mile	2.365194299	litres/mile
RVR length (miles)	3.5	Miles	3.5	miles
Existing KESR section length (miles)	10	Miles	10	miles
Total annual mileage increase (%)	35%		35%	
Total annual mileage increase (miles)	6,170.108	Miles	1,349.572	miles
RVR section fuel usage	199.85	tonnes	3,192	litres
Density of diesel	n/a		900	kg/m3
RVR section fuel usage	199.85	tonnes	2.8728	tonnes
RVR section fuel usage	0.00019985	Mtonnes	2.8728E-06	Mtonnes
SO2 emissions calculated from sulphur content	0.002954681	ktonnes	5.73958E-08	ktonnes
SO2 emissions calculated from sulphur content	2.954680723	tonnes	5.73958E-05	tonnes
SO2 emissions calculated from NAEI factor	0.002279637	ktonnes	4.48157E-08	ktonnes
SO2 emissions calculated from NAEI factor	2.279637126	tonnes	4.48157E-05	tonnes
NOx emissions	0.000909318	ktonnes	0.000248764	ktonnes
NOx emissions	0.909318302	tonnes	0.248764186	tonnes
PM emissions (as black smoke)	no info		2.1546E-06	ktonnes
PM emissions (as black smoke)	no info		0.0021546	tonnes
SO2 emissions calculated from sulphur content	2,955	kg/annum	0.045	kg/annum
NOx emissions	909	kg/annum	249	kg/annum
PM emissions (as black smoke)	no info	kg/annum	2	kg/annum

Annual SO2 emissions per kilometre of track	**525**	**kg/annum**
Annual NOx emissions per kilometre of track	**206**	**kg/annum**