**Catherine Williams**
Deputy Director, Railway Markets and
Economics

1 August 2018

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Dear Mr McClean and Ms Gilliland

**Application for a new track access contract for services between London Waterloo and Southampton Central**

1.      We have carefully considered Alliance Rail Holdings Limited (operating as Grand Southern)'s application for a track access contract with Network Rail Infrastructure Limited (Network Rail). This was submitted to us under section 17 of the Railways Act 1993 (the Act) in December 2016. ORR has today rejected the application. This letter explains the reasons for our decision.

**Background**

2.      The application was for rights to run nine services a day on the South West Main Line (SWML) (seven off peak and two peak) between London Waterloo and Southampton Central, calling at Wimbledon, Hook, Basingstoke, Winchester and Eastleigh. Grand Southern originally planned to start services in December 2017, using Class 442 rolling stock in five and ten-car formation.

3.      While we were considering Grand Southern's application we have also been considering an application from the franchisee First MTR South Western Trains (SWR) to extend its current access rights beyond December 2019 with additional services on the SWML and Windsor Lines from December 2018

4.      We are still considering the SWR application, and provided <u>an update</u> on our consideration of both applications in March 2018.  As noted in that update, SWR and Network Rail have been discussing a range of issues in relation to this application and we understand that these are not yet resolved. We are not therefore in a position to progress this application at this time. We have asked Network Rail to provide an update on the status of these discussions.

**ORR's role and approach**

5. Under the Act we have an approval function in relation to track access contracts between Network Rail and train operators and any amendments to them. If Network Rail and a train operator reach agreement, they jointly submit the proposed contract for our approval, under section 18 of the Act. If they cannot reach agreement, the train operator can apply under section 17 of the Act and ask us to direct Network Rail to enter into the contract. This application was made under section 17.

6. When we consider track access applications we do so in the manner we consider best calculated to achieve our statutory duties, which are set out mainly in section 4 of the Act. The weight we place on each duty is a matter for us depending on the circumstances of each case. Where the duties point in different directions, we balance them against each other to help us reach a decision.

7. Although our duties are wide ranging, our experience generally is that a subset tend to be especially relevant to access decisions with the others not pointing strongly one way or the other. In this case we considered all our duties; these were the most relevant:

- promote improvements in railway service performance;

- protect the interests of users of railway services;

- promote the use of the network for passengers and goods;

- promote competition for the benefit of rail users;

- have regard to the funds available to the Secretary of State [for Transport] for the purposes of his functions in relation to railways and railway services;

- have regard to any general guidance given to ORR by the Secretary of State about railway services or other matters relating to railways; and

- enable operators to plan their businesses with a reasonable degree of assurance.

8. ORR is supportive in principle of open access, by which we mean passenger services provided outside of a franchise or concession. This reflects our duty to promote competition for the benefit of rail users and our recognition that competition can make a significant contribution to innovation in terms of the routes served, ticketing practices and service quality improvements, by both the new operator and through the competitive response of existing operators.

9. But we must also consider our other duties when making access decisions. These include duties to have regard to the funds available to the Secretary of State in relation to railways and to protect the interests of users of railway services, both passengers and freight customers. These require us to consider the impact of new open access services not just on the passengers benefitting directly from those services but all users of railway services.

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10.     With those issues in mind, our approach is to test whether new services such as these would be "not primarily abstractive" (NPA) as explained in our published criteria and procedures for the approval of track access contracts. In essence, the NPA test aims to limit cherry-picking and help us balance our duties, in particular those to promote competition for the benefit of users and to have regard to the funds available to the Secretary of State. The extent to which we value the potential benefits competition can bring is reflected in the threshold for the test that we expect new services to reach – we would not expect to approve applications that did not generate at least 30p of new revenue for every £1 abstracted from existing operators (i.e. achieve a ratio of 0.3:1).

11.     In addition to the NPA test, our criteria and procedures explain the range of other issues we expect to look at, including capacity and performance. We also consider the absolute impact on the funds available to the Secretary of State. We discuss these later.

**Industry consultation**

12.     In advance of submitting the application to ORR, and in line with our published guidance, Grand Southern carried out an industry consultation in December 2016. Several train operators and other stakeholders responded:

> (i)     The Department for Transport (DfT), which raised a number of operational, performance and financial concerns;
>
> (ii)    Freightliner, which raised concerns over the impact on its services over the route between Southampton Central and Basingstoke;
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> (iii)   Govia Thameslink Railway, which questioned the availability of capacity at Southampton Central;
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> (iv)    Great Western Railway, which questioned the performance impacts of the services;
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> (v)     SWR, which raised revenue generation and capacity concerns;
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> (vi)    Stagecoach Rail, which raised operational and capacity concerns; and
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> (vii)   Transport Focus, which was broadly in favour of the new rights being granted, but with caveats, namely that competition must be delivered within a framework of co-ordination and that there must be no significant disbenefit to any existing group of passengers.

13.     The concerns raised by consultees generally related to the availability of capacity, the effect on performance and the impact on the funds available to the Secretary of State.

**Statutory Consultation**

14.     As it did not support the proposal, as required by the Act, we consulted Network Rail in December 2016. It provided an initial response on 16 January 2017 and further updates to its position on capacity in August and November 2017, and on performance in December 2017, January 2018 and April 2018. We set out further detail on Network Rail's views in the sections on capacity and performance below.

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**Engagement with the parties**

15.     In addition to the industry and statutory consultations, when reviewing an application we may hold discussions with the parties, seeking and clarifying the information we need to make our final decision. In this case we have engaged fully with Grand Southern and its consultants, and Network Rail, throughout the course of this application.

16.     Grand Southern also took the opportunity to provide further detailed submissions to us. In reaching our decision we considered all the material provided by Grand Southern and indeed other stakeholders.

17.     This included recent correspondence from the DfT, which raised several points including concerns around the performance impacts of the proposal, passenger impacts and track access charges.

18.     The remainder of this decision is structured in five sections: potential passenger benefits; capacity and performance; rolling stock; the NPA test; and conclusions.

**Potential passenger benefits**

19.     The proposed Grand Southern service could bring a number of potential benefits to passengers on the route.

20.     Additional services on the route would offer more choice to passengers and potentially differing journey opportunities. Further, any additional services would offer crowding relief, especially to commuters. Crowding is a significant issue on the route, particularly into and out of London Waterloo during peak hours.

21.     In its application to us, Grand Southern argued that its service would bring price competition to the route, particularly in off peak hours. Further, it committed to offering passenger choice and innovation in terms of fares, comfort and customer services. Specific benefits Grand Southern noted as being under consideration were: offering a guaranteed seat on a nominated train for season ticket holders; flexible season tickets; advance fares with a reservation; on-board catering; and WiFi.

22.     We recognise that competition can make a significant contribution to innovation in terms of the routes served, ticketing practices and service quality improvements, by both the new operator and through the competitive response of existing operators.  However, these benefits need to be offset against the potential impact to passengers of introducing a new service.

**Capacity and performance**

*Capacity*

23.     Although Grand Southern submitted its application in December 2016, we explained in our letter of 2 March 2017 that we needed to see the outcome of the franchise competition to provide services on the SWML before we could properly assess it. The franchise was awarded to SWR on 27 March 2017.  SWR submitted its access application to us on 25 July 2017, ahead of the franchise beginning in August 2017.

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24.     Network Rail undertook an analysis of whether there was sufficient capacity to accommodate the two applications. It submitted its initial views on capacity in August 2017 and updated these in November 2017. We published this capacity study on our website.

25.     Following this capacity study, in December 2017 Network Rail confirmed its view in an email to us that it was technically possible to develop a timetable that included the aspirations of both Grand Southern and SWR which was compliant with the Timetable Planning Rules in terms of capacity.

*Performance*

26.     Network Rail's assessment of Grand Southern's application described above showed that capacity was technically available for all the proposed services.  However, Network Rail told us in its statutory consultation response to the SWR application in September 2017 that its high level analysis indicated the Grand Southern services were highly likely to impact train performance into Southampton and Waterloo. It was particularly concerned about the erosion of 'firebreaks' in the timetable. Network Rail explained that a firebreak was an elongated gap between train services designed to allow the timetable to recover from perturbation.

27.     On 11 December 2017, we asked Network Rail to share its analysis, summarise how material it thought the performance impacts might be, explain what work had been done to investigate possible mitigations, and set out its plans to do any further work on performance risks. On 11 January 2018, Network Rail told us it had not carried out a full performance analysis and considered it was inappropriate to do more given the applicant's timescales for starting services.  We take this to refer to the fact that a full performance analysis can take a significant length of time to complete whereas Grand Southern was keen to continue to progress the application quickly.

28.     Notwithstanding the challenges of carrying out detailed performance analysis, we considered that we needed further information to enable us to fully consider the application.  Therefore, on 8 March 2018, we again asked Network Rail to better substantiate its concerns about the impact on performance of the Grand Southern proposals.

29.     On 6 April, Network Rail responded to us with more detail on the results of the analysis it had carried out. The analysis particularly focused on the impact of reducing the number of firebreaks. Network Rail found, at a high level, based on an assumption that nine additional services remove nine firebreaks, the nine individual following services would see on average a drop of 5% of their PPM which would result in a drop of 0.25% SWR weekday PPM for services approaching London Waterloo. Given the relatively small number of services, this represents a high level of impact per train. Network Rail noted that this analysis did not take into account any further potential "ripple effects" of delays.

30.     Network Rail asked us to consider these impacts in light of current performance difficulties on the Wessex Route. We recently reported on these difficulties in our report "Review of Network Rail's performance delivery to South Western Railway services". As described in this report, SWR trains arriving on time dropped from 90.5% in 2015-16 to 84.3% in 2017-18. 68% of this delay was caused by Network Rail in 2017-18.

31.     Grand Southern responded to Network Rail's conclusions, questioning the concept of firebreaks and the analysis based on them. Network Rail recognised that Grand Southern raised a number of valid points regarding its analysis, in particular regarding inaccuracies in the description of the source data and assumptions used in the report.  However, Network Rail did not believe they invalidated the analysis undertaken or the overall conclusions reached.

32.     Overall, taking account of the evidence of all the parties, some concerns about the impact on performance that this application will have on the SWML still remain. We note the existing performance challenges on the SWML and Network Rail's view that there is a risk of a further drop in the weekday PPM for SWR if we approved these services. We consider that NR could carry our further work to assess the impact of adding additional services on the SWML.  However, given the other concerns we have with this application set out below, we do not consider it is necessary to have this information to enable us to reach an overall decision to reject this application. But we would expect to see further evidence on potential performance impacts before we could decide any future application.

**Rolling stock**

33.     Grand Southern planned to run the service using Class 442 Electric Multiple Units, in 5 and 10-car formation. Each 5-car unit would offer around 325 seats after refurbishment. Class 442s have previously run on the SWML.

34.     In May 2018, Grand Southern informed us that there were no longer any Class 442 units available for it to lease, and it would have to develop alternative rolling stock proposals.

35.     Grand Southern has started investigating alternative rolling stock, but confirmed it would be some months before it may be able to offer a fully developed solution.

36.     It is important that if we approve an application, an operator will be in a position to use the capacity that it has been allocated. This ensures that capacity is being used efficiently.  In this case, given the current position with the rolling stock, we do not have evidence that Grand Southern has a plan which would allow it to operate a service if we allocated the rights.

**The Not Primarily Abstractive (NPA) test**

37.     Where new proposed services would compete with another operator's existing services we conduct an NPA test. In the test, we use economic modelling to evaluate the impact of the proposed services in terms of new revenue they are likely to generate and revenue they are likely to abstract from other operators' services.

38.     We have a long-standing policy of not approving new open access services that we consider would be primarily abstractive of an incumbent's revenue. In practice, this means we will not normally approve new services with a generation/abstraction ratio of less than 0.3:1 (i.e. that do not generate at least 30p of new revenue for every £1 abstracted from incumbents). The threshold is set at a relatively low level that reflects the value we place on the benefits competition can bring.

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39.     Grand Southern engaged consultants AECOM to carry out the economic modelling for the NPA test and submitted this to us in November 2016. This analysis showed that Grand Southern's new services would achieve a generation/abstraction ratio of 0.55:1.

40.     We undertook our own assessment of the modelling and employed an independent consultant, John Segal, to support us with this.  We identified that the NPA test results were particularly sensitive to certain assumptions made in the modelling, in particular with regard to crowding impacts.

41.     Where trains are crowded, a proportion of passengers who would otherwise wish to travel by train decide not to do so.  They either travel by other modes of transport or do not travel at all.  This means that if trains are crowded there is a level of supressed demand. New services that relieve crowding on existing services can therefore meet this demand, meaning those new services generate more revenue rather than just abstract revenue from existing services.

42.     There are different ways in which the impact of crowding relief on revenue generation and abstraction can be modelled and differences in these approaches all impact the different estimate of crowding benefits from the new services.  This was a key issue in considering Grand Southern's application.  The issues considered as part of the analysis of the NPA test included:

(i)     Model calibration - in order to provide accurate crowding impacts forecast crowding models should be calibrated to reflect the existing level of crowding on services. An accurately calibrated model can forecast a significantly different level of crowding impact than one that is un-calibrated.

(ii)     Calculation of supressed demand – modelling the crowding effects described above, requires an estimate of supressed demand.  Standard industry models do not contain an estimate of this supressed demand.  Different approaches to adjusting standard industry models to try to calculate this will result in differences in the estimate of crowding benefits.

(iii)     Future SWR capacity - the level of future capacity on SWR services impacts on the estimate of crowding benefits.  We considered that there is an argument that modelling of capacity should be based on the future known SWR train load capacities based on franchise commitments.  However, Grand Southern's view is that it is more appropriate to base the model on the timetable used in Network Rail's capacity study discussed above. We undertook scenario analysis on both alternatives.

43.     We also found the outcome of the NPA test is sensitive to which version of the Passenger Demand Forecasting Handbook[1] (PDFH) Grand Southern used in its fares analysis.  AECOM's initial analysis used PDFH 5.1 as the basis for parameters such as

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[1] The PDFH summarises existing knowledge on rail passenger demand forecasting and is based on information gained in a large number of research studies. It gives clear recommendations that enable users to forecast changes in demand in light of anticipated changes in circumstances.

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fares elasticities and spread parameters reflecting the impact of fares competition between operators. However, the PDFH was subsequently updated to PDFH 6.0. This changed some of these parameters. We asked Grand Southern to submit revised models based on the parameters in PDFH 6.0. This changed the modelling results and we and AECOM ran sensitivities to consider the results under both sets of assumptions.

44.     Between December 2016 and March 2018, we and our consultant worked closely with Grand Southern and AECOM to consider the most appropriate way of modelling these issues. Our consultant also identified a number of issues with the modelling which we asked AECOM to address. A full description of the issues relating to the NPA modelling is set out in the Appendix to this letter.

45.     In March 2018, AECOM submitted revised analysis taking into account the issues we had raised. This provided results for a number of scenarios using different modelling approaches and assumptions. This forecast a generation/abstraction ratio of between 0.36:1 and 0.57:1. The central case was ~ 0.47:1.

46.     We undertook a further assessment of their analysis and we continued to have concerns regarding the modelling approach and assumptions they had used. Our consultant produced some revised modelling for a number of scenarios. This modelling forecast a generation/abstraction ratio of between 0.17:1 and 0.41:1 with a central case of ~ 0.29. We submitted this revised modelling to Grand Southern and AECOM for comment in April 2018.

47.     AECOM responded with a further range of forecasts based on our consultant's recommended approach that showed a generation/abstraction ratio of 0.15:1 - 0.41:1, with a central case of ~ 0.28:1. These are similar results to those obtained by our consultant.

48.     Subsequently, as noted above, Grand Southern have informed us that they are now considering alternative rolling stock. Different rolling stock assumptions could materially impact the outcome of the demand forecasting used in the NPA analysis. Neither we nor Grand Southern have therefore carried out any further work on the economic analysis.

*Initial conclusions from NPA analysis*

49.     The annex to the Appendix sets out a range of results for the NPA test based on a range of different scenarios carried out by both us and AECOM.

50.     In our view the analysis should be based on the latest information and the correct PDFH methodology, PDFH6. We therefore consider that we should only take results of the NPA test from scenarios that use PDFH6.

51.     We also consider that current train loads should be reflected as accurately as possible in any crowding model and this requires model calibration where the data is available. We were able to use SWR data from Spring and Autumn 2017 to do this. We recognise that this data is not available to Grand Southern/AECOM but since ORR does have access to data, it should be included in the modelling. We therefore consider that we should only take results of the NPA test from scenarios that are "calibrated".

52.     Finally, we acknowledge there is uncertainty about the future level of capacity on SWR services.  However, the different capacity estimates provided by our consultant and Grand Southern/AECOM provide a useful range to test the sensitivity of the crowding impacts to different capacity levels.  We have not relied on either scenario in reaching our conclusion on the NPA test.

53.     On this basis, based on the modelling results from our consultant set out in Table 2 in the Appendix, we estimate the forecast generation/abstraction ratio lies between 0.17:1 - 0.22:1, with a central estimate of ~ 0.20:1.

54.     Our conclusion at this stage is therefore that the application does not generate sufficient revenue to pass the NPA test.  Given the other issues with the application described above, we do not consider we need to carry out further work on the NPA test at this stage to be able to reject the application.

55.     If Grand Southern resubmits this application to us in the future, it will need to submit revised economic modelling based on latest available information. We will use the analysis carried out in this assessment to help inform our approach to any future assessment.

**Conclusion**

56.     We have considered the application fully, including all the issues discussed above, and balanced our duties as we are required to do so.

57.     As the Class 442 rolling stock Grand Southern originally planned to use is no longer available and there is no developed viable alternative as yet, Grand Southern would not be in a position to operate services if we approved this application.  We have therefore decided to reject the application.

58.     However, notwithstanding this, there were also other issues which taken as a whole would also have been reason to reject this application.  These are:
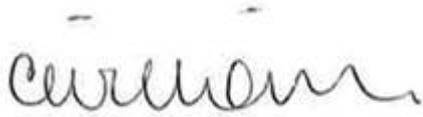
59.     Network Rail has confirmed that there is technically capacity available for these services and in our view, the proposed new services could bring some passenger benefits in terms of competition, more services, and new journey opportunities.  However, based on the evidence provided by Grand Southern and Network Rail, and our own analysis, we have not been convinced that these benefits are outweighed by the risk that these services would have an impact on performance on the SWML.

60.     Although the difficulties with rolling stock meant Grand Southern did not intend to commission any further work from AECOM, or engage further on its demand forecasting with ORR, we believe we have sufficient information to conclude that the revenue generation/abstraction ratio of this application is in the range of 0.17:1 - 0.22:1, with a central estimate of ~ 0.20:1. We therefore consider the application fails our NPA test.

61.     Once a way forward for the rolling stock has been identified, Grand Southern would be able to submit a revised application, going through the relevant industry processes.  As indicated above, in order to approve this application, we would need an evidenced assessment of the performance impacts of the services and a revised NPA test addressing the issues set out above.  We are happy to discuss these requirements in advance of any new application being submitted.

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62.     I am copying this letter to Ray Harris at DfT and Karene Raymond at SWR. We will also place a copy on our website.

Yours sincerely

**Catherine Williams**

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**Appendix – details of not primarily abstractive test**

1.      Grand Southern submitted its initial demand forecasting analysis, carried out by its consultants AECOM, in November 2016 and we met them to discuss the report on 30 November.  AECOM's analysis modelled the level of new revenue generated and the revenue abstracted from SWR resulting from the introduction of Grand Southern's service. This took into account the impact of factors such as changes to journey times, lower fares offered by Grand Southern and crowding relief on SWR current services as a result of the additional capacity supplied by Grand Southern's new services, adjusting for the potential for crowding on the new services.

2.      AECOM initially modelled the impact of Grand Southern's new services against the December 2016 timetable.  In November 2017 it submitted a revised forecast updating the December 2016 timetable to take account of new service levels proposed as part of the, then, newly appointed SWR franchise.

3.       The results of this analysis (based on the November 2017 submission) forecast that Grand Southern's new services would achieve a generation/abstraction ratio of 0.55:1.

4.      We undertook a review of AECOM's forecast.  We considered that the modelling of timetables and fares was in line with industry standards, except with regard to which version of the Passenger Demand Forecasting Handbook[2](PDFH) should be used. This is discussed further below. However, it became clear that the results were very sensitive to the way in which the impact of crowding was modelled.  Modelling crowding is complex and needs to be properly calibrated to reflect the particular characteristics of existing and proposed services to be analysed. Our review of AECOM's demand forecasting therefore centred on its modelling of crowding.

5.       We appointed independent consultant John Segal (JS) to review AECOM's crowding impacts modelling to ensure that it was in line with PPDFH methodology and applied correctly. Because the impact of lower fares offered by Grand Southern is an important input to the crowding analysis we also asked JS to include AECOM's fares modelling in his review.

6.      JS undertook his review in two stages. First, JS did an interim review of AECOM's modelling and this was presented to Grand Southern/AECOM to give them the opportunity to respond.  Following this, AECOM re-submitted its analysis taking account of the issues raised in JS's interim report.  JS then undertook a second review of the analysis which was again presented to Grand Southern/AECOM to respond.   We set out the findings and issues raised in both the interim and second review below.

**Interim Review**

7.      JS's interim review of AECOM's demand forecasting identified a number of issues including potentially incorrect assumptions, methodological and computational errors.

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[2] The PDFH summarises existing knowledge on rail passenger demand forecasting and is based on information gained in a large number of research studies. It gives clear recommendations that enable users to forecast changes in demand in light of anticipated changes in circumstances.

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Some of these had only minor impact on the results, others more significant. The issues that materially impacted the results are discussed below.

AECOM's Fares Analysis

8.      AECOM's initial fares modelling used PDFH 5.1 fares elasticities and spread parameters. Since this initial analysis, the PDFH was updated to PDFH 6.0, incorporating the latest research underpinning PDFH parameters such as fares elasticities. JS recommended AECOM should update its analysis to include results based on PDFH6.0 in addition to those based on PDFH 5.1.

9.      PDFH 6.0 recommends lower fares elasticities for London and South East markets (the markets relevant to this application) than in PDFH 5.1. Taken together with the impact of using updated spread parameter values, this resulted in a lower initial generation/ abstraction ratio, prior to crowding impact, than AECOM's forecast based on PDFH 5.1.

10.     We recognise that Grand Southern/AECOM could not have known about future changes to PDFH at the time of making the application[3]. However, we consider that we should take account of the latest available evidence when reaching a decision. As such, we asked Grand Southern/AECOM to submit a revised forecast using PDFH 6.0 parameters in its fares analysis.

AECOM's crowding modelling

11.     AECOM modelled two crowding impacts arising from the introduction of Grand Southern's services, which have partial offsetting impacts in terms of  levels of generation and abstraction:

- The initial crowding relief to SWR services (the 'SWR model'): this modelled the impact of passengers switching from SWR to Grand Southern's services creating room on SWR's services and so releasing suppressed demand. This generates new revenue to rail but because of the passengers switching from SWR it also abstracts some revenue from SWR.

- The impact of crowding on Grand Southern's services (the 'Grand Southern Model'). AECOM's modelling forecast that one of Grand Southern's peak services would also suffer crowding, reducing the number of existing SWR passengers who could, in fact, switch to the new services. This will reduce revenue abstraction from SWR.

12.     JS's review identified a number of areas in the way in which AECOM had applied its crowding modelling, which had the effect of either overstating the crowding benefits or gave counterintuitive results.

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[3] Although Grand Southern/AECOM should have known about the potential impact of new fare spread parameters as these were published in the Leigh Fisher Report for ORR, *'Evidence of revenue generation and abstraction from historical open-access entry and expansion.'* 7 January 2016. It could therefore have taken account of these at least as a sensitivity in its analysis.

13. Common to both the SWR model and Grand Southern model was AECOM's assumption that MOIRA[4] output (from which train load data is derived), is constrained demand and which therefore requires adjusting to determine total demand i.e. including suppressed demand in the base (described as 'deconstraining').

14. AECOM had deconstrained demand on a train by train basis. However, JS argued that this is the wrong approach because, although MOIRA output is constrained in aggregate as it is based on LENNON[5] revenue data, MOIRA time of day profiles are unconstrained. This means that on a train by train basis, demand is already unconstrained

15. The approach AECOM had taken to deconstraining output was calculating very high levels of supressed demand (up to 30%) for individual trains (i.e. a large increase in capacity would result in up to 30% increase in demand). JS found that the AECOM model was resulting in an estimate of crowding benefit from Grand Southern's limited peak service close to the maximum level achievable with a very large increase in capacity. He considered that this level of benefit was unlikely. He therefore considered that the AECOM approach to deconstraining output was not producing plausible results. This was compounded by computation errors in the spreadsheet.

16. JS considered that a modest amount of overall deconstraining is appropriate, he estimated this to be about at about 2% of peak demand.

17. He suggested that a better approach to deconstraining output would to first treat the MOIRA output as unconstrained but make an adjustment to overall forecast growth in demand to take account of overall deconstraining. A crowding factor could then be applied to determine how much demand each train can actually accommodate.

Train load calibration

18. JS also raised issues with the calculation of crowding in the Grand Southern model (i.e. the model considering crowding on Grand Southern's own services). To estimate the crowding impact on Grand Southern's services, AECOM derived a base case against which it could test the impact of fares and external factors on crowding levels. The base case included Grand Southern's train service, with the train load of the base case being taken from MOIRA, subject to a capacity cap of 90% of seating plus standing space. This case was compared with what happened when fares and external growth in passenger numbers (due to economic factors for example) were included to provide an estimate of how much demand would be crowded off Grand Southern services. However, this ignores any crowding that may exist in the "base case" which needs to be taken into account.

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[4] MOIRA is a software tool that models the impact of timetable changes on both the overall rail market and individual train operating companies.

[5] LENNON is the GB railway's national revenue database.

19.    JS analysed the Grand Southern model by testing the effect of different assumptions:

- He found that where the train load capacity cap is set at high level (i.e. we assume a train that has a very large amount of standing space) and there is no growth, then there is no demand suppression even where passengers are currently standing. However, under such conditions you would expect a proportion of demand to be crowded off; and

- He found that if there is some crowding in the base case and then growth is included, then all growth is crowded off.

20.    In his view, neither of these results were plausible and raised doubts about the accuracy of their crowding impacts forecast.

21.    Modelling the impact of crowding usually involves an iterative process that adjusts the level of demand as passengers respond to changing levels of crowding until an equilibrium in demand is reached. AECOM was unable to do this but developed a proxy for the re-iterative process.  JS found this also to be overly complex, resulting in dubious results.  JS proposed a simpler approach based on previous crowding modelling work he had undertaken.  He proposed undertaking the first iteration and then reducing the suppressed demand by 30% to take account of subsequent iterations.

Treatment of crowding benefit in generation/abstraction calculation

22.    Another area JS questioned was AECOM's treatment of the estimated crowding benefit in its generation/abstraction ratio calculation. AECOM counted the level of crowding benefit as both generation and 'negative abstraction', i.e. it calculated the generated demand and then deducted the same amount from the total abstraction by Grand Southern's services. JS's view was that the crowding impact value should only be treated as generation.

23.    Based on his analysis JS made a number of corrections to the AECOM model, correcting errors or changing the methodological approach to produce a better forecast and plausible results.  His revised modelling forecast a generation abstraction ratio of around 0.21:1, below the threshold necessary to pass the NPA test.

Other issues

24.    JS also highlighted a number of elements he considered as missing from AECOM's analysis. The most significant of these was that in his view AECOM should have taken account of additional train capacity in the December 2018 and 2020 timetable changes that were set as part of SWR's franchise commitments.  Based on figures provided by SWR, JS estimated these services would deliver around 25.7% more capacity on SWR trains and as a result this would significantly impact on the estimate of crowding benefits made by AECOM. He modelled that accounting for the additional capacity would further reduce the generation/abstraction ratio to 0.19:1.

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25.     We submitted JS's interim report to Grand Southern/AECOM on 6 February 2018, followed by a meeting with Grand Southern/AECOM on 14 February 2018 for them to respond to and challenge its findings.

**Grand Southern's response to interim review**

26.     Taking account of JS's review and subsequent meeting with ORR, AECOM submitted revised analysis to us on 13 March 2018.  It made a number of revisions to its own models, for example changes to the annualisation factor which adjusts train loads to account for periods where demand is lower e.g. during school holidays and employing JS's iteration factor as described above. AECOM also changed its treatment of the forecast crowding benefits in its generation/abstraction ratio and provided further explanation of their reasons in response to JS's query about this in his interim review.

27.     It submitted two versions of its SWR model, one that retained AECOM's original approach, but with changed assumptions and the JS iterative proxy, and a second version claimed to use JS recommended approach. However, AECOM only submitted one version of the Grand Southern model, based on its original model, arguing that a version using JS's approach gave counterintuitive results. For each of the models it also undertook an analysis of the sensitivity of their results to the impact of using different parameters from the different versions of the PDFH.

28.     Separately, Grand Southern objected to ORR estimating future SWR train load capacities based on franchise commitments as this included services that had not yet secured access rights.  Grand Southern argued that the base timetable that should be used in the assessment should reflect services used in Network Rail's capacity study.  Based on this Grand Southern estimated SWR train load capacity would increase by around 8.5%.

29.     Table 1 below summarises the full range of AECOM's revised forecast for each model version. Taken together, AECOM's revised analysis forecast a generation/ abstraction ratio within the range of 0.36 - 0.57:1, with a central case forecast of ~ 0.47:1.

**Second Review**

30.     As with AECOM's previous submission, JS's review identified a number of issues that did not have a material impact on the results which we do not intend to discuss further.  The most significant piece of additional analysis undertaken by JS was to calibrate the base train loads used in the crowding model to current actual train loads using data supplied by SWR.

31.     JS found that changes AECOM had made to key assumptions such as the annualisation factor were approximately correct.  AECOM had also tested alternative fares elasticities and spread parameters.  However, as discussed below he found that AECOM's modelling approach for crowding remained flawed in a number of areas.

AECOM's revised crowding models

32.     AECOM submitted two versions of its SWR model used to calculate the crowding impacts on SWR.  The first version retained the approach initially submitted of deconstraining demand as discussed earlier. JS estimated that this approach artificially

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raised the estimate of suppressed demand in the base case by around 19%, and so overstated the final level of crowding benefit from Grand Southern's services. In addition, he found computational errors which resulted in an overestimate of crowding impacts or counterintuitive results.

33.    The second version of the SWR model was based on JS's recommended modelling approach. JS assessed this as more appropriate in terms of methodology.  In his view, this now produced credible results, subject to a number of minor issues.  However, there remained an issue relating to the impact of the use of a train load capacity cap. AECOM continued to use the cap as a substitute for not having real count data, but increased its value from 90% of capacity, to 100%.

Train load calibration

34.    As discussed earlier, crowding models should be calibrated to reflect the existing level of crowding on services in order to provide accurate crowding impacts forecast. As part of the second review, ORR was able to obtain train load data for Spring and Autumn 2017. JS was then able to use this to calibrate MOIRA output to the average of the two counts.  This resulted in a significant drop in the level of crowding in the base case compared to AECOM's un-calibrated model, significantly reducing the forecast crowding benefit to SWR services.

35.    We recognise that AECOM could not have calibrated its model this way as it did not have access to confidential loading data. However, as ORR is able to calibrate the model it is right that we take account of the impact of model calibration in our assessment of AECOM's own crowding modelling forecast.  We consider this is more accurate than the approach AECOM took to take account of existing crowding by assuming a 90% or 100% capacity cap on the level of train capacity in the base case.

36.    As previously, JS took account of the additional train services SWR planned to introduce as part of its franchise commitment; he modelled two sensitivities, an 8.2% increase based on using longer trains and/or different seat configurations, and a 25.7% increase based on these rolling stock changes together with additional trains. These increases in  SWR's train capacity reduce the crowding benefits of Grand Southern's services.

Treatment of crowding benefit in generation/abstraction calculation

37.    JS reviewed AECOM's further explanation of how it treated the revenue impact of SWR crowding relief in its generation/abstraction ratio calculation. Following this explanation, he accepted AECOM's argument that it is appropriate to treat the crowding impact as both generation and to off-set the same amount against abstraction from SWR.

38.    However, AECOM had now changed the way it allocated demand and revenue from crowding impacts on its own trains between generation and abstraction impacts. Previously it was netted-off the SWR crowding impact before allocating, now AECOM allocated the revenue pro-rata in line with the generation and abstraction ratio resulting from MOIRA timetable and fares impacts.

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39.     Although JS agreed that this revised approach was also appropriate, it was not correct to spread the Grand Southern suppressed demand across all SWR services. This is because the crowding impact only takes place on one Grand Southern peak time service and hence the crowding impact will only apply to the SWR services that compete directly at the time of this Grand Southern service. JS examined the timetable and showed that only a single SWR train, the 05.10 Exeter to London Waterloo service, competed directly with the Grand Southern peak time service.  By allocating demand across all SWR services, AECOM overstated the crowding relief impact. If AECOM corrected this, then JS concluded that AECOM's revised forecast of Grand Southern's crowding impact using the Grand Southern crowding model was reasonable.

Results of second review

40.     JS produced a range of results for different scenarios, using his recommended modelling methodology, plus various sensitivities. This included sensitivities to different versions of the PDFH for use in the fares analysis and calibrated and un-calibrated versions of the crowding models. He also ran sensitivities to two different assumptions about future train capacity as described in paragraph 36. His full results are set out in Table 2 at Annex A. Based on this range of scenarios, JS forecast a generation/ abstraction ratio in the range of 0.17:1 – 0.41:1, with a central estimate of ~ 0.29:1.

41.     We submitted JS's second review to Grand Southern/AECOM on 16 April 2018.

**Grand Southern's response to second review**

42.     Grand Southern/AECOM responded in writing on 4 June 2018. However, it is clear that crowding model calibration, estimates of future SWR train capacity and which version of PDFH is used for the fares analysis had the most significant impact on the results. We have therefore set out below AECOM's main response to each of these.

*Crowding model calibration*

43.     AECOM said that it could not comment on the model recalibration because it did not have access to the underlying data.  However, it asked that as calibration results in the model train loads matching actual train loads on SWR, does the model now contain the constrained level of demand. And if so, should the deconstraining be brought back in to play?

*SWR capacity assumptions*

44.     Grand Southern repeated its objection to ORR using estimates of future SWR train load capacities based on franchise commitments in its modelling, rather than capacity based in the timetable used in Network Rail's capacity analysis.

45.     Grand Southern/AECOM also challenged JS's allocation of his estimated additional (25.7%) capacity across all SWR trains as incorrect.  They argued that if new services are to be included in the analysis, their impact on demand, either as a result of an improved timetable and/or capacity relief, should also be assessed.  This would, lead to an increase in demand and the benefits of any subsequent crowding relief.

46.    AECOM argued further that any increase in capacity as a result of additional SWR trains is likely to lead to a reduction in crowding on Grand Southern's services. This would mean Grand Southern could accommodate more passengers switching from SWR services to escape crowding and thereby increase overall crowding benefits. It is not reasonable, they argued, to assume that the Grand Southern crowding impact would remain unchanged if SWR operate additional trains in the peak.

47.    Notwithstanding these comments, AECOM submitted a further range of forecasts, which corrected for the way in which JS had treated the crowding impact in the generation and abstraction ratio calculation and with sensitivities around model calibration, different versions of PDFH and assumptions about future train load capacity, using JS's estimate of additional capacity of 8.2% and 25.7%. These are summarised in Table 3.  Taken together, the revised analysis forecast a generation/ abstraction ratio within the range of 0.15:1 to 0.41:1, with a central estimate of ~ 0.28:1.  These results closely match JS's forecast.

## Conclusion

48.    On 18 May 2018 Grand Southern wrote to inform us that it did not intend to commission any further work from AECOM, or engage further with ORR on its demand forecasting based on deploying Class 442 EMUs. This was because Grand Southern had been advised that these units were no longer available for it to lease it was now in the process of seeking alternative rolling-stock to that used in the original modelling. Different rolling-stock assumptions could materially impact the outcome of any demand forecasting work. We have therefore been unable to discuss further the issues raised by Grand Southern/AECOM's response to JS's second review.

49.    It is clear from our analysis that the level of forecast crowding benefit hinges primarily on the crowding model calibration.  However, other areas of dispute also have a range of impacts on the modelling results, including the assumption about future SWR train load capacity and which version of PDFH is used for the fares analysis.

50.    We have considered the range of scenarios that have been modelled in reaching our conclusions about the results of the NPA test.

51.    We are confident our analysis is based on the latest information and the correct PDFH methodology. In considering the results, we therefore think that the range of results should only include that are based on PDFH 6.

52.    We also consider that current train loads should be reflected as accurately as possible in any crowding model and this requires model calibration where the data is available.  We recognise that this data is not available to Grand Southern/AECOM but since ORR does have access to data, it should be included in the modelling. We therefore consider that the range of results should only include those from scenarios that are "calibrated".

53.    Finally, we acknowledge there is uncertainty about the future level of capacity on SWR services. However although the different capacity estimates provided by JS and Grand Southern/AECOM provide a  useful range to test the sensitivity of the crowding

impacts to different capacity levels, both sets of forecasts show that it is model calibration that has the greater impact on final results.

54.    Based on the modelling results set out in Table 2, we consider that our forecast generation/abstraction ratio lies in the range 0.17:1 - 0.22:1, with a central estimate of ~ 0.20:1

55.    Based on this, and in the absence of any further information or evidence from Grand Southern/AECOM, our conclusion is that the application does not generate sufficient revenue above the threshold necessary to pass our NPA test.

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*Table 1: AECOM's revised forecast results following JS's interim review*

| PDFH version | SWR crowding methodology | Grand Southern crowding methodology | Generation £m | Abstraction £m | Total £m | Generation/ abstraction ratio |
|---|---|---|---|---|---|---|
| PDFH5.1 | AECOM approach | AECOM approach | £3,579 | £6,262 | £9,841 | 0.57 |
| PDFH5.1 + updated spread parameter | AECOM approach | AECOM approach | £3,563 | £6,730 | £10,293 | 0.53 |
| PDFH6 | AECOM approach | AECOM approach | £3,263 | £6,994 | £10,257 | 0.47 |
| PDFH5.1 | JS Approach | AECOM approach | £3,004 | £6,837 | £9,841 | 0.44 |
| PDFH5.1 + updated spread parameter | JS Approach | AECOM approach | £2,989 | £7,305 | £10,294 | 0.41 |
| PDFH6 | JS Approach | AECOM approach | £2,689 | £7,568 | £10,257 | 0.36 |

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*Table 2: JS's 2nd review forecast results*

| PDFH version | SWR Crowding | Capacity Increase | Generation £m | Abstraction £m | Total £m | Generation/ abstraction ratio |
|---|---|---|---|---|---|---|
| PDFH5.1 | Uncalibrated | 8.20% | £ 2,777 | £6,709 | £9,486 | 0.41 |
| PDFH5.1 + updated spread parameter | Uncalibrated | 8.20% | £ 2,763 | £7,175 | £ 9,938 | 0.39 |
| PDFH6 | Uncalibrated | 8.20% | £2,471 | £7,431 | £9,902 | 0.33 |
| PDFH5.1 | Calibrated | 8.20% | £2,067 | £7,419 | £9,486 | 0.28 |
| PDFH5.1 + updated spread parameter | Calibrated | 8.20% | £ 2,053 | £7,884 | £9,938 | 0.26 |
| PDFH6 | Calibrated | 8.20% | £1,762 | £8,140 | £9,902 | 0.22 |
| PDFH5.1 | Uncalibrated | 25.70% | £2,415 | £7,070 | £9,486 | 0.34 |
| PDFH5.1 + updated spread parameter | Uncalibrated | 25.70% | £2,402 | £7,536 | £9,938 | 0.32 |
| PDFH6 | Uncalibrated | 25.70% | £2,110 | £7,792 | £9,902 | 0.27 |
| PDFH5.1 | Calibrated | 25.70% | £1,742 | £7,744 | £9,486 | 0.23 |
| PDFH5.1 + updated spread parameter | Calibrated | 25.70% | £1,729 | £8,209 | £9,938 | 0.21 |
| PDFH6 | Calibrated | 25.70% | £1,438 | £8,464 | £9,902 | 0.17 |

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*Table 3: AECOM's revised forecast results following JS's second review*

| Fares analysis PDFH version | SWR Crowding | Capacity Increase | JS Ratio | Updated all SWR trains at capacity | Updated capacity on SWR trains | Midpoint |
|---|---|---|---|---|---|---|
| PDFH5.1 | Uncalibrated | 8.20% | 0.36 | 0.38 | 0.45 | 0.41 |
| PDFH5.1 + updated spread parameter | Uncalibrated | 8.20% | 0.33 | 0.35 | 0.41 | 0.38 |
| PDFH6 | Uncalibrated | 8.20% | 0.28 | 0.30 | 0.36 | 0.33 |
| PDFH5.1 | Calibrated | 8.20% | 0.23 | 0.24 | 0.3 | 0.27 |
| PDFH5.1 + updated spread parameter | Calibrated | 8.20% | 0.22 | 0.23 | 0.28 | 0.25 |
| PDFH6 | Calibrated | 8.20% | 0.17 | 0.18 | 0.23 | 0.21 |
| PDFH5.1 | Uncalibrated | 25.70% | 0.29 | 0.30 | 0.37 | 0.34 |
| PDFH5.1 + updated spread parameter | Uncalibrated | 25.70% | 0.27 | 0.28 | 0.34 | 0.31 |
| PDFH6 | Uncalibrated | 25.70% | 0.23 | 0.24 | 0.29 | 0.26 |
| PDFH5.1 | Calibrated | 25.70% | 0.17 | 0.18 | 0.23 | 0.21 |
| PDFH5.1 + updated spread parameter | Calibrated | 25.70% | 0.16 | 0.17 | 0.22 | 0.19 |
| PDFH6 | Calibrated | 25.70% | 0.13 | 0.13 | 0.18 | 0.15 |

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