Development Group

Eastern Region

Wisbech Rail Review

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Table of Contents

1. Overview

The purpose of this document is to capture Network Rail's view on the Wisbech Rail GRIP 3 documentation produced by Cambridgeshire and Peterborough Combined Authority (CPCA) in response to a request from CPCA. The report will broadly cover four areas:

- Business Case review
- PACE / GRIP review including PM review of documentation
- Engineering review
- Light Rail feasibility

The review of these four areas will identify any gaps in the existing documentation and will provide a list of recommendations/requirements to address them.

2. Executive Summary

This document summarises Network Rail's assessment of the development work completed to date by CPCA on reconnecting Wisbech and March by rail.

The document provides analysis and commentary on the areas listed in section 1 and below:

- Business Case review
- PACE / GRIP review including PM review of documentation
- Engineering review
- Light Rail feasibility

From assessing the work done to date the report recommends the further activities required to complete PACE 1 (broadly equivalent to GRIP 3) should the project continue as a rail scheme.

It is acknowledged that the project has been developed to this point with minimal input from Network Rail and has, necessarily, not been subject to Network Rail's internal governance processes. Thus, while it may appear there are gaps in areas such as GRIP documentation this can be explained by the fact Network Rail have not been heavily involved to date and did not formally remit the earlier work. It does not imply that the work produced to date is of a poor standard, in fact much of it is of a very good standard.

It should also be noted that, as per the introduction to the Mott MacDonald GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report (398128-009-C), a "slimmed down" version of the GRIP 3 design process has been used, with the focus on developing designs for those elements which significantly impact capital cost. This is a very reasonable approach for CPCA to adopt.

It is also acknowledged in the conclusion of the same report that there are a number of deliverables required to achieve GRIP 3 stage gate approval and it is stated that a full list would need to be developed in conjunction with Network Rail.

The Full Business Case executive summary also states that further work is required prior to completion of GRIP 3, partly due to the limited input to date from Network Rail or the DfT. This report should be read with that context in mind.

Business Case

The business case produced by Mott MacDonald is overall a well-presented document, with a strong strategic focus, highlighting the need for public transport links from Wisbech and the perceived benefits of this link extending to Cambridge. However, the level of information and detail is not at an appropriate level of maturity for Full Business Case (FBC) level. There are assumptions throughout, particularly around infrastructure and timetabling, that would not be expected or accepted at this stage of work. These assumptions would need to be verified and further explored to allow the project to progress to an FBC stage.

The key issues that have been identified sit in 10 broad categories which are explored in more detail in section 4:

- Timetabling and train path availability, particularly from March to Cambridge
- Performance impacts on timetable
- Cost assumptions, particularly for infrastructure from March to Cambridge
- Level Crossing approach
- Expected passenger numbers and demand
- Do Minimum scenarios
- Proposed contract structures
- Options development assumptions
- Approvals and deliverability
- COVID assumptions and impact

The biggest risk sits with any integration onto the main line. Removing assumptions around what the Ely Area Capacity Enhancement (EACE) project will provide and understanding what this scheme itself will need to provide is key. This also applies to the capital cost assumptions and patronage, both of which are vital components of a successful business case.

Engineering Status

The reports produced by Mott MacDonald are wide-ranging with well thought out options and conclusions. However, there are some gaps in the reports which would need to be addressed before the project is able to pass through the PACE 1 phase gate. Some of the gaps that need to be addressed include:

- The strategic approach towards level crossings. This needs to consider the safety, financial, project and performance risks and issues associated with closure, upgrade, highway diversion and grade separated crossings
- There is limited consideration of the requirements of the Common Safety Method – Risk Evaluation and Assessment (EU 402/2013) now enshrined in UK law
- The demand modelling is limited and there is insufficient evidence to support a heavy rail solution. The reports demonstrate a desire to facilitate freight services, without providing any clarity on the services required or that the potential market for freight services exists

Decisions need to be made to reduce the number of options and permutations in relation to modal choice, station location and passenger/freight demand. This decision making will help define the future direction of the project.

Uninterrupted connectivity onto the wider rail network is dependent on the availability of train paths. Currently these are constrained and there are competing demands from train operators for these train paths. Future

demand and economic valuation of train paths together with forthcoming changes to the industry structure will introduce a greater strategic focus on network capacity utilisation and may affect the availability of train paths beyond the Wisbech to March route.

While the review concludes that heavy rail is a viable option, lower cost light rail may offer a more credible solution. It is recommended that further work be undertaken to examine the light rail option.

The full NRDD engineering study can be found in Appendix A.

Light Rail Feasibility

The light rail feasibility study concludes that there is potential for a light rail passenger operation between March and Wisbech. The assessment of suitable rolling stock types concludes that Tram; Tram-Train or Very Light Rail (VLR) vehicles could be used. The choice of rolling stock being subject to the specification of the short and long term service aspirations.

The study further concludes that in consideration of the client's specification a tram-train solution appears the best credible light rail option. Tram-train would enable future operation on both the national rail network and any on-street operation into Wisbech town centre or to the Garden Town.

On the basis that light rail is considered a credible and feasible option further work is recommended to examine the options in more detail and to develop cost estimates to assist the business case for reopening the line.

The full light rail feasibility study can be found in Appendix B.

GRIP/PACE Status

The work produced to date by Mott MacDonald on behalf of CPCA is of a good standard. However, there are a large number of GRIP/PACE deliverables missing that would normally be expected to have been completed by the conclusion of GRIP 3/PACE 1. In order to pass through the PACE 1 phase gate these missing deliverables should be produced, reviewed and signed off. Section 6 covers these products in more detail.

A number of the key documents produced by the project to support the GRIP 3 work have issues that should be addressed with input from Network Rail. There are wide ranging assumptions that need to be worked through and validated that will have a significant impact on the viability of some areas of the proposals, e.g., the impact of the Ely Area Capacity Enhancement (EACE) project.

Overall, from a GRIP/PACE product perspective, the project is not mature enough to pass through the PACE 1 phase gate.

3. The Project

The following sections provide an overview of the project and a summary of the project's objectives and outputs.

3.1. Project Overview

The key project aim is to improve transport access to Wisbech, which is not well-served by existing public transport provision. In particular, improving access to Cambridge as a key regional centre for employment. The current proposal is to reopen the mothballed Wisbech branch and connect it to the Ely-Peterborough line at March.

3.2. Boundaries

Boundaries are not yet formally fixed as this is dependent on the final service provision selected. However, the engineering review undertaken by Network Rail Design Delivery (NRDD)/Capital Delivery Eastern is limited to the existing mothballed Wisbech branch and connections at March.

The remitted stage also includes work to evaluate the business case and the possibility of non-heavy rail options. This required consideration of areas beyond the boundaries identified above at a strategic level only. These elements of work have been delivered by NRDD, the Network Rail Light Rail team, Eastern Investment Directorate, Anglia Sponsorship and System Operator as appropriate.

3.3. Interfaces

This project interfaces with the emerging North Anglia portfolio of railway projects. In particular, ambitions to run services beyond March to Cambridge are subject to sufficient capacity being created along the line of route. This is likely to have a particular dependency on Ely Area Capacity Enhancement (EACE) and the signalling renewal on the Ely-Peterborough line anticipated in CP7 (2024-2029).

4. Business Case Review

4.1. Overview

The purpose of this section is to capture Network Rail's view on the Full Business Case (FBC) submitted by CPCA in June 2020. The section provides thoughts on the key areas covered within a proposed business case of this level, citing areas that require revision or deeper examination.

4.2. High Level Summary

It is a consensus among all who have reviewed the business case that the level of information and detail throughout is not at an appropriate level of maturity for FBC level. There are assumptions throughout, particularly around infrastructure and timetabling that would need to be verified and further explored to allow the project to progress to a Full Business case stage.

The key issues that have been identified sit in 10 broad categories:

- Timetabling and train path availability
    - The timetable analysis to date is not at an adequate level of detail to give us confidence that the paths the CPCA seek (2 trains per hour (tph) Wisbech-Cambridge) are currently achievable.
    - The Ely Area Capacity Enhancement (EACE) scheme provides no commitment to additional capacity being made available for services serving Wisbech-March-Cambridge.
- Performance impacts
    - Should the proposed paths be made available there is little/no evidence that these new paths will avoid any negative impact on the current timetable
- Cost Assumptions
    - Business case assumes capital costs for infrastructure from March to Cambridge is included in the overall capital costs for March to Cambridge in the EACE scheme. Works between Wisbech and March are not included in the EACE scope at this time
- Level Crossing Approach
    - Although the approach and perceived costs of closing and adapting/diverting level crossings has been included, there is no evidence showing increased capital costs for increased level crossing risks along the March to Wisbech route
- Expected Passenger Numbers and Demand
    - Variance between the patronage showed in the business case for additional trips up to 2039 and that EACE have identified, with this scheme being in excess of that predicted by EACE
    - Almost all of the forecast patronage comes from the resulting increase in services from March-Cambridge (approximately 90 %). This is not dependent on the Wisbech branch reopening (which is the only part the business case proposal assumes as its cost base, costing circa £200m).
- Do Minimum scenarios
    - Lack of evidence that all committed schemes being delivered in the region are included within the Do Minimum scenario of the economic case. This may have led to double counting of benefits
- Proposed Contract Structures

    - Proposition within the Commercial case suggests CPCA sit as the single lead entity. A single delegated delivery body could be used for the scheme, potentially sitting under a client group led by CPCA.
- Options Development Assumptions
    - Treating this scheme as a standalone shuttle service between Wisbech and March initially could be a useful method to determine and show demand and removes the schemes reliance on EACE
    - Dismissal of a light rail solution may need some additional thought as this could provide a viable option for the above.
- Approvals and Deliverability
    - Various assumptions and omissions around deliverability, programme and risks require further examination. Further exploration of these would add robustness to the case
- COVID assumptions and impact
    - The effects of COVID-19 have not been considered. Now that the railway is recovering and there is a better understanding of how the railway will look moving forward, this should be included in forecasting and demand modelling.

4.3. Detailed Findings

The business case produced by Mott MacDonald for CPCA is overall a well-presented document, with a strong strategic focus, highlighting the need for public transport links from Wisbech and the perceived benefits of this link extending to Cambridge.

Although well researched, the overall findings of the document lack a certain level of maturity that would be expected from an FBC. These gaps reduce the validity of certain statements in the case and increase the risks associated with the project greatly should the scheme progress.

From the review undertaken by Network Rail, the table below provides a review of the key areas that would require further detail and examination to improve any business case submitted:

Theme	Comments
Timetabling analysis & train path availability	• The timetable analysis to date is not at an adequate level of detail to give us confidence that the paths the CPCA seek (2 trains per hour (tph) Wisbech-Cambridge) are currently achievable. The analysis is not sufficiently detailed for a scheme that is at FBC or in late GRIP 3; as such the risk remains that the paths are unachievable or additional scope (both between March – Cambridge and March – Wisbech) is required to deliver the business case output. ○ The CPCA's analysis suggest that there may be retiming of other services required (but little indication as to which services) in order to make 2tph Wisbech-Cambridge work in full. The implications of this could be substantial on the extent of recast required of the timetable; the worst case, for example, could be that the proposal impacts Great Northern (Thameslink) services.
	• The Ely Area Capacity Enhancement (EACE) does not include the Wisbech path/s within its scope however, the business case is wholly dependent on a path/s being available following completion of the EACE scheme. Please can you clarify how the train service would be operated without an Ely path?
Performance impacts	• Should the 2tph Wisbech-Cambridge path/s be achievable no evidence is provided to demonstrate that the performance of the network would not be significantly affected. The reliability of the network is based on the usage of the infrastructure as well as the interactions of services with other services using the same track.. This is particularly pertinent noting the majority of the March – Wisbech reopening

	proposal is predicated on single line running. Elements of the work show very high utilisation factors which is a very early way of understanding the likely performance of a proposal. ○ We support the position within the business case that train performance is a Critical Success Factor. However, at this stage the risk remains that additional infrastructure (both between March – Cambridge and March – Wisbech) is required to deliver this requirement.
Cost Assumptions	• The business case assumes that the EACE scheme provides all the infrastructure necessary from March-Cambridge to run these services. This includes potential level crossing upgrades. EACE has commissioned a study to see if an additional service between Peterborough and Cambridge would trigger a need for further level crossing infrastructure. It should be noted that infrastructure on the route between Peterborough and Ely is not currently in EACE's scope. • EACE is currently remitted to provide a total capacity of 11train paths per hour. Based on the current assumptions in the EACE proposal, there are not enough paths to provide the 2tph assumed in the Wisbech-Cambridge proposal. ○ Should a decision be taken to commission work to add additional paths beyond the **11th path** currently assumed in the EACE proposal, it is likely that the proposed Wisbech – Cambridge **service would be in direct competition with other proposals for paths through Ely. These may include future propositions such as Cambridge – Norwich (which could be in the form of an EWR eastern extension), Cross-country – Cambridge (potentially Stansted)/Norwich or freight. If an 11th path is created by the EACE programme, it should not be assumed that this would be an Ely to Wisbech service.**
	• End to end journey infrastructure costs do not appear to have been fully taken into account. Could you clarify what out of the following BCR costs does CPCA have and what needs further work? ○ All level crossing costs that would require upgrade to run the service (including those around Cambridge) ○ Any costs for signalling changes to operate the service ○ Power upgrade costs ○ Additional rolling stock costs (only the operational expenditure of rolling stock seems to have been accounted for) ○ Depot and stabling costs ○ Any infrastructure costs for upgrades required at Cambridge or other stations to allow the service to run ○ Full operating costs (from discussions with potential operator) • The scheme should not assume EACE will be delivered and full costs should be included with no dependence on final approval of other schemes. EACE is at Develop stage within RNEP with no guarantee of scheme delivery.
	• Costs need to be benchmarked against the actual outturn costs of recent comparable projects. • In turn the elements building up the project need to be carefully considered to ensure that they are appropriate for a line of this type – for example it appeared that the S&C work being proposed for March station to connect to the new branch was a type suited to quite high-speed operation, probably over specified for this application, and in that context it also appeared to be somewhat more expensive than expected. • The Wisbech-March line proposed will be relatively low speed so assumptions around the purchase of brand new material may also be inflating costs unnecessarily. With Whitemoor Yard adjacent there is opportunity to source material recently removed from high speed mainlines which is still perfectly

	adequate for lower speed line use. Sourcing from Whitemoor will also ensure that material is 'local' and reduces overall transport distances.
Level Crossing Approach	• We note that a substantial element of the capital cost is related to the closure and diversion of existing level crossings along the route between March and Wisbech, but that the business case does not include any costs for addressing increased level crossing risk between March and Cambridge (see above). We note that the CPCA may wish to seek a decision which would allow a number of the existing level crossings to be re-instated on the March to Wisbech section in order to consider reducing cost. Given NR obligations to mitigate or remove level crossing risks and the proposal we will be the asset owner of the resulting reopening, NR and ORR would clearly wish to be involved in any consideration of proposals in this regard.
	• ORR's policy on the creation or reinstatement of level crossings on rail lines is clear that these are only to be considered when there is no other reasonably practicable option available. The proposals that CPCA have already generated indicate that there are 'practicable' options for grade separation for the road/rail interfaces, and that including for these costs the overall scheme BCR is above 1. Arguments therefore about the 'reasonableness' of any particular site to be proposed as a crossing will need to be extremely robust if it is to be shown that the costs of closure, diversion or basic grade separation at a particular location are grossly disproportionate to the costs of a suitable at-grade crossing.
	• While ORR does not have a role to approve or agree the decision making around this level crossing question it is important that it is approached in a way that is clear and defensible. ORR may wish to discuss this further with CPCA to ensure that there is clarity on the evidence and process necessary. ORR is a statutory consultee to Transport and Works Act Inquiries and will be expected to make a Statement of Case offering an opinion on the safety of the proposals and this would of course include any level crossings. If ORR are not of the opinion that a proposed level crossing is the only reasonably practicable option then ORR will have to make that point to the Inquiry.
Expected passenger numbers and demand	• The patronage in the business case appears to show that circa 6.6m additional trips will be generated per annum by the proposal by 2039. These numbers appear to be in excess of growth that EACE has been able to identify within the same catchment area.
	• The case must be aligned with WebTAG growth rates as per DfT guidance. • https://www.gov.uk/guidance/transport-analysis-guidance-webtag .
	• Almost all of the forecast patronage appears to come from the resulting increase in services from March-Cambridge (approximately 90 %). This is not dependent on the Wisbech branch reopening (which is the only part the business case proposal assumes as its cost base, costing circa £200m) as in theory all that would be needed is turnaround capability at March. As the scheme does not propose to fund any of the required improvements for the March-Cambridge stretch, and instead assumes EACE does, these benefits could be argued to be required to be attributed to EACE. This could make the March to Wisbech economic case weaker.
Do Minimum scenarios	• Could you confirm whether all committed schemes being delivered in the region are included within the Do Minimum scenario of the economic case, most notably the Kings Lynn – Cambridge 8-car scheme. If this hasn't been included this could result in the double counting of benefits. ○ In addition, although the 2tph Wisbech-Cambridge paths are presumed predicated on the EACE infrastructure, no indication is within the Do Minimum scenario that all the passenger services EACE enables has also been included.
Proposed Contract Structures	• Experience suggests that in rail projects with their many separate technical and operational disciplines, with the related differing sub-contractors, there is great benefit in having a single body responsible for delivery. This places responsibility

	for integration in a single place. Structures with different delivery bodies carry much greater integration risks. There is no reason that CPCA and others should not form some type of joint client board, but then place a single body below this with the responsibility and delegated authority to deliver.
	• We note the examples of major road schemes and the Cambridge guided bus as projects delivered, but consider that the degree of technical complexity in a rail scheme, particularly one integrating into existing rail infrastructure, is of a significantly different scale and the previous experience may not be comparable.
	• Have all delivery modes been adequately considered?
Option Development Assumptions	• The option development should consider the RNEP stage and the dependency on a non-committed scheme. Should the CPCA not wish to include the costs of EACE in the business case for the Wisbech-Cambridge proposal, the CPCA concept around beginning services with some form of shuttle between March and Wisbech appears to be a sensible choice. This could be linked to a proportionate level of connection to the existing network to support stock transfer etc. • Establishing early demand with a shuttle connection could be a sensible first step. • In the context of a stand-alone shuttle, there are concerns around the rejection of light rail modes on the basis of technical risk. Light rail does not imply overhead electrification; a diesel tram-train could be an option though it is acknowledged that there is a limited supply market compared to other rolling stock types. • The use of tram type rolling stock and operational concepts could in turn lead to different decisions about some of the intersections of roads and rail alignment, and the approach to signalling needs on the line.
	• The weighted assessment in table 2 is very close between National Rail and the two tram-train options. This seems to be mainly influenced by "no existing client knowledge and experience of delivering tram-train schemes, plus the technology and delivery mechanisms are less proven" (2.15.4). This may be correct, but as the scores are so close some further sensitivity analysis might be beneficial to confirm the approach.
Approvals and deliverability	• Based on other schemes, the schedule presented in Table 12 looks potentially achievable, but also very optimistic. For example, the case references Cambridge South station, which is probably much lower complexity as a scheme being approved in March 2020 and opening in 2025 (section 2.9.1).
	• The risk identification in table 13 correctly references approvals as a risk, but is limited to NR design approval. Approvals and authorisations are more complex than this and the risk may be underestimated.
	• The strategic case and the management case both reference a QRA is yet to be done. This would significantly help inform the robustness of assumptions made in the case.
	• Table 3.19 risk ID 8 refers to a tight radius at March station. If this affects platform curvature this could be a significant issue. Managing the step gap between track and train is a key issue for the industry with almost half the total harm for passengers arising from this gap. Curved platforms mean bigger steps. If the Class 755 is used this does have design features that help, but it's easy to underestimate the risk and impact.
COVID impact	• Covid-19 is likely to impact the strategic case at least; without more detailed work it is difficult to assess the magnitude of impact, or indeed whether it is positive or negative.
Consents	• For a project at FBC level a consenting strategy would be expected. Beyond a high-level mention within the management case, there doesn't appear to be a defined consent strategy. The lack of one adds considerable risk to any proposed programme as there is no confidence in the ability to obtain land or permissions.

4.4. Conclusion

The case for change within the Business Case is apparent. Wisbech is an area of deprivation that suffers from not having a reliable form of public transport beyond that of buses trying to operate on already congested roads. The use of the mothballed March-Wisbech line presents an opportunity to connect this Town onto the wider rail network, connecting the people of Wisbech to a greater array of employment, healthcare and education.

Although compelling from a strategic perspective, the FBC submitted relies on a lot of assumptions which would not be expected or accepted at this level. The biggest risk sits with any integration onto the mainline – removing assumptions around what EACE will provide and understanding what this scheme itself will need to provide is key. This is also relevant for capital cost assumptions and patronage – both of which are vital components of a successful Business case.

Based on the size, maturity and the number of uncertainties, the project may in fact benefit from re-addressing the above and look to submit an Outline Business case. This may also be of benefit if a light rail solution is investigated further.

5. Project Reports Review

This section of the report covers the key documents produced by the project and provides commentary and suggestions for future work from a Project Management perspective.

5.1. GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report (398128-009-C)

There are a number of assumptions documented in the report that should be validated. For example, railway asset condition and highways/level crossings condition.

Interfaces with other Network Rail projects, e.g., Ely Area Capacity Enhancement (EACE) and re-signalling projects need to be checked and reconsidered in light of industry changes since production of the report.

The report mentions engagement with the likely Train Operating Company (TOC), Greater Anglia (GA), but does not detail what discussions have been held. The TOC will need to be consulted on operations, proposals for the stations, staffing requirements etc. These discussions may influence the requirements and the designs for the project.

There is a lack of evidence of scoring of options in the report and justification for selecting particular options. For example, section 5.6.2.2 in the report includes a paragraph covering platform construction type. A preferred option is chosen but without any specific evidence to show why.

Designs have been produced for March Station, including platform modifications, car parks etc. Work is currently taking place to redevelop March station, including a new ticket hall and waiting area, as well as an expansion to the current car park to the south of the station. This is likely to mean that the works proposed at March Station as part of this study will need to be reconsidered.

The environment section of the option selection report appears quite light, and it is difficult to see how it is weighted relevant to other considerations during option selection. This should be reviewed.

A Carbon Assessment is provided in Appendix T of the report. Some of the assumptions/exclusions within the assessment would benefit from some clarification – for example, track foundations already being in place, temporary works for drainage not being considered, P-Way fittings not being included etc. Some of the graphs are quite difficult to interpret and there is little explanatory text. This is not of a standard that would be suitable for a NR project and would likely need to be revisited. Evidence of carbon being integrated into the option selection process and general design process should also be provided.

5.2. Options Assessment Report (398128-005-D)

The cost estimate for the tram-train scheme does not appear to have been built up using the same methodology as the estimate for the heavy rail scheme, which may have led to unfair comparisons being made. The guided busway option (DS3) includes vehicle costs, but other options do not, again meaning that estimates are difficult to compare on a like for like basis.

As per the GRIP 3 heavy rail report, assumptions need to be validated, particularly around Ely Area Capacity.

5.3. Delivery Strategy (398128-009-E)

The high level programme shown in table 5 has GRIP 5 detailed design starting well before completion of TWAO process. This would present a risk and should be understood and assessed by the project.

5.4. Assessment of Rail Operations (398128-007-C)

The report acknowledges that the Ely area is unable to accommodate any additional services without compromising performance and adversely affecting the existing level crossing risk. It is also stated that the EACE scheme aims to provide up to 11tph through Ely North Junction, and that to accommodate 2tph from Wisbech – Cambridge, capacity for 13tph would be required. This is beyond the current scope of the EACE project.

Platforms 5/6 at Cambridge are identified for services running to/from Wisbech. It is not clear whether any assessment of platform availability at Cambridge has been carried out.

The report also acknowledges that running additional services between Wisbech and Cambridge could change level crossing risk profiles, triggering the need for upgrades on the mainline between March and Cambridge. This does not appear to have been factored into cost estimates.

Section 5.3.4 summarises the modelling carried out to date and concludes that finding a path for 2tph from Wisbech to Cambridge is not possible with the current timetable and would only be possible if Ely North Junction is remodelled to accommodate these services. This therefore creates a dependency on the Ely Area Capacity Enhancement project, or a similar scheme, neither of which are confirmed or have the paths for Wisbech services built into their output requirements.

5.5. Environmental Report (398128- MMD-00-XX-RP-EN-0001-B)

The purpose of the Environment Report is slightly unclear and there are a number of omissions, though some of these have been covered by the Preliminary Ecological Appraisal (PEA) and elements of the option selection report.

One area that does not appear to have been considered is Social Value. The Socio-Economic impacts from this scheme will be significant, both during construction and operation. It is recommended that an assessment is completed to strengthen any business case for the development. Additionally, this project could be a good candidate for the newly released NR Social Value Profit Calculator.

5.6. Preliminary Ecological Appraisal (PEA) (398128-MMD-00-XX-RP-EN-0003-B)

The PEA is a thoroughly written document and provides a good starting point for developing an approach to ecology management. A lot of constraints have been identified, as anticipated, and there will need to be extensive statutory stakeholder engagement. The number of additional surveys required is considerable, and these will need to be appropriately programmed as the project proceeds. Habitat creation normally requires quite significant land acquisition, so this needs to be factored into the consents strategy as well as the project cost estimate.

5.7. Estimating

Capital cost estimates have been produced for both tram-train and heavy rail options and are contained in the respective reports covering these options. There are a number of exclusions in these estimates that could have a significant bearing on the overall project costs, including, but not limited to:

- Land purchase or rental (added in the business case for the heavy rail option)

- Utilities diversions, relocation and protection (for tram-train scheme)
- Re-location of affected businesses
- Planning and consents costs
- Inflation (added in the business case for the heavy rail option)
- All costs associated with Insurance Top Up Fund, the Network Rail Fee Fund or the Industry Risk Fund (only mentioned for tram-train scheme)
- Project risk allowance (added in business case and options assessment report)

5.8. Heavy Rail Estimate

The estimate appears to cover the relevant elements of the scheme (exclusions aside) and the unit rates used for the rail elements seem appropriate.

As stated in the Railway Control Systems section of the exclusions table, the cost of interlocking is assumed to be borne by another project. It may be more prudent to include the cost of interlocking in this project estimate and present the potential for it to be funded by another scheme as an opportunity, rather than treating it as an exclusion.

The allowance for environmental mitigation measures (2.5 %) appears low, particularly given the findings of the Preliminary Ecological Appraisal. The cost and schedule impacts of environmental mitigation can be significant and had a considerable influence on a recent similar project to bring the Dartmoor line back into National Rail service.

The allowance for civils/drainage works on the Heavy Rail Option 4C (and other options) appears low considering the relatively unknown ground conditions in the area. Further ground investigations will be required to more accurately inform these allowances.

5.9. Light Rail Estimate

The indirect costs presented for the light rail scheme appear high, constituting more than 50 % of the total cost for both options DS1 and DS5.

Estimates produced by the project for light rail and heavy rail are difficult to compare. For example, the light rail estimate includes an allowance of circa £14.5m for signalling works, including re-signalling of March East area. The heavy rail estimate for the selected option (option 4C) assumes this cost is borne by another project (as mentioned above) and has a total allowance for signalling of circa £4m. Another example is Contractor's preliminaries. These have been calculated differently for the light and heavy rail schemes, resulting in very different figures being produced. The estimates should be produced using the same methodology and assumptions (as far as possible) to enable informed comparison and decision making.

As identified in the GRIP/PACE review (section 6 of this report), a cost planning report should be provided alongside any estimate. This should contain explanation of the estimate produced, as well as benchmarks to provide confidence that the estimated cost is realistic.

6. GRIP/PACE Review

6.1. Overview

At the time the documentation to be reviewed was produced by CPCA, Network Rail operated under the Governance for Railway Investment Projects (GRIP) project and programme delivery framework. This approach was developed to manage and control infrastructure investment projects in order to minimise and mitigate the risks associated with delivering projects and programmes.

In response to the government's challenge to the rail industry to pioneer new ways of working that will reduce the time and cost of delivering infrastructure projects, project SPEED (Swift, Pragmatic and Efficient Enhancement Delivery) was jointly developed by the Department for Transport (DfT) and Network Rail in the summer of 2020. This led to a number of key themes being identified, including Governance and Assurance.

This in turn led to the creation of PACE (Project Acceleration in a Controlled Environment). The PACE framework replaces GRIP and is designed with an increased level of flexibility and delegated authority for decision making to Network Rail's regions including individual projects and programmes.

All PACE deliverables have been assigned a RAG rating in accordance with where the requirement for their completion originates. The RAG rating supports the Sponsor and Project Manager in selecting the right products for the project and understanding what level of approval may be required to follow a different approach where that is in the best interests of successful project delivery.

Due to this change in project delivery framework, the documentation produced to date has been reviewed against both GRIP and PACE, with recommendations for addressing any gaps assessed only against PACE.

6.2. GRIP Product Analysis

Below is the list of GRIP products that would typically have been expected to be produced by a project that has reached GRIP stage 3 alongside Network Rail's assessment of whether these products have been created or not. As stated earlier in the document, due to the works not being undertaken by NR at that stage, it is envisaged that there will naturally be gaps in the GRIP products produced.

		GRIP Stage				
Ref	Product Name	1	2	3	Produced by Project	Comments
G1	Stage Gate Checklist				X	
G2	Stage Gate Certificate				X	
G3	LoC Assessment *(Management Level of Control)*				X	
CS1	Client Remit				X	
CS2	Sponsors Instruction				X	
CS3	Feasibility Report				✓	GRIP 2 Heavy Rail Feasibility Report Low Cost Alternative Tram-Train Feasibility
CS4	Option Selection Report				✓	GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report
CS5	Asset Management Plan (AMP Process)				X	
CS6	Diversity Impact Assessment				X	
PM1	Project Management Plan				X	
PM2	Stakeholder & Customer Management Plan				X	
R0	Requirements Management Plan (RMP)				X	
CA1	Land and Consents Strategy				X	Outlined in business case and delivery strategy
CA2	Land and Consents Commitments Register				X	
CA3	Network Change				X	Informal consultation only at GRIP 2 & 3.
CA4	Station and Depot Change				X	
CP2	Formal Cost Planning Report				X	Estimate produced but without accompanying report

CP5	Lifecycle Cost GRIP 3 Report				X	Specifically excluded from business case - see section 5.3.2
RV1	Strategic Risk Assessment				X	
RV2	Risk Register				✓	Contained within business case
RV4	Quantitative Cost Risk Assessment (QCRA)				X	Risk based on percentages
RV5	Programme Quantitative Schedule Risk Assessment (QSRA)				X	
RV6	VM Output Definition				X	
RV7	VM Option Selection				X	
RV9	VM Lessons Learnt				X	
EG0	Preliminary System Definition and Safety Verification Categorisation Application				X	Acknowledged by Mott MacDonald in GRIP 3 report that CSM has not yet been considered - see section 14.2
EG5	Project Hazard Record				✓	Hazard record in appendix C of GRIP 3 report - HAZID has been held
EG4	System Definition				X	
EG6	System Safety Plan				X	
EG7	Safety Justification Report				X	
EG2	Project Authorisation Strategy				X	
EG10	Engineering Compliance Certificate				X	
EN1	Environmental & Social Performance Appraisal				X	Environmental Report and Preliminary Ecological Appraisal have been produced
HS1	Safety Risk & Mitigation Log				X	
HS2	Project Safety Strategy				X	
HS3	Health and Safety File				X	
CDM1	CDM Plan				X	

6.3. PACE Product Analysis

Below is the list of PACE products that would typically have been expected to be produced by a project that has reached the end of PACE 1, alongside Network Rail's assessment of whether these products have been produced or not. A narrative on each product has also been provided to explain its purpose as well as Network Rail's assessment on what would need to be done in order for the project to complete PACE 1.

Ref	Product Name	Produced by Project	Comments/Recommendations
P.CR1	Client Remit	X	To be produced in order to complete PACE 1
P.CR2	Sponsors Instruction	X	To be produced in order to complete PACE 1
P.CR3	Asset Management Plan (AMP Process)	X	AMP001-003 forms to be produced in order to complete PACE 1
P.CR4	Diversity Impact Assessment	X	To be produced in order to complete PACE 1
P.CR6	Option Selection Report	✓	
P.MP1	Phase Plan	X	To be produced in order to complete PACE 1
P.MP2	Phase Gate Certificate	X	To be produced in order to complete PACE 1
P.MP3	LoC Assessment	X	To be produced in order to complete PACE 1
P.MP4	↓ Project Management Plan	X	To be produced in order to complete PACE 1
P.MP4/1	→ Risk Management Plan	X	Arrangements for risk management detailed within business case. Strategy to be produced in order to complete PACE 1 - this can form part of the PMP
P.MP4/2	→ Stakeholder & Customer Management Plan	X	Brief section within business case discussing communications and stakeholder management. Plan to be produced in order to complete PACE 1 - this can form part of the PMP
P.MP4/3	→ Scope Management Plan	X	To be produced in order to complete PACE 1 - this can form part of the PMP
P.MP4/4	→ Land & Consents Strategy	X	Outlined in business case - should be either a standalone document or form part of PMP
P.MP4/5	→ Project Safety Strategy	X	To be produced in order to complete PACE 1 - this can form part of the PMP

P.MP4/6	→ Integrated Assurance & Approvals Plan	X	Not required/appropriate at this stage. To be produced at next stage when there is more clarity over project direction.
P.MP5	Risk Register	✓	Risks listed within business case and option selection report - do not appear to be quantified. These should be collated and quantified in terms of cost, time and probability (with appropriate mitigations defined) before the end of PACE 1.
P.RM1	Quantitative Cost Risk Assessment (QCRA)	X	To be produced in order to complete PACE 1 for LoC 1 & 2 projects
P.RM2	Project Quantitative Schedule Risk Assessment (QSRA)	X	To be produced in order to complete PACE 1 for LoC 1 & 2 projects
P.HS1	Health & Safety File	X	To be produced and updated as far as possible in order to complete PACE 1 - QF703 to be in place
P.HS2	CDM Plan	X	To be produced in order to complete PACE 1
P.HS3	Pre-Construction Information	X	To be produced in order to complete PACE 1
P.HS6	Safety Risk & Mitigation Log	X	To be produced in order to complete PACE 1 - this can be combined into a single log with the Project Hazard Record (EG5) if preferred
P.CA2	Land and Consents Commitments Register	X	To be produced in order to complete PACE 1
P.CA3	Network Change	X	Not required at this stage - can be produced in PACE 2
P.CA4	Station and Depot Change	X	Not required at this stage - can be produced in PACE 2
P.EN1	Environmental & Social Appraisal	X	Some environmental deliverables produced but this is still required in order to complete PACE 1
P.CP1	Formal Cost Planning Report	X	Summarised in business case - full report required in order to complete PACE 1
P.CP5	Lifecycle Cost Report	X	Specifically excluded from business case - see section 5.3.2. It is recommended that this is produced before the end of PACE 1.

P.RV6	VM Output Definition	✗	Best Practice to complete this for complex projects in order to complete PACE 1
P.RV7	VM Option Selection	✗	Best Practice to complete this for complex projects in order to complete PACE 1
P.RV9	VM Lessons Learnt	✗	Recommended that lessons learnt session is held prior to completion of PACE 1
EG0	Preliminary System Definition and Safety Verification Categorisation Application	✗	Acknowledged by Mott MacDonald in GRIP 3 report that CSM has not yet been considered - see section 14.2 of GRIP 3 report. This needs to be produced in order to complete PACE 1.
EG2	Project Authorisation Strategy	✗	Acknowledged by Mott MacDonald in GRIP 3 report that CSM has not yet been considered - see section 14.2 of GRIP 3 report. This needs to be produced in order to complete PACE 1.
EG4	System Definition	✗	Acknowledged by Mott MacDonald in GRIP 3 report that CSM has not yet been considered - see section 14.2 of GRIP 3 report. This needs to be produced in order to complete PACE 1.
EG5	Project Hazard Record	✓	Hazard record in appendix C of GRIP 3 report - HAZID has been held
EG6	System Safety Plan	✗	Acknowledged by Mott MacDonald in GRIP 3 report that CSM has not yet been considered - see section 14.2 of GRIP 3 report. This needs to be produced in order to complete PACE 1.
EG7	Safety Justification Report	✗	Acknowledged by Mott MacDonald in GRIP 3 report that CSM has not yet been considered - see section 14.2 of GRIP 3 report. This needs to be produced in order to complete PACE 1.
EG10	Engineering Compliance Certificate	✗	To be produced in order to complete PACE 1

6.4. PACE Products Narrative

P.CR1 Client Remit
The purpose of the Client Remit product is to provide an overview of the scheme, including boundaries, interfaces, and known exclusions. It is also used to define the project requirements which will be developed through the lifecycle of the project. This document should be created at the point of project inception and helps to provide requirements traceability to ensure that all project requirements are delivered. This document should be produced in order to complete PACE 1.

P.CR2 Sponsors Instruction
The Sponsors Instruction acts as the project requirements document through the lifecycle of the project. It should be updated at regular intervals through the project lifecycle to track requirements at a level of detail appropriate to the stage the project is at. This document should be produced in order to complete PACE 1.

P.CR3 Asset Management Plan (AMP Process)
The Asset Management Plan (AMP Process) provides a mechanism for introducing new assets or affecting existing assets on NR's infrastructure through the development and implementation of an AMP which defines:

a) The responsibilities for the various elements of inspection and maintenance before, during and after project works.
b) The relationships and the exchanges of information between the Maintainer, Asset Owner and the Project Manager; and
c) The required AMP deliverables in support of project works.

This supports:

a) The arrangements for the management of assets undergoing change:
b) Assurance of the continued safe and effective maintenance of all assets through the project lifecycle; and
c) Network Rail in discharging its duties under the Construction, Design and Management Regulations, in accordance with NR/L2/OHS/0047, through the provision of pre-construction information.

In order to complete PACE 1 AMP forms 001-003 should be completed and agreed with the relevant Network Rail Project Interface Coordinator (PIC). The purpose of these forms is primarily to provide the asset maintainers with information regarding the project including scope and key contacts, and to agree a draft list of AMP products to be produced later in the project lifecycle.

P.CR4 Diversity Impact Assessment
The Diversity Impact Assessment (DIA) is a tool that helps the industry make sure that our programmes, policies, projects and the way we design, build and operate services works well for our staff and customers and ensures we are compliant with the Equality Act 2010. All projects should produce a DIA as early as possible during PACE 1, this can then be updated as the project progresses. A DIA should be produced in order to complete PACE 1.

P.CR6 Option Selection Report
A report containing evidence of a robust option selection process should be completed by all projects. This should include details of areas including (but not limited to): scope, requirements, selected option, compliance with requirements, constructability, access & possessions, programme, risks and assumptions.

An Option Selection Report has been produced for the project. Comments on this are provided in section 5 and Appendix A.

P.MP1 Phase Plan
The phase plan is a document that records the agreement between the Sponsor and the Project Manager regarding which PACE products are required, what stage of the project they are to be produced at and who is responsible for producing them. This should be populated by the project and used as the basis for the P.MP2 Phase Gate Certificate required below in order to complete PACE 1.

P.MP2 Phase Gate Certificate
The phase gate certificate is a version of the Phase Plan that contains a record of the project status at the end of each PACE phase. It details which products have been completed and provides a link to where they are stored on an appropriate document management system. This document should be signed by the Sponsor and Project Manager. This should be completed by the project as a formal record of the PACE 1 phase gate review.

P.MP3 LoC Assessment
The Level of Control (LoC) Assessment is a tool to determine how complex a project is, and in turn the controls and checks that must be placed around it. Projects are categorised from LoC 1 – 4, with LoC 1 being the most complex and LoC 4 the least complex. Projects are assessed against 6 categories:

1) Novelty
2) Technology & Design
3) Delivery Complexity
4) Pace
5) Operational Impact
6) Stakeholder Complexity/Reputational Risk

This assessment should be carried out by the project in order to complete PACE 1. Due to the proposed size and complexity of the project, it is likely to be assessed as a LoC 1 or LoC 2 project.

P.MP4 Project Management Plan
The Project Management Plan (PMP) describes how the project will be managed. This should include details of areas including (but not limited to): Scope, roles and responsibilities, stakeholder management, reporting, governance, risk management, planning, procurement and commercial management, environment and sustainability. Due the proposed size and complexity of the project it is recommended that a PMP be produced by the project in order to complete PACE 1.

P.MP4/1 Risk Management Plan
This document describes how risk is to be managed on a project. It is permissible for this to form a section of the PMP or to be a standalone document. Within Network Rail, a regional Risk Management Plan can be referred to if appropriate. Due the proposed size and complexity of the project it is recommended that a Risk Management Plan be produced by the project in order to complete PACE 1.

P.MP4/2 Stakeholder Management Plan
This document describes the project's approach to stakeholder management. It is permissible for this to form a section of the PMP or to be a standalone document. Due the proposed size and complexity of the project it is recommended that a Stakeholder Management Plan be produced by the project in order to complete PACE 1.

P.MP4/3 Scope Management Plan
The purpose of this document is to describe the processes and roles & responsibilities associated with the development, management and validation of the scope. It is permissible for this to form a section of the PMP or to be a standalone document. Due the proposed size and complexity of the project it is recommended that a Scope Management Plan be produced by the project in order to complete PACE 1.

P.MP4/4 Land & Consents Strategy
The purpose of this document is to identify the broad scope of land and consents requirements for the project and set out how these will be obtained/satisfied and supported through the project. The strategy should be produced as early as possible in PACE 1 and reviewed/updated throughout the project lifecycle.

It is noted that an outline Land & Consents Strategy has been included in both the business case and delivery strategy for the project. These documents have identified a Transport and Works Act Order (TWAO) as the preferred consenting route. Network Rail concur that this is appropriate for the currently proposed scheme.

It is recommended that a Land & Consents Strategy, either standalone or as part of a Project Management Plan, be produced by the project in order to complete PACE 1.

P.MP4/5 Project Safety Strategy
The Project Safety Strategy outlines the health and safety principles that apply to the project. It describes the safety policy, organisation and overall project safety arrangement applicable to design and delivery phases of the project. Due the proposed size and complexity of the project it is recommended that a Project Safety Strategy be produced by the project in order to complete PACE 1.

P.MP4/6 Integrated Assurance & Approvals Plan (IAAP)
This document enables the project to capture all assurance and approval activities in one place to provide an oversight of governance and assists in co-ordinating assurance activities and approval points to avoid overlaps or gaps. It is not necessary for the project to produce an IAAP in order to complete PACE 1, though it is recommended that one is produced at the start of the next stage of development.

P.MP5 Risk Register
The risk register exists to track and monitor any risks that might impact on a project. Risks are quantified in terms of time, cost and probability and feed into the QCRA (P.RM1) and QSRA (P.RM2) processes. A risk register has been created by the project and currently forms part of the business case document. These risks should be quantified in terms of time and cost to provide a view on the level of risk exposure to the project. These values will also feed into the QCRA and QSRA processes described below.

P.RM1 Quantitative Cost Risk Assessment (QCRA)
The QCRA is undertaken to provide a range of risk exposures (recommend appropriate contingency value) for an investment decision and/or to inform the adequacy of the current contingency (compare remaining exposure against the remaining contingency). A QCRA should be undertaken by the project in order to complete PACE 1.

P.RM2 Quantitative Schedule Risk Assessment (QSRA)
The QSRA is used to assess the likelihood of completing a programme of works to planned timescales and/or to provide a range of potential completion dates. The QSRA report captures the assumptions, risks and uncertainty to the delivery of the programme of works, together with any action plans required to ensure successful delivery. A QSRA should be undertaken by the project in order to complete PACE 1.

P.HS1 Health and Safety File

The Health and Safety File is a repository of health and safety information that serves as a legal record, benefitting both clients and end users – from initial construction through use, cleaning, maintenance, alterations and refurbishment, and demolition. By the end of PACE 1, the Principal Designer representative for the project should have:

a) Contacted the NR National Records Group to obtain the QF703; H&S File Memorandum of Agreement and Deliverable Document Matrix;
b) Completed the QF703, H&S File Memorandum of Agreement and Deliverable Document Matrix; and
c) Agreed the format of records in the H&S file with the Client Representative and the National Records Group.

P.HS2 CDM Plan

The CDM plan provides detail and assurance on how the duties of the CDM regulations 2015 will be discharged and met by the project. The project should compile a CDM plan prior to completing PACE 1.

P.HS3 Pre-Construction Information

The purpose of this document is to draw together information in the client's possession (or which is reasonably obtainable by or on behalf of the client), which is relevant to the construction work and is of an appropriate level of detail and proportionate to the risks involved, including:

a) Information about:
    i. The project
    ii. Planning and management of the project
    iii. Health and safety hazards, including design and construction hazards and how they will be addressed; and
b) Information in any existing health and safety file.

The project should compile a Pre-Construction Information pack prior to completing PACE 1.

P.HS6 Safety Risk & Mitigation Log

This document is used to identify and record any health and safety risks on the project, as well as actions to address them. It is permissible for this product to be standalone, or to be combined with EG5 Project Hazard Record. A Safety Risk & Mitigation Log should be produced prior to completing PACE 1.

P.CA2 Land and Consents Commitments Register

The purpose of this document is to record any consents that are required for the project based on the information known at the time. This document is a live register that is updated throughout the lifecycle of the project. A Land & Consents Commitment Register should be produced in order to complete PACE 1.

P.CA3 Network Change

Network Change is the process that projects must comply with if they are proposing anything that constitutes a physical change to the network, or a change to the operation of trains on the network. The process is in place to ensure that train operators are made aware of any changes to the network so that they can assess any impact this may have on their services and can plan accordingly. The project should begin informal consultation during PACE 1 and begin the formal process at the start of PACE 2.

P.CA4 Station and Depot Change

Stations alter throughout their life as things are added and taken away from them, and their use within the rail network changes. When stations are updated, either by projects or changing use, the contractual elements that guide the relationship between Network Rail and the Station Facility Owner will also change. These contractual elements are defined in the Station Access Conditions (SACs) for each station.

Station Change is the regulatory process used to facilitate these changes. The procedures are set out in the SACs and ensure that all users of stations are properly consulted about changes and that changes are formally registered with the ORR, so that the various parties can understand their obligations. The project should begin this process at the start of PACE 2.

P.EN1 Environmental and Social Appraisal (ESA)
This is a tool used to help identify and manage the environmental and social risks and opportunities associated with the project. The output of the tool is an action plan which allows projects to be developed in accordance with compliance obligations and industry best practice. Completing the ESA provides the project with a holistic assessment of the environmental and social risks and opportunities that must be managed for the successful delivery of the project. An Environmental and Social Appraisal should be produced in order to complete PACE 1.

It is noted that the project has produced a number of environmental deliverables, primarily an Environmental Report and a Preliminary Ecological Appraisal (PEA). Comment on these reports is provided in section 5.

P.CP1 Formal Cost Planning Report
The purpose of the Cost Planning Report is to provide a cost estimate for the project as well as a narrative explaining the makeup of costs and applicable benchmarks. Estimates are built using the Rail Method of Measurement (RMM) format. It is noted that an estimate has been produced as part of the GRIP 3 work for input into the business case. A Formal Cost Planning Report including benchmarking should be produced in order to complete PACE 1.

P.CP5 Lifecycle Cost Report
The purpose of the lifecycle cost report is to quantify the long-term costs of maintenance, operation and disposal to ensure that major capital projects balance the cost of acquisition with these ongoing whole life costs. It is recommended that a Lifecycle Cost Report is produced by the project prior to completion of PACE 1.

R.RV6 VM Output Definition
This is part of the NR Value Management process and comprises a facilitated workshop to determine the project purpose and functional requirements. A report is then produced to record the outputs of the workshop. It is recommended that a VM Output Definition workshop is held at the earliest available opportunity in order to help define the Minimum Viable Product (MVP) for the project.

R.RV7 VM Option Selection
This is the next part of the NR Value Management Process. It provides confirmation of the preferred option(s) for progression and is usually the result of a facilitated workshop but may also consist of a summary of option appraisals undertaken by the project and design teams. A VM Option Selection Workshop should also be held prior to the completion of PACE 1 in order to validate the work to date with reference to the VM Output Definition Workshop and MVP process.

R.RV9 VM Lessons Learnt
Another part of the NR Value Management Process. Lessons Learnt workshops should be held at the end of each PACE phase as minimum. The purpose of this is to support NR's strategic vision to become a learning organisation, improving business through better understanding of systemic issues. It is recommended that the project holds a Lessons Learnt workshop prior to the completion of PACE 1.

EG0 Preliminary System Definition and Safety Verification Categorisation Application
This document should be produced during the feasibility stage of the project (GRIP 2/PACE 1 ES2) at the latest. It provides details of the project scope, novelty and complexity amongst other things, which help to provide a project position on Common Safety Method (CSM) significance and Interoperability. This position

then needs to be verified by Network Rail Assurance Panel (NRAP) and influences the level of application of CSM and Railways (Interoperability) Regulations (RiR) required on the project. The Preliminary System Definition and Safety Verification Categorisation Application should be produced by the project as soon as possible as the outcome of these processes will influence the level of CSM-RA application required on the project.

EG2 Project Authorisation Strategy

The Project Authorisation Strategy sets out which elements of the project will require authorisation for placing into service under the RiR and also whether the project delivers significant change to the railway system as defined by the CSM regulations. The document should set out the proposed scope, structure and timescales for:

- The authorisations to be obtained from the safety authority;
- Any derogations from the requirements of applicable technical specifications for interoperability (TSIs) to be obtained from the competent authority; and
- The safety assessments and associated safety acceptances required to bring the project into use.

This document needs to be produced to enable the project to complete PACE 1.

EG4 System Definition

The System Definition is one of the key CSM documents to be produced by projects. The purpose of the document is to complement the hazard record by bounding the scope of the hazard identification and risk assessment process and provide sufficient context to facilitate an assessment of the correct application of the process by an independent body. This is a live document that should be updated through the project lifecycle as details of the project emerge.

This document needs to be produced to enable the project to complete PACE 1.

EG5 Project Hazard Record

A hazard record should be started from the beginning of the project to record safety hazards for the various options being considered and be used to inform feasibility work and subsequent option selection. The hazard record should be updated (including identification of any new hazards) and maintained throughout the project lifecycle. It is noted that a HAZID workshop has been held and a hazard record produced and provided in appendix C of the GRIP 3 multi-disciplinary report, though the format of this hazard record does not meet all the mandated requirements of CSM-RA.

EG6 System Safety Plan

The System Safety Plan is another key part of the CSM suite of documents. The main purpose of the document is, as part of the risk management process, to identify the different 'actors' tasks, and their risk management activities through the lifecycle of the project. It should be updated at regular intervals as the project develops.

This document needs to be produced to enable the project to complete PACE 1.

EG7 Safety Justification Report

A further key part of the CSM process, the purpose of the Safety Justification Report is to present the hazards identified as a result of the significant change and demonstrate that these are controlled to be tolerable and As Low as Reasonably Practicable (ALARP) through a means of safety measures. It should show that the system is suitably safe by demonstrating compliance with all safety requirements set in the System Definition, or, where Safety Requirements have not been met, the safety impact has been judged to be tolerable and ALARP.

This document needs to be produced to enable the project to complete PACE 1.

EG10 Engineering Compliance Certificate

The purpose of the Engineering Compliance Certificate is to formally accept evidence of compliance to the technical scope and requirements documentation, identify any formalised changes or variations to this scope as well as present any non-compliance to Network Rail standards. This can be utilised at any point in the project lifecycle to check compliance but is typically used at the end of GRIP stages/PACE phases. An Engineering Compliance Certificate should be produced in order to complete PACE 1.

7. Next Steps

Before the project proceeds any further, it is recommended that discussions are held between NR, CPCA and DfT to determine the future direction of the project. As well as heavy rail, other options such as tram-train and light rail should be further considered as per the recommendations of the NR engineering report and NR light rail feasibility study.

Next steps from the NR engineering and light rail feasibility studies are collated below.

NR Engineering Report

1. The multiple options and permutations for providing a service between March and Wisbech need to be reduced and refined to enable the project to move forward.

   The continued consideration of multiple options and permutations impedes cost and time efficient development.

2. The development of a more detailed strategic approach to level crossings is required that considers the safety, financial, project and performance risks and issues associated with closure, upgrade, highway diversion and grade separation.

   There will be an increase in the level crossing risk profiles due to an increase in road traffic since the line last operated. Closure of any level crossing will be subject to agreement with any users and financial settlements may be required. Where level crossings are to remain open risks will need to be mitigated in the context of different modal options and how rail vehicles operate along the line.

3. Further work is required to explore the light rail tram-train solution

   Network Rail's Light Rail and Knowledge team's report (Source Document 11) concludes that there is potential for a light rail passenger operation between March and Wisbech. The assessment of suitable rolling stock types concludes that Tram; Tram Train, or Very Light Rail vehicles could be used. The operating costs of light rail are likely to be significantly lower than comparable heavy rail services.

4. Further work is required to confirm the passenger and freight demand, particularly post COVID-19 pandemic, to determine the most appropriate solution that meets this demand.

   The reports do not adequately evidence a thorough Transport Study and therefore do not provide a solid base on which to make an informed decision. Both heavy and light rail tram-train facilitate freight services. A light rail tram-train option offers a potentially more credible solution based on overall cost, an optimised level crossing strategy, connectivity to the National Rail network and direct access into Wisbech Town and Wisbech Garden Town.

5. Develop a System Definition and System Safety Plan in line with the proposer's legal obligations set out in Common Safety Method for Risk Evaluation and Assessment Regulation (EU) 402/2013.

   The starting point for anyone proposing any change in relation to the mainline railway system is the Common Safety Method – RA, and this applies when any technical, operational or organisational change is being proposed to the railway system. The proposer in this instance is deemed to the combined local authority or their agent.

6. A detailed asset condition survey is required for the entire route. This will assist in confirming the rail infrastructure work required for the option selected.

The condition of the former railway infrastructure is not known and it has not been fully maintained since the line was mothballed. A full asset condition survey will enable greater clarity on the scale and costs of any railway infrastructure works required.

Light Rail Feasibility Report

1. The legal status of all the former level crossings on the March to Wisbech line should be confirmed. Confirmation is required if the legal status needs to change if the route is to be used by light rail vehicles.

   Establishing the existing rights and liabilities at each crossing will help inform the appropriate solution for each vehicle option.

2. Options for the ownership, operations and maintenance responsibility for the route need to be identified and resolved prior to further development. This includes any on street system into Wisbech town centre or the extension to serve the Garden Town.

   While Network Rail retains the freehold of the former railway alignment and associated land there are various options for the long term reinstatement of the route and service. Any extensions beyond the existing Network Rail land boundary create options for the delivery, operation and ownership of any assets.

3. A detailed asset condition survey is required of the entire route. This will assist to confirm the level of remedial work required to reinstate any form of rail infrastructure. This survey to include March Station and the required alterations to create a fully accessible route to the Wisbech platforms.

   The former railway infrastructure has not been fully maintained since the line was mothballed. A full asset condition survey will enable greater clarity on the scale and costs of any reinstatement of railway infrastructure.

4. Continued analysis of the light rail rolling stock market and the opportunity for further development in areas such as stored energy and very light rail.

   There are continuing technological developments in light rail that may provide further opportunities for the Wisbech to March route. The very light rail market is still emergent and the full capability (and limitations) of this mode are not yet fully understood.

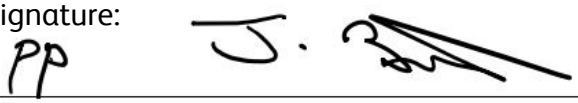
5. Consider the requirements of providing a double track route between Wisbech and March.

   The ability to provide a full double track route will confirm the maximum capacity of the route and determine the degree to which any future-proofing works are required should the initial phase of reopening be less than double track.

Appendix A. NRDD Engineering Review

March to Wisbech Engineering Assessment Report

Project Name:	March to Wisbech	
Project Number:	OP: 176291	Task: 1.3.1
Development Manager:	Mark Chettle	

Prepared by: Christopher Ruddy	Signature: 
Date: 22-0-2022	Job Title: Senior Project Engineer
Peer Reviewed by: Peter Harman	Signature: 
Date: 22-02-2022	Job Title: Principal Engineer
Approved by: Amanda Mumford-Rudd	Signature: 
Date: 22-02-2022	Job Title: Scheme Design Team Lead and Principal Engineer

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22.02.22	2.0	Christopher Ruddy	Amanda Mumford- Rudd	Final document for issue

Executive Summary

The railway from March to Wisbech was opened by the Eastern Counties Railway in 1847 and became part of the Great Eastern Railway in 1862. Originally built as a double track railway to serve the Port of Wisbech, it was later extended to Watlington Junction on the Ely to King's Lynn route.

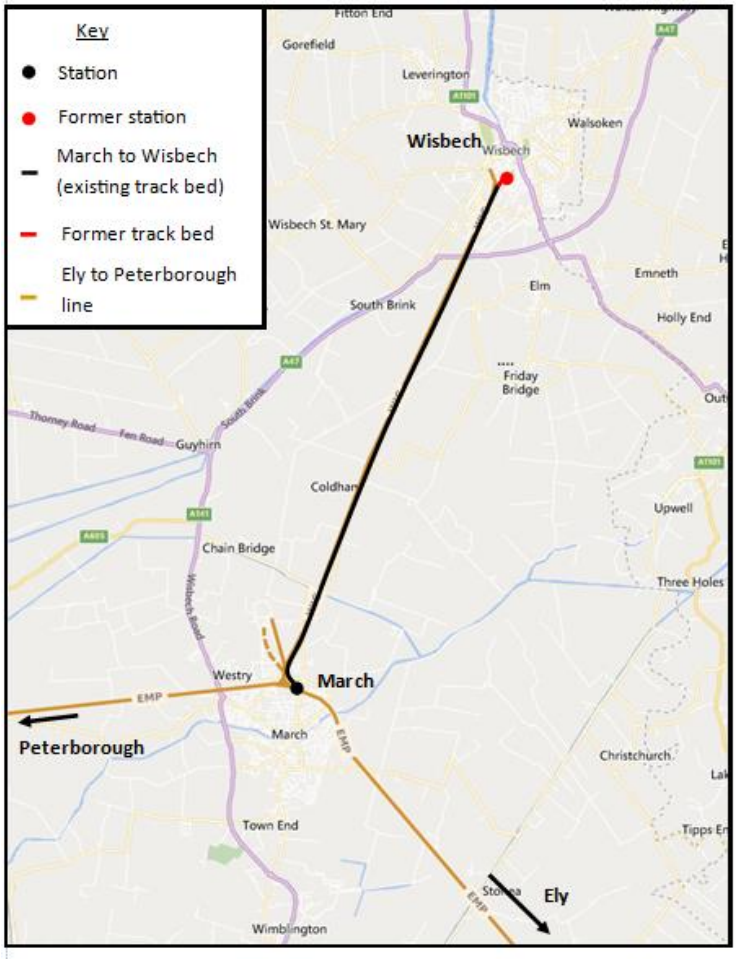

Figure 1 March to Wisbech Line

Passenger service ceased in the 1960s. Until 2000 it was used for freight-only operations as far as the Metal Box and Purina sites, located south of Wisbech. The line has not been formally closed, nor has it been subject to Network Change. It remains part of the existing railway network.

Cambridgeshire and Peterborough Combined Authority propose a transport link from Wisbech to Cambridge based on the previous rail connection between March and Wisbech. Mott MacDonald have investigated the feasibility of heavy rail and light rail alternatives and concluded the preferred transport mode is heavy rail.

Network Rail's Scheme Design Team have been asked by Network Rail's Capital Delivery Eastern Region to undertake a feasibility review of the proposals developed by Mott MacDonald on behalf of the Cambridgeshire and Peterborough Combined Authority based on 9 key documents and other supporting information produced by Mott MacDonald. This report summarises the findings of that review.

The purpose of the Scheme Design Team's review is:

a) to consider any identified gaps in the scope of the study or recommendations as to areas to investigate further
b) to review the risks of undertaking the work identified in the study to Network Rail and advise on the completeness of the hazards detailed within the material presented for review
c) to recommend what actions will be required to develop the study to achieve the end of GRIP 3 (PACE Phase 1)
d) to advise on the appropriateness of the rail solution proposed and consider this relative to light rail options
e) to consider the impact of freight services running on a new line to Wisbech

This feasibility review concludes:

- The reports produced by Mott MacDonald are wide ranging with options and conclusions which are considered in this report.
- There are gaps in the reports including:
  - The assumptions relating to level crossings require further examination and the development of a more detailed strategic approach that considers the safety, financial, project and performance risks and issues associated with closure, upgrade, highway diversion and grade separation
  - There is limited consideration of the requirements of the Common Safety Method - Risk Evaluation and Assessment (EU 402/2013), now enshrined in UK law
  - The demand modelling is limited, and the reports do not provide sufficient evidence on which to make an informed decision to reinstate conventional heavy rail services. The reports demonstrate a desire to facilitate freight services, without providing any clarity on the services required or that the potential market for freight services exist.
- The risks identified are wide ranging and appropriate for this stage of development. Looking forward:
  - As the project progresses all new and existing risks will need to be considered on an iterative basis for the transport solution progressed
  - The lack of a clear level crossing strategy is currently the biggest risk to the project
  - The qualifications and assumptions documented including those relating to level crossings will need to be validated

- Given the current number of options and permutations including those relating to modal choice, station location and passenger/freight demand, progression to GRIP 3 (now PACE Stage A/1) is challenging. To successfully progress requires:
  - The client to make informed decisions limiting the options and permutations
  - A detailed geotechnical survey of the trackbed, embankments and major structures is required along the entire route to confirm their suitability for use and to identify any remedial works required
- A heavy rail solution facilitates the introduction of conventional freight and passenger services and uninterrupted connectivity to the National Rail network. However, a lower cost Tram Train/light rail solution may be more appropriate based on:
  - A Tram Train solution facilitates uninterrupted connectivity for passenger services to the National Rail network with the added advantage of including a service to Wisbech town centre and to the proposed Wisbech Garden Town
  - A light rail solution, whilst not facilitating uninterrupted connectivity for passenger services to the National Rail network, is a credible solution for point-to-point transport and services to Wisbech town centre and to the proposed Wisbech Garden Town
  - The overall strategy for addressing the issues associated with level crossings is simplified by a Tram Train/light rail solution, which would permit application of lower cost minimum intervention installations
  - There is an opportunity to consider light freight trams/Tram Train as has been utilised in Europe
- Conventional freight services are only accommodated by a heavy rail infrastructure solution. The reports demonstrate a desire to facilitate freight services, without providing any clarity on the services required or that the potential market for freight services exist. The impacts of facilitating freight services on the line include:
  - Potential interruption to passenger train paths by freight services
  - An increase in the rate of degradation of the asset
  - Increased capital and maintenance costs associated with heavy rail
- Uninterrupted connectivity onto the wider rail network is dependent on the availability of train paths. Currently these are constrained and there are competing demands from train operators for these train paths. Future demand and economic valuation of train paths together with forthcoming changes to industry structure will introduce a greater strategic focus on network capacity utilisation and may affect the availability of train paths beyond the Wisbech route

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In conclusion, the Scheme Design team's feasibility review considers that whilst heavy rail is a viable option, light rail may offer a more appropriate solution. We recommend further work to examine the lower cost light rail Tram Train option. This is reinforced by Network Rail's Light Rail team's study which concludes that light rail is a credible and feasible option.

Contents

1. Introduction

Network Rail Design Delivery's Scheme Design Team have been instructed by Network Rail's Capital Delivery Eastern Region to undertake a feasibility review of the proposals developed by Mott MacDonald on behalf of the Cambridgeshire and Peterborough Combined Authority, who propose a transport link from Wisbech to Cambridge based on the previous rail connection between March and Wisbech.

The work undertaken by Mott MacDonald began in 2015 and a significant number of documents were produced to inform the development of the proposed transport link. Key documents were updated and re-issued in 2020 and the feasibility review by Scheme Design Team is based on a desktop review of these updated documents.

2. Background

The railway from March to Wisbech was opened by the Eastern Counties Railway in 1847 and became part of the Great Eastern Railway in 1862. Originally built as a double track railway to serve the Port of Wisbech, it was later extended to Watlington Junction on the Ely to King's Lynn route. The line from March to Wisbech; the Wisbech Goods Branch, Engineer's Line Reference (ELR) WIG, runs from March East Junction at 85 miles 78 chains to the nominal end of the line at 93 miles 49 chains at Wisbech. Passenger service ceased in 1968. The track has been substantially removed beyond Weasenham Lane level crossing at 93 miles 15 chains. The remaining rail corridor remains in Network Rail ownership.

The line was constructed as a twin track railway but was single lined in 1972. From 1972 to 2000 it was used for freight only operations as far as the Metal Box and Purina sites, located south of Wisbech. The March end of the line continues to be used to access Whitemoor Yard in conjunction with the chord line from March West Junction and to support shunting movements, but only as far as 86 miles 18 chains.

The line was operated on the "One Train" principle with a Train Staff (OTS), and therefore facilitated only one train operating on the line at any one time.

Since 2000, the line has been officially described in the Network Rail Sectional Appendix as "Out of Use" (temporarily), from 86 miles 18 chains to Wisbech". The line has not been formally closed, nor has it been subject to Network Change, taking it out of the existing National Rail railway network.

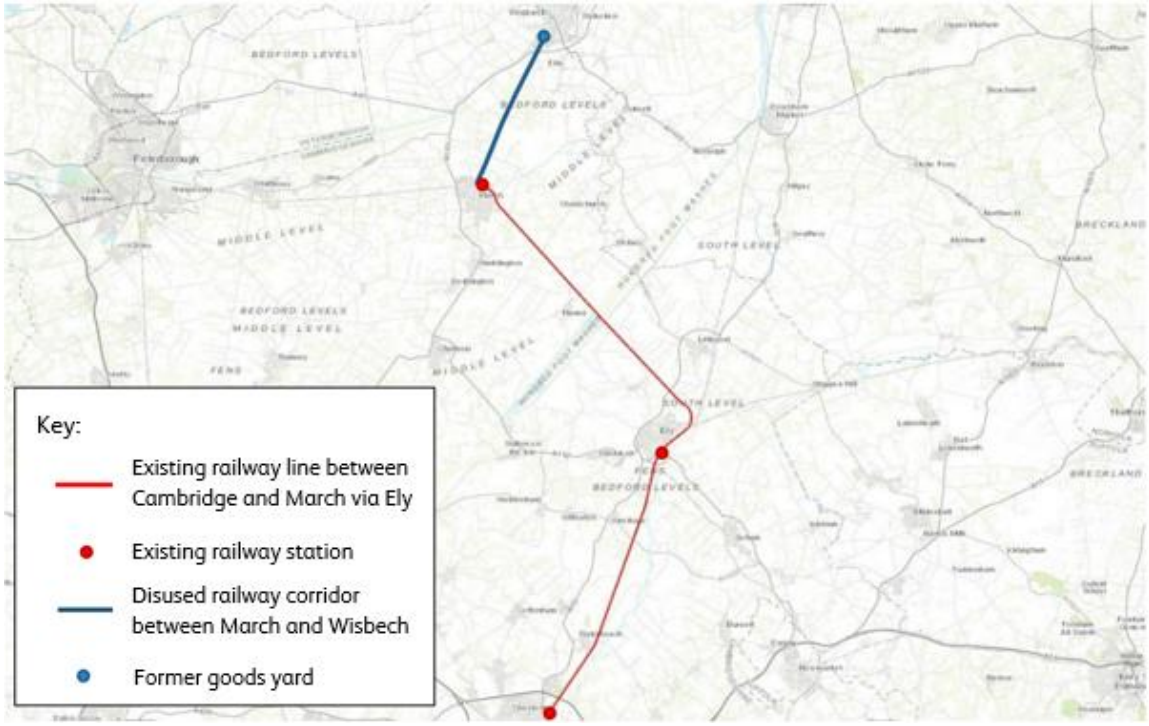

Figure 2 Cambridge to Wisbech via March.

Source: Mott MacDonald/GIS Mapping Low cost alternative Tram Train feasibility report 2019

When in freight only use, the line had a nominal permissible speed of 25mph, but lower restrictions applied over some of the numerous level crossings to manage level crossing risks associated with the line of route, which is largely straight and virtually level throughout.

The line has not received any recent maintenance nor renewal of track and other discipline apparatus.

3. Scope of the study

The scope of this study is to undertake a feasibility review of the proposals developed by Mott MacDonald on behalf of the Cambridgeshire and Peterborough Combined Authority, who propose a transport link from Cambridge to Wisbech based on the previous rail connection between March and Wisbech.

The purpose of the review is:

a) to consider any identified gaps in the scope of the (Mott MacDonald) study or recommendations as to areas to investigate further
b) to review the risks of undertaking the work identified in the study to Network Rail and advise on the completeness of the hazards detailed within the material presented for review
c) to recommend what actions will be required to develop the (Mott MacDonald) study to achieve the end of GRIP 3 (PACE Phase 1)

d) to advise on the appropriateness of the rail solution proposed (by Mott MacDonald) and consider this relative to light rail options
e) to consider the impact of freight services running on a new line to Wisbech

The report structure reflects these five subject areas.

This is a desktop review informed by nine key documents commissioned by Cambridgeshire and Peterborough Combined Authority and written by Mott MacDonald. These documents are:

1. Heavy rail feasibility report:

   March to Wisbech Transport Corridor: GRIP2 Heavy Rail Feasibility Report
   05 August 2019 398128 | 002 | B

   This report investigates the feasibility and cost of re-opening the railway line between March Station and Wisbech to heavy rail services.

2. Heavy rail multi-disciplinary option selection report

   March to Wisbech Transport Corridor: GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report
   26 June 2020 398128 | 009 | C

   This report documents the optioneering and engineering employed, to develop a single preferred heavy rail solution, for the March to Wisbech transport corridor, to the level of detail required to support Full Business Case (FBC) cost estimation.

3. Assessment of rail operations report:

   March to Wisbech Transport Corridor: Assessment of Rail Operations
   17 March 2020 398128| 007| C

   This report describes the operational analysis that has been undertaken to examine possible timetable patterns, service constraints and capacity for introducing a two train per hour (2tph) service between Wisbech and March.

4. Low-cost alternative - Tram -Train feasibility report:

   March to Wisbech Transport Corridor: Low-Cost Alternative – Tram Train
   16 August 2019 398128 | 004 | B

   This report describes the proposed Tram Train solution and set out the rationale for selecting this mode as the low-cost alternative to heavy rail.

5. Delivery strategy:

   March to Wisbech Transport Corridor: Delivery strategy
   20 July 2020 398128 | 009 | E

   The purpose of the Delivery Strategy is to identify and assess potential approaches to deliver the preferred scheme option that was identified earlier in the project lifecycle in the Options Assessment Report (OAR).

6. Environmental report:

   March to Wisbech Transport Corridor: Environmental Report
   July 2020 398128|MMD-00-XX-RP-EN-001|B

This report presents the environmental constraints and opportunities for the reinstatement and refurbishment of the March to Wisbech rail corridor and March Station as well as the creation of a new railway station at Wisbech.

7. Alternative highway schemes report:

   March to Wisbech Transport Corridor: Environmental Report
   10 July 2020

   This report summarises alternative options for highways Schemes 1 and 2 and recommends a preferred option for each scheme.

8. Comments register:

   This spreadsheet captures inputs from industry and the requirement to actively involve and consult with industry providing their advice on potential delivery structures and mechanisms to support the business case submission.

9. Full business case:

   March to Wisbech Transport Corridor: Full Business Case
   26 June 2020 398128-011-E

   This report identifies a single option design in accordance with Transport Appraisal Guidance requirements for the March to Wisbech Transport Corridor.

10. Other related documents have been considered including:

11. Network Rail's Light Rail Knowledge & Development team's Report

    Wisbech to March: Potential for Light Rail
    December 2021

    Network Rail's Light Rail Knowledge & Development team assess the potential for reopening rail passenger services on the former March to Wisbech line using light rail technology. This report summarises the findings of that assessment.

No topographic surveys, site investigations, structural condition assessments or site visits were required or undertaken as part of this review.

4. Supporting background information

In this section of the report, we provide additional background on factors affecting the introduction of heavy rail passenger and freight services between March and Wisbech and onward to Cambridge. This is intended to provide additional context relating to project risks, opportunities, barriers, dependencies and constraints relating to the introduction of train services and summarises the known capacity and journey time constraints on the existing rail network.

Operational constraints including connectivity to wider network

As custodians of the existing rail network, Network Rail is responsible for maintaining and developing the current operational railway alongside enhancements. This is an agreed industry process which engages TOC, FOC, Local Authorities and other appropriate partners and stakeholders.

There are several possible schemes being considered on the routes from March which have the potential to impact on any proposed March to Wisbech service.

Current and proposed infrastructure allows for maximum of 2 trains per hour from Wisbech to March. There is limited expansion capability to improve upon this with current proposals. There is an aspiration for trains to continue onward to Cambridge. Currently there are no onward paths to Cambridge.

At the time of writing, no major renewals or enhancements are known to be confirmed, although various works streams have been proposed, most notably a project at Ely North Junction, known as the Ely Area Capacity Enhancement (EACE). This project aims to increase the trains paths through Ely North Junction to 11 trains per hour, but crucially this does not appear to include any provision for additional services for Wisbech to Cambridge, which would require 13 trains per hour through Ely North Junction. To fully understand the performance/resilience impact, operational modelling is required, and should be carried out as part of the March to Wisbech project and the Ely Area Capacity Enhancement project.

Further constraints include the existing platform and track layout arrangement at March station which would require some alteration to allow for the additional train movements required to run trains to/from Wisbech. The track layout at March is already very restrictive as trains have to use the bi-directional Platform 2 to reach Whitemoor Junction and Whitemoor Yard. The proposed infrastructure includes reinstatement of a Platform 3 at March.

The main constraint on train services is the fact that this is a single line route, with no capacity for trains to pass. This facilitates a maximum of two trains per hour in each direction. The introduction of a passing loop is required to enable a 30 minute service interval to be achieved, enable service reliability, and allow for any potential increase in service. However, there will be limitations subject to timetable recast to provide any service further than March.

Infrastructure assets

The existing asset condition and the need for major renewal of track bed, rails, sleepers and fastenings is required, as well as heavy maintenance or renewal/upgrade of several bridge structures on the route.

Level crossings

There will be an increase in the level crossing risk profiles due to an increase in road traffic since the line last operated. Re-introducing conventional heavy rail services will require an assessment of ALCRM level crossing risk scores. It is assumed it will be possible to close the majority of level crossings. However, where this is not possible, such as the A47 trunk road, significant highway redirection or a grade separated crossing would be required, at significant cost. Where level crossings are proposed for closure, there is a need for a full consultation with users on the future of the crossings. Although most are minor roads, they do serve communities which may be severely inconvenienced by closure. Closure of any level crossing will be subject to agreement with any users and financial settlements may be required. Where level crossings are to remain open, all level crossing apparatus would require to be completely renewed and upgraded to meet current legislation and regulatory requirements.

A light rail Tram Train operation would permit application of lower cost minimum intervention installations and could cut the cost of project implementation and operation by a considerable factor.

Should train services continue to Ely or Cambridge, there are 38 level crossings of various types between March and Cambridge. Each one of these would be subjected to risk assessments associated with the introduction of additional rail services. This is a significant issue for the Wisbech - Cambridge 2 trains per hour (tph) service pattern, if implemented. The introduction of a 2 tph service would increase the number of trains across these level crossings by four services within a one - hour period. Network Rail would need to demonstrate that risk factors such as barrier down time (affecting road traffic) have been considered and increased risk of interaction between trains and road/pedestrian users is mitigated. As additional services running through the existing level crossings between March and Cambridge would increase level crossing risk, they may also trigger a requirement to upgrade these level crossings or replace with bridges.

Environmental including land acquisition

The original line of route is no longer complete, with conurbation and industrial building developments over the original line. Any new railway operating would be significantly shorter than the original without considerable new green field railway line being built or property acquisition to regain the original route lost to development.

For a heavy rail solution the only realistic option for the town would be a brownfield site next to the Nestle Factory. The factory is located at the northern end of the discussed railway corridor, the existing factory occupies the site of the former Wisbech Goods Yard. The site prevents a direct link from the corridor to Wisbech town centre.

For a light rail Tram Train solution, a street running agreement with the council would be required to limit/avoid property demolition.

Rolling stock

Any rail solution will be dependent on the availability or procurement of additional rolling stock irrespective of level of service or modal choice.

This needs to be in line with current decarbonisation and elimination of dependence on fossil fuel strategies. This means rolling stock needs to be powered by battery, OLE, hydrogen, diesel/battery. Self-powered, bi-mode and hybrid are all potential considerations.

The availability of heavy rail rolling stock for cascading is limited and unlikely to deliver against a decarbonisation strategy. Adapted or new rolling stock would be required.

Light rail Tram Train vehicles support a low carbon traction power solution. Light rail vehicle suppliers routinely design rolling stock to meet individual system requirements on which they will operate.

A light rail solution does not preclude freight. A Tram Train or light rail solution offers a possible alternative freight potential using freight tram trains similar to those used in Europe.

Heavy rail freight and Tram Train are suited to and support different types of freight movement. A light rail freight solution can have the advantage of facilitating the transport of materials and goods that are uneconomic to move using heavy rail.

The freight capability of rolling stock is dependent on both the rolling stock and the infrastructure provided.

5. Study gaps and further investigation

The reports explore the feasibility of heavy and light rail options and are wide ranging with options and conclusions that are considered in this report. This report identifies a number of areas which would benefit from further investigation.

Level crossings

Level crossings have been considered for all potential solutions. However, the level crossing portfolio would benefit from further consideration as the safety, financial, performance and project risks remain a significant liability for the project.

The Mott Macdonald report identifies 23 level crossings which includes the Wisbech Bypass AOCL crossing the A47 trunk road. This is informed by Network Rail's 2016 Level Crossing Closure report and a 2015 Mott MacDonald site walkout. Network Rail Light Rail and Knowledge team's report (*Source Document 11*) identifies 7 active and 12 passive crossings. This is informed by analysis of mapping imagery/data to identify physical evidence of level crossings in situ supported by evidence obtained from a site visit. The number of level crossings and the project requirements at these locations; closure, upgrade, highway diversion and grade separation, need to be clarified.

It is entirely possible that where level crossings are present, these could not be brought back into use in today's environment; grade separated crossing would be required, such as road bridges or re-routed highway. The potential costs associated with grade separation and re-routing of highways are included in the report costs estimates.

The GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report (*Source Document 4)* assumes that several level crossings could be closed, either by Compulsory Purchase Order or negotiation, and others can be bought from landowners. No alternatives are given, and further work is required to identify alternatives should this not be the case and there are challenges associated with closure.

The GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report (*Source Document 4)* also assumes that a number of more complex highway level crossings will be replaced with bridges. Work needs to be done to confirm that these assumptions can be realised. Again, no alternatives are given should this not be the case.

Depending on the modal choice, rolling stock and traction type eventually decided upon, level crossing closure or renewal will be a major consideration, and safety and financial risk. This is further exacerbated by the potential need for grade separated crossings between rail and road traffic which potentially requires major road redirection or grade separated structures to be built.

A light rail option would permit application of lower cost minimum intervention installations, or retention of automatic installations. A full Tram Train option would offer the opportunity to remove standard railway crossing controls completely with the

installation of signalised traffic light junctions at light rail/road interfaces. This would be subject to suitable risk assessment at each location.

Common Safety Method

None of the documents reviewed mention Regulation 402/2013 on the Common Safety Method for Risk Evaluation and Assessment (CSM - RA) to any great extent, other than the financial cost of carrying out this process. CSM - RA is a legal requirement mandated by EU, and now UK law. It is essential that the process to identify existing hazards (as well as known and potential future hazards) is started as early as possible, and how the risks these present are, or may, be mitigated.

A simple, initial Hazard Record is included in Appendix C of the GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report – Page 193 (*Source Document 4)*. However, the format of the hazard record does not meet all the mandated requirements of CSM - RA.

Determine the need for freight

The demand modelling is limited. The reports demonstrate a desire to facilitate freight services, without providing any clarity on the services required or that the potential market for freight services exist. A specialist transportation demand assessment for both potential passenger and freight traffic would inform the decision of modal choice and potential current and future freight opportunities. The need for freight capability and the type of capability on the line needs to be further understood and confirmed, as this impacts on the appropriate solution to be taken forward, and whether or not the line continues to be suitable for freight traffic including gross tonnage and frequency.

Heavy rail/Tram Train/light rail solution

A study by Network Rail's Light Rail Knowledge team (*Source Document 11)*, commissioned by Cambridgeshire and Peterborough Combined Authority, has considered the suitability of light rail technology for the provision of a passenger rail service between March and Wisbech. The study concludes that a light rail operation appears feasible with several options of vehicle type available. These include the potential for the introduction of light rail freight vehicles. The report further concludes:

- a Tram Train would be an optimum light rail solution
- the number of level crossings on the route may make a full or hybrid light rail operation cheaper than a comparable heavy rail solution

Further work is recommended to examine the light rail and in particular the Tram Train option in more detail.

Signalling

The method of new signalling is not fully detailed; the line was One Train Staff working previously. If a passing loop is required, then Track Circuit Block with new colour light signals is stated as being the only option for signalling. The number and location of signals is entirely dependent on the headways required, number of level crossings and

what type of level crossings are implemented. There is no confirmation that the existing electro-mechanical signalling is suitable for additional locking that may be required at March East Signal Box, especially if layout alterations at March East Junction and/or station layout are required. The reports reviewed only suggests a new NX (eNtry – eXit) panel or Visual Display Unit (VDU) solution may be needed at March Signal Box for any new signalling option.

There is no mention as to what means of signalling would be employed if Tram Train or other light rail were to be chosen as the solution. This is perhaps not needed at this early stage.

Traction power

There is currently no traction power supply on the existing railway between Ely and Peterborough via March. The various reports reviewed provide limited information on traction power solutions.

There is some commentary on the difficulty of providing OHLE apparatus for a light rail solution in Wisbech town centre due to the nature of the streets and buildings, coupled with their listed status. The reports do not comment on the feasibility or difficulties that may be encountered by electrifying the March to Wisbech branch other than it would be expensive. There is no commentary on the feasibility of providing the necessary infrastructure to cater for OHLE, and if this would be achieved using conventional piles, or screw/helical piles, or if the topography of the landscape is suitable for these types of structures. There is no mention if geotechnical surveys have been carried out for this purpose, however, the GRIP 3 heavy rail report does state that these may be required at a later stage; GRIP 4.

Traction power based on low carbon alternatives are not considered. There are similar low carbon traction power systems for heavy and light rail options. There are opportunities to introduce self-powered vehicles using new and existing technology including battery, hydrogen, diesel/battery/bi-mode/hybrid and ground based fast charging systems. Battery/bi-mode technology is used in Europe and is currently being introduced onto the UK national rail network. A ground based fast charging system is currently being trialled in the UK.

Approaches to traction power need to be explored in more detail.

Geotechnical and ground condition for overhead line

Geotechnical and ground topographical surveys for any OHLE apparatus structure may be required to assess the ground suitability for these structures, and for any grade separated crossing solutions.

Future work bank

The full business case report (*Source Document 9)* provides minimal commentary on Network Rail Eastern's current workbank, and any opportunities to combine any works

required with planned workbank to take advantage of any line of route or major renewals, and to provide economy of scale. Projects mooted include resignalling of Ely and Cambridge areas (CP7) and the Ely Area Capacity Enhancement (EACE) Scheme (no indicative Control Period date given, CP7 earliest)

6. Risk review of work identified

As a general principle, the original reports have considered the potential hazards and subsequent risks but may have not fully accounted for all the hazards and risks that may be introduced by some of the options presented.

The Full Business Case (*Source Document 9)* document has a comprehensive risk section, detailing risk in a hierarchy with three categories:

1. Strategic risk
2. Programme risk
3. Scheme risk

Mitigating factors for these risks are provide in tabular form in the report.

These are further broken down into 19 key project risks, along with uncertainties and sensitivity analysis coupled with assumptions. No mitigating factors are proposed.

The Heavy Rail Feasibility Report (*Source Document 4)* has 10 principal risks identified for that option:

Risk 1. The timetabling assessment work has been based on the existing timetable. There is a risk that a re-cast of the timetable will affect the assumptions made.

Risk 2. Network Rail have previously stated that the timetable alterations for a service from Wisbech to Cambridge are not deemed possible at this time. This is not seen as best use of current infrastructure on what is an already constrained network. The capacity upgrade proposals for the Ely to Ely North Junction area are a key dependency for any proposed Wisbech to Cambridge rail service.

Risk 3. The introduction of a new double junction at March is unlikely to be welcomed by Network Rail Asset Management and an alternative layout might be required – this may not be readily achieved.

Risk 4. The layout is constrained by March East Signal Box; its listed status may mean relocating it.

Risk 5. The introduction of a new fixed diamond crossing for the Peterborough turnback layout is unlikely to be accepted by Network Rail Asset Management. An alternative layout might be required, and this may not be readily achieved.

Risk 6. The provision of a diverse “B-leg” for safety critical signalling and telecommunications circuits has not been explored but will be required.

Risk 7. Re-decking WIG/2314 Chain Bridge may not be possible without alterations to the levels of the adjacent highway.

Risk 8. The effect on pedestrian flow and fire evacuation arrangements resulting from the proposals for March Station have not been investigated.

Risk 9. The effect of the March Station proposals on the Operation of Whitemoor Yard has not been investigated in detail.

Risk 10. For services from Wisbech to Cambridge and Wisbech to Peterborough, additional rail traffic on the network will alter level crossing risk profiles between March and Cambridge/Peterborough Stations. This may trigger requirements for additional level crossing upgrade or closure schemes.

Completeness of hazards

At this early stage, the hazards encountered by constructing and operating the chosen solution have not yet been fully investigated and would need to be considered via a Quantified Risk Assessment (QRA) and/or hazard workshop(s) once the final solution has been chosen. This process should already have been started and documented, driven by CSM - RA obligations. This process should be started as early as possible. CSM - RA legislation dictates the risks should be reduced so far as is reasonably practicable. CSM - RA legislation also states that a project should list the existing hazards, prior to any work commencing or changes implemented.

Hazards regarding the numerous level crossings on the route are not fully complete, given that it may not be possible to re-open some level crossing, landowners may reject the opportunity to sell or give up access, and if others cannot be closed by Network Rail.

For the level crossings that remain, there is little commentary on the difference between level crossing operation when used by heavy rail (including freight) versus Tram Train/light rail. As a general principle, heavy rail requires more onerous controls and limitations on speed, sighting and time of road closure, versus light rail which has less onerous requirements and a simpler interface.

Hazards relating to new electrification have not been considered, nor have hazards around mixed traffic if Tram Train is utilised on the National Rail network. For light rail services, point to point changing at March station has not been considered, with regard to items such as differing platform heights and passenger movements.

Operational risk

The Assessment of Rail Operation Report (*Source Document 3)* describes the operational analysis undertaken to examine possible timetable patterns, service constraints and 2 trains per hour capability between March and Wisbech.

The report highlights that operating rail services over the level crossings between March and Wisbech would introduce a level of risk. The report also states that any service that continued to Cambridge would increase the trains per hour crossing the numerous level crossings on that route, leading to an increase of barrier down time. This raises the potential for a need to mitigate the risks associated with level crossings (closure, upgrade, bridge, grade separation) between Ely and Cambridge.

The Full Business Case report (*Source Document 9)* assumes that Network Rail will be the Infrastructure Manager and Owner for the railway infrastructure delivered by this Scheme, which also leads to the assumption that Network Rail will operate, maintain and renew the infrastructure following its handover. This would seem a reasonable assumption for a conventional heavy rail solution, but one that would have to be agreed by the promotor and Network Rail.

It is possible that Network Rail could divest itself of all these risk by allowing the combined local authority to take on the operation of the railway, especially if a Tram Train or Very Light Rail option is taken forward.

With a light rail solution, Network Rail staff operating and maintaining the railway would require appropriate training and competence. This approach has been successfully implemented on the Tram Train Pilot Operation in South Yorkshire.

However, allowing a third party to operate a rail system which could interface or run alongside Network Rail infrastructure introduces its own set of risks, and the combined authority may not be best placed to operate a transport system they have no experience or knowledge of.

It is noted that lineside fencing is incomplete throughout the existing line and would most likely need to be completely renewed to deter trespass and vandalism, and animal incursion.

Level crossings

There is a financial and project risk if landowners do not want to sell or readily agree to their accommodation or user worked level crossings being closed, especially if compulsory purchase orders are needed.

The local authorities will require extensive consultation where roads are required to be diverted or where the level and frequency of road traffic prohibit level crossings being reopened.

The GRIP 3 report (*Source Document 4)* concludes that level crossing risk assessments should be carried out at a later GRIP stage to determine whether lower cost alternatives to the NR level crossing closure schemes can be shown to align with legislative and regulatory requirements for level crossing safety.

Depending on the modal choice, rolling stock and traction type eventually decided upon, level crossing closure or renewal will be a major consideration with associated safety and financial risk.

Asset condition

Some of the existing assets appear to be in various states of disrepair, there is no guarantee these can be repaired or are suitable for reuse. Full renewal is anticipated.

This is particularly true for permanent way, where it is concluded that all of the rail, sleepers and fastenings would need to be completely renewed. Some of the existing components are now obsolete. Although photographic evidence suggests that parts of the line might have been re-laid in modern flat bottom rail on concrete sleepers, the track has not been maintained for an extended period of time, it is overgrown by lineside vegetation, suffers major ballast contamination and the current geometric condition is unknown. It is assumed that the line must be completely re-laid, from formation level upward including substantial ballast renewal before the re-introduction of a passenger service. The site walk out by Network Rail's Light Rail and Knowledge Development team supports this approach.

The adoption of light rail Tram Train would permit a lighter form of track construction to be used and therefore a marginal reduction in track costs, however this may preclude the running of any conventional heavy rail freight.

The clearance of substantial amounts of trackside vegetation will also be required. It is also be assumed that all lineside fencing will need to be replaced and upgraded where appropriate, due to recent lineside residential, and other, developments.

Most of the route is carried on a low embankment 2.0 - 3.0m high above the surrounding fens. Although the condition of these embankments will need to be formally assessed, they would appear to be in generally good condition and in need of only minimal remedial works prior to the re-introduction of a passenger service. An earlier site visit identified a potentially unstable embankment between 89 - 90m. Further assessment of earthworks and track bed along the entire route is recommended.

Overhead line

There is little or no commentary as whether local ground conditions (topography, geotechnical survey) are suitable for installation of overhead line apparatus if this option were to be chosen for Tram Train or light rail electric traction.

7. Progress to end of GRIP 3 (PACE Phase 1)

Mott MacDonald list several recommendations relating to required infrastructure in section 14.1 of the GRIP 3 heavy rail report (*Source Document 4)*, which then goes on to recommend a comprehensive list of further actions relating to:

- Surveys
- Stakeholder consultation
- Assurance
- Engineering management
- Track
- Signalling
- Highways
- Geotech
- Telecoms
- And others.

Network Rail Design Delivery's Scheme Design Team recommended actions required to achieve GRIP 3 are summarised below.

Options and permutations

To allow the project to move forward to GRIP 3/PACE ES3, it is advised that some of the many options and permutations still to be decided upon are narrowed down or eliminated. These include, but are not limited to:

- Freight requirements
- Station location at Wisbech (Parkway, or Town centre Garden Town)
- Route of any new line
- Point to point or through service to Ely/Cambridge
- Rolling stock and traction type

Tram Train or light rail solution

The Scheme Design Team recommends consideration of Tram Train solution and identification of hazards for a mixed traffic solution, and further investigation into realistic level crossing solutions where light rail is used.

Further, the location of any new station also needs to be narrowed down or confirmed, as this also impacts on the solution taken forward.

The budget available for the project would need to be ascertained, a heavy rail solution is quoted as being more expensive, due to the need to address the level crossing issues and potentially the need to build grade separated crossings in some cases.

Freight

The need or desire for freight to operate on the line needs to be confirmed, as this greatly affects the solution taken forward. It should be noted that the option assessment report (Appendix A) of the Full Business Case report (*Source Document 9)* concluded that freight is not deemed financially viable. Whilst sufficiently sized markets may emerge in the future, and the scheme design should not, as far as reasonably practicable, preclude future provision of freight facilities at Wisbech, the current business case development processes has proceeded on the working assumption that rail freight services will not be delivered on the March to Wisbech corridor.

Common Safety Method

New mainline railways within Great Britain and Northern Ireland are subject to the provisions of both the Railway (Interoperability) Regulations 2011 and the Common Safety Method on Risk Evaluation and Assessment (CSM - RA) Regulation. If the project were to be treated as the opening of a new section of the mainline railway network the design of its infrastructure would also need to comply with National Technical Specification Notices (NTSN) and current National Technical Rules (NTR). However, there is potential to apply for exemption from the Railway Interoperability Regulations particularly if a Tram Train solution is utilised. Tram Train vehicles and infrastructure required for Tram Train operation is exempt from the Railway (Interoperability) Regulations 2011. Where the line is proposed as Tram Train or light rail consideration should be given to excluding the route from the main line railway requirements of the Railway and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS). This would make the March to Wisbech line and vehicles subject to urban rail standards currently under development by RSSB. The CSM – RA applies to the railway irrespective of interoperability.

The Common Safety Method for Risk Assessment (CSM - RA) process does not appear to have been formally started, as mandated by the legislation. A Preliminary System Definition and System Safety Plan should be completed at the earliest opportunity by the proposer, together with a Project Hazard Record compliant with the requirements of the CSM - RA legislation.

The project should start the process of CSM - RA as early as possible and in due course identify an independent assessment body.

8. Consideration of an alternative light rail solution

Network Rail Design Delivery's Scheme Design Team have not been specifically asked to propose a solution based on the material provided for review. However, we have been asked to advise on the appropriateness of the recommended heavy rail versus a light rail solution. A Tram Train or light rail solution appears to be valid lower cost solution worthy of serious consideration.

Heavy rail solution

A heavy rail solution as proposed as one of the main conclusions and recommendations of the Mott MacDonald reports utilising National Rail infrastructure potentially allows for services to continue to Ely, Cambridge and beyond. This solution also has the potential to support any freight running.

However, the potential can only be realised if the significant risks associated with the level crossings between March and Wisbech can be mitigated. The increase in level crossing risk between Ely and Cambridge will also need to be mitigated.

A conventional heavy rail solution supports a Wisbech Parkway type station as the line could only extend as far as the out-of-town station propositions, whereas Tram Train or light rail would be able to extend into Wisbech town centre and/or to the proposed Garden Town if this was desired.

Tram Train/light rail solution

This section should be read in conjunction with the November 2021 report produced by Network Rail's Light Rail Knowledge & Development team; Wisbech to March: Potential for Light Rail (November 2021) report (*Source Document 11)*

One of the Mott Macdonald documents provided for review was a light rail feasibility option dated 16 August 2019. The light rail feasibility report recommends a diesel - electric hybrid vehicle Tram Train option as the likely outcome, after a modal and route sifting workshop. This is a credible solution which is worthy of serious consideration. The document stops short however, of recommending Tram Train or light rail as a final solution, rather lists some of the major hurdles of construction needing overcome to utilise this solution.

A consideration with a Tram Train solution is the provision of electric traction power. Electrifying the route with for example 750V d.c or 25kV OHLE is not considered in the Mott Macdonald documents. However, battery technology has advanced significantly in the last 10+ years with the potential for electric rail vehicles to travel up to 40 miles between charges with further developments anticipated extending this to 60 miles. Light rail/Tram Train traction power options also include onboard energy storage systems, diesel/battery, and battery hybrid options. A Tram Train solution using dedicated hybrid rolling stock would appear to be a cost effective, feasible solution worth exploring further.

Light rail/Tram Train rail vehicle opportunities are explored more fully in the report by Network Rail's Light Rail and Knowledge Development team's report (*Source Document 11)* dated December 2021

Light Rail/Tram Train vehicles operating on tramways are designed for highway interfaces. For level crossings along the route, that remain open, the level of infrastructure can be substantially reduced compared to heavy rail options based on "line of sight" operation with a Tram Train or other light rail vehicle able to stop much quicker and within a shorter distance. This would make the road - rail interfaces at level crossing less costly, simpler and safer.

Movement of freight is not precluded by a Tram Train solution but would potentially limit the million gross tonnage per annum (MGTPA) of freight.

Several options for line of route and station locations are included in the light rail feasibility report (*Source Document 2)* produced by Mott MacDonald. The report also lists several benefits, including improved connectivity to the town centre, the ability to serve the new Garden Town, and negates the need for grade separated highway crossings (reducing costs and risk). This also retains the ability to connect to the National Rail network. However, there are also significant challenges presented, including access to Wisbech town centre particularly around accommodating a tram in the town environment.

The historic town of Wisbech is a highly constrained urban environment. Any new infrastructure to be built next to, or in, the town is potentially constrained by:

- Numerous listed buildings and structures
- Narrow streets, particularly Cromwell Road (B198), which is currently a two-way carriageway bound by terraced housing to the east and the River Nene to the west. There is therefore no potential to widen the street without significant infrastructure impacts
- The River Nene which separates the proposed Garden Town from the existing Wisbech town centre

The Network Rail Light Rail Knowledge and Development team report (*Source Document 11)* considers and identifies routes into Wisbech Town Centre which minimise any impact from these constraints seeking full penetration into the town centre and limiting any demolition required. A traction power stored energy solution limits any infrastructure requirements that might affect the setting of historic buildings or areas of conservation.

The studies to date generally focus on the technical and engineering aspects of introducing rail services on the route and thus lead to a discussion on modal options. The operating cost of each mode may be a factor in the overall case. In this case the operating cost of light rail options are likely to be significantly lower than comparable heavy rail services.

9. Freight services between March and Wisbech

A solution that accommodates freight services running on a new line to Wisbech needs to be set in the context of opportunities, risks and dependencies. These considerations include:

- Conventional heavy rail freight would normally be catered for by a heavy rail infrastructure solution
- The asset condition of the four main underbridges on the route and works that may be needed to make them suitable for freight, depending on the gross tonnage and Route Availability (RA)
- Freight services would impact on train running, line speed and level crossing provision with a heavy rail solution
- Locomotive, wagon type and gross annual tonnage expected would need to be confirmed
- It is possible that Tram Train rolling stock could be used for light weight palletised type freight, but with limited gross tonnage with the benefit that lighter freight volumes become economically viable.
- The operation of freight services on light rail is possible with suitable light rail controls and with track infrastructure suitable for freight vehicle axle loads.

A heavy rail solution accommodates traditional passenger and freight services. A Tram Train solution has the potential to accommodate passenger and freight services dependent on the infrastructure provided suitable controls. The level and type of control is dependent on risk assessment, the type of freight and frequency of movements.

The Mott Macdonald light rail feasibility report (*Source Document 2)* does not provide any commentary on freight opportunities as to what, if any, freight could be employed when using a Tram Train solution. Network Rail's Light Rail Knowledge and Development team's report (*Source Document 11)* provides further information on light rail solution freight opportunities.

10. Conclusions

This Engineering Assessment Report is the output of a feasibility review of March to Wisbech Transport Corridor Options, developed by Mott MacDonald on behalf of Cambridgeshire and Peterborough Combined Authority.

The modal choices considered in this report include:

- **Heavy rail** Conventional heavy rail that has the potential to facilitate passenger and freight services
- **Light rail** Light Rail Tram Train which has the potential to facilitate passenger and freight services with direct access into Wisbech Town and Wisbech Garden Town
- **Very Light Rail** This has not been considered to any great extent in the context of this report

Light Rail (Tram Train and tram) and Very Light Rail options are considered in a study completed by Network Rail's Light Rail Knowledge team (*Source Document 11)*.

This feasibility review concludes that heavy rail is a viable solution, which has the potential to provide uninterrupted connectivity onto the National Rail network together with a freight capability. However, there are significant hurdles with regards to level crossings that would need to be overcome.

In comparison, light rail in the form of Tram Train offers a potentially more credible solution based on overall capital and operating costs, an optimised level crossing strategy and connectivity into Wisbech town centre and Wisbech Garden Town.

In addition, there is lack of available train paths onto the wider Network Rail network, which combined with an unproven need for freight means a Tram Train option should be considered. This is reinforced in the report (*Source Document 11)* by Network Rail's Light Rail team that concludes *"light rail is considered a credible and feasible option and recommends further work to examine the light rail options in more detail, and to develop cost estimates to assist the business case for reopening the line."*

Table 1 provides a summary analysis comparing heavy and light rail (Tram Train) options informed by this feasibility review.

Modal solution	Heavy rail	Light rail Tram Train
Connectivity for passengers	Potential for uninterrupted connectivity onto National Rail network. No direct access to Wisbech Town and Wisbech Garden Town.	Potential for uninterrupted connectivity onto National Rail network. Potential for direct access into Wisbech Town and Wisbech Garden Town.
Level Crossings	Complex conventional level crossing infrastructure and highway interfaces. Risks associated with ability to close level crossings and divert highways.	Designed for highway interfaces. Level crossing design can be optimised, and the level of infrastructure required substantially reduced.
Rolling Stock	Finite availability of rolling stock nationally and potential acquisition of new rolling stock required. Operation and maintenance costs are known and similar to existing heavy rail.	New Tram Train vehicles required. The premise of Tram Train is that vehicle designs are adaptable and able to be tailored to meet system specific infrastructure requirements routinely. Operation and maintenance costs dependent on system specific requirements.
Signalling control	Complex conventional signalling including level crossing infrastructure and interfaces.	Opportunity for a simplified control system and substantially reduced level crossing infrastructure for Tram Train only operation.
Station	Location of station limited to out of town/brown/greenfield site. Conventional heavy rail station infrastructure.	Opportunity for direct access into Wisbech town centre and new Garden Town. Opportunity for simplified light rail station infrastructure.
Freight operations	Accommodates freight movements on conventional infrastructure.	Potential to facilitate freight but requires heavy rail infrastructure with associated increase in infrastructure costs.
Traction Power Supply	Diesel traction requires no additional infrastructure. Missed opportunity for decarbonisation. Electric traction requires 25kV OLE infrastructure.	Potential for diesel/electric or hybrid traction requiring no additional infrastructure. Opportunity for electric traction supporting decarbonisation using

	There is currently no OLE infrastructure between March and Ely. Self-powered; battery, hydrogen, diesel/battery, hybrid requiring limited infrastructure to recharge rail vehicles	light weight 750V dc infrastructure. Self-powered; battery, hydrogen, diesel/battery, hybrid requiring limited infrastructure to recharge rail vehicles
Estimated capital costs of proposed infrastructure	March to Wisbech circa £178m. *Reference: GRIP 3 Heavy Rail Report Q2 2019 prices excluding risk allowances and optimism bias.*	Option 1: March to Wisbech Parkway circa £126m. Option 2: March to Wisbech Town circa. £178m. *Reference: Low cost alternative tram train feasibility report Q2 2019 prices excluding risk allowances and optimism bias.*

Table 1 Heavy and light rail option considerations

A heavy rail solution facilitates the introduction of conventional freight and passenger services and uninterrupted connectivity to the National Rail network. However, a lower cost light rail Tram Train solution may be more appropriate based on:

- A Tram Train solution facilitates uninterrupted connectivity for passenger services to the National Rail network with the added possible advantage of including a service to Wisbech town centre and to the proposed Wisbech Garden Town
- The overall strategy for addressing the issues associated with level crossings is simplified by a Tram Train/light rail solution, which would permit application of lower cost minimum intervention installations
- A light rail or Very Light Rail solution does not facilitate uninterrupted connectivity for passenger services to the National Rail network. It is a credible solution for point-to-point transport and services to Wisbech town centre and to the proposed Wisbech Garden Town

We now consider gaps in the reports, risks to Network Rail, progression to GRIP 3/PACE1 and freight considerations.

There are gaps in the reports produced by Mott MacDonald relating to:

- The lack of a strategic approach in respect of level crossings that considers the safety, financial, project and performance risks and issues associated with closure, upgrade, highway diversion and grade separated crossings
- There is limited consideration of the requirements of the Common Safety Method - Risk Evaluation and Assessment (EU 402/2013) now enshrined in UK law

- The demand modelling is limited and there is insufficient evidence to support a heavy rail solution. The reports demonstrate a desire to facilitate freight services, without providing any clarity on the services required or that the potential market for freight services exist

The risks considered up to this point are deemed applicable for the current stage of development. As the project progresses all new and existing risks will need to be considered on an iterative basis for the transport solution progressed. As a key stakeholder, Network Rail need to be part of this hazard identification and risk assessment process to ensure risks to Network Rail are managed. The lack of a robust level crossing strategy is currently the biggest risk to the project.

To allow the project to move forward to GRIP 3/PACE 1 some of the many options and multiple permutations need to be discounted. Limiting the number of options allows for the cost effective development of a credible solution. Key elements that need to be considered are:

- Confirming the freight demand and the implications of providing this facility on the project including any impact on the business case
- Confirming the anticipated passenger numbers by completing a thorough transportation study
- Reducing the number of station locations currently being considered to a manageable and realistic number of sites
- Reducing the number of line of route options for any new service provision
- Developing an option based on a point to point service provision given the current and future lack of train paths beyond March
- Undertaking asset condition surveys to identify the work required to support heavy or light rail options

Facilitating freight services is one of the clients desired outcomes. The reports demonstrate a desire to facilitate freight services, without providing any clarity on the services required or that the potential market for freight services exist. A transport study would identify that the local and regional transport demand, for freight (and passengers), exists. Outputs could then be used to inform modal choice decisions.

Conventional freight services are only accommodated by a heavy rail infrastructure solution. Operationally, light rail Tram Train could co-exist on the route without any restricted working. Other light rail or Very Light Rail solutions and freight could potentially co-exist if the freight requirement were relatively limited and could be timed outside light rail and Very Light Rail operating times. The reports focus on a heavy rail solution, but do not explore the nuances of freight, light rail and Very Light Rail operation and demonstrate a desire to facilitate freight services, but do not provide any clarity on the services required or that the potential market for freight services exist.

The impacts of facilitating freight services on the line include:

- Potential interruption to passenger train paths by freight services
- An increase in the rate of degradation of the asset
- Increased capital and operating costs associated with heavy rail

Based on all the parameters considered, heavy rail is a valid solution. However, light rail in the form of Tram Train offers a potentially more credible solution based on overall cost, an optimised level crossing strategy and connectivity to the national rail network. Light rail Tram Train additionally offers the opportunity for direct access into Wisbech town centre and Wisbech Garden town, whilst not discounting the introduction of freight services now, or at a point in the future.

11. Next steps

This report has identified a number of next steps. These are summarised below and should be read in conjunction with the five next steps identified in the Network Rail Light Rail team report "Wisbech to March: Potential for Light Rail November 2021", Appendix 3:

Next step 1

The multiple options and permutations for providing a service between March and Wisbech need to be reduced and refined to enable the project to move forward.

The continued consideration of multiple options and permutations impedes cost and time efficient development.

Next step 2

The development of a more detailed strategic approach to level crossings is required that considers the safety, financial, project and performance risks and issues associated with closure, upgrade, highway diversion and grade separation

There will be an increase in the level crossing risk profiles due to an increase in road traffic since the line last operated. Closure of any level crossing will be subject to agreement with any users and financial settlements may be required. Where level crossings are to remain open risks will need to be mitigated in the context of different modal options and how rail vehicles operate along the line.

Next step 3

Further work is required to explore the light rail Tram Train solution

Network Rail's Light Rail and Knowledge team's report (Source Document 11) concludes that there is potential for a light rail passenger operation between March and Wisbech. The assessment of suitable rolling stock types concludes that Tram; Tram Train; or Very Light Rail vehicles could be used. The operating cost of light rail are likely to be significantly lower than comparable heavy rail services.

Next step 4

Further work is required to confirm the passenger and freight demand, particularly post Covid-19 pandemic, to determine the most appropriate solution that meets this demand

The reports do not adequately evidence a thorough Transport Study and therefore do not provide a solid basis on which to make an informed decision. Both heavy and light rail Tram Train facilitate freight services. A light rail Tram Train option offers a potentially more credible solution based on overall cost, an optimised level crossing strategy, connectivity to the National Rail network and direct access into Wisbech Town and Wisbech Garden Town.

Next step 5

Develop a System Definition and System Safety Plan in line with the proposer's legal obligations set out in Common Safety Method for Risk Evaluation and Assessment Regulation (EU) 402/2013.

The starting point for anyone proposing any change in relation the mainline railway system is the Common Safety Method – RA, and this applies when any technical, operational or organisational change is being proposed to the railway system. The proposer in this instance is deemed to be the combined local authority or their agent.

Next step 6

A detailed asset condition survey is required for the entire route. This will assist in confirming the rail infrastructure work required for the option selected.

The condition of the former railway infrastructure is not known, and it has not been fully maintained since the line was mothballed. A full asset condition survey will enable greater clarity on the scale and costs of any railway infrastructure works required

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Appendices

Please see below a list of the appendices referenced in this document.

Appendix A – Glossary

Appendix B – Reference source documents

Appendix A: Glossary

Acronym	Meaning
0m 00ch	miles and chains
ac	Alternating Current
AWS	Advanced Warning System
dc	Direct Current
DfT	Department for Transport
DMU	Diesel Multiple Unit
DNO	Distribution Network Operator
EaWR	Electricity at Work Regulations
EMU	Electric Multiple Unit
ETCS	European Train Control System
GRIP	Governance of Rail Investment Projects
GSM-R	Global Standard for Mobile communications - Railway
FOC	Freight Operating Company
FTN	Fixed Telecoms Network
LRSSB	Light Rail Safety and Standards Board
NTSN	National Technical Specification Notices
OLE	Overhead Line Equipment
ORR	Office of Rail and Road
PACE	Project Acceleration in a Controlled Environment
RIR	Railway (Interoperability) Regulations
ROC	Railway Operating Centre
ROGS	Railway and Other Guided transport Systems (Safety) Regulations
RSSB	Rail Safety and Standards Board
S&C	Switches & Crossings

TOC	Train Operating Company
tph	Trains per hour
TPWS	Train Protection Warning System
TSI	Technical Specifications for Interoperability

Appendix B: Source Documents

Documents commissioned by combined authority produced by Mott MacDonald

1. Heavy rail feasibility report:

March to Wisbech Transport Corridor: GRIP2 Heavy Rail Feasibility Report 05 August 2019 by Mott MacDonald 398128 | 002 | B

The primary objectives of this report commissioned by Cambridgeshire and Peterborough Combined Authority are to investigate the feasibility and cost of re-opening the railway line between March Station and Wisbech to heavy rail services. This report was originally developed by Mott McDonald in 2015 as part of a wider Cambridgeshire County Council commissioned study, which included DfT Business Cases. In 2018 Mott McDonald were commissioned to update and further develop design and DfT Business Cases for the March to Wisbech Transport Corridor. This report has been updated as part of the 2018 commission.

2. Low-cost alternative - Tram - Train feasibility report:

March to Wisbech Transport Corridor: Low-Cost Alternative – Tram Train 16 August 2019 by Mott MacDonald 398128 | 004 | B

The aim of this report commissioned by Cambridgeshire and Peterborough Combined Authority is to describe the proposed Tram Train solution and set out the rationale for selecting this mode as the low-cost alternative to heavy rail. Key challenges in delivering tram train are also set out, together with indicative journey times and capital costs for the scheme.

3. Assessment of rail operations report:

March to Wisbech Transport Corridor: Assessment of Rail Operations 17 March 2020 398128| 007| C

This report describes the operational analysis that has been undertaken to examine possible timetable patterns, service constraints and capacity for introducing a two train per hour (2tph) service between Wisbech and March, and ideally running through to Cambridge.

4. Heavy rail multi-disciplinary option selection report

March to Wisbech Transport Corridor: GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report
26 June 2020 398128 | 009 | C

The purpose of this GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report commissioned by Cambridgeshire and Peterborough Combined Authority is to document the optioneering and engineering employed, to develop a single preferred heavy rail solution, for the March to Wisbech transport corridor, to the level of detail required to support Full Business Case (FBC) cost estimation. A slimmed down version of the GRIP 3 design process has been used, with the focus on developing designs for those elements which significantly impact capital cost.

5. Delivery strategy

March to Wisbech Transport Corridor: Delivery strategy 20 July 2020 398128 | 009 | E

The purpose of the Delivery Strategy is to identify and assess potential approaches to deliver the preferred scheme option that was identified earlier in the project lifecycle in the Options Assessment Report (OAR).

6. Environmental report

March to Wisbech Transport Corridor: Environmental Report
July 2020 398128|MMD-00-XX-RP-EN-001|B

The Environmental Report presents the environmental constraints and opportunities for the reinstatement and refurbishment of the March to Wisbech rail corridor and March Station as well as the creation of a new railway station at Wisbech. A high-level qualitative assessment of the constraints identified is also provided. The report focuses on the proposed rail corridor, March Station, potential locations for a Wisbech Heavy Rail station and stops in Wisbech for a Tram Train Option.

7. Alternative highway schemes report

March to Wisbech Transport Corridor: Environmental Report
10 July 2020

The purpose of this report is to summarise alternative options for highways Schemes 1 and 2 and recommend a preferred option for each scheme. The report is intended to be read with the March to Wisbech Transport Corridor GRIP 3 Heavy Rail Multi-Disciplinary Option Selection Report 398128-009-C.

8. Comments register

Updated draft 6 May 2020

This document captures inputs from industry and the requirement to actively involve and consult with industry (including NR and ORR) as well as potential infrastructure investors providing their advice on potential delivery structures and mechanisms to support the business case submission.

9. Full business case

March to Wisbech Transport Corridor: Full Business Case
26 June 2020 398128-011-E

The purpose of this Full Business Case (FBC) is to identify a single option design in accordance with Transport Appraisal Guidance requirements for the March to Wisbech Transport Corridor.

10. Other related documents have been considered

Documents commissioned by combined authority produced by Network Rail

11. Network Rail's Light Rail Knowledge & Development team's Report

Wisbech to March: Potential for Light Rail
December 2021

Network Rail's Light Rail Knowledge & Development team assess the potential for reopening rail passenger services on the former March to Wisbech line using light rail technology. This report summarises the findings of that assessment.

Appendix B. Light Rail Feasibility Study

Report

Wisbech to March: Potential for Light Rail

December 2021

Authorisation

Prepared by	Checked by	Approved by
Alex Dodds Light Rail Knowledge Manager	Ian Ambrose Technical Lead, Light Rail	Simon Coulthard Head of Light Rail Knowledge & Development
		

Document version control				
Date	**Version**	**Editor**	**Approver**	**Description / Change Reason**
12/11/21	1.0	Alex Dodds	**SC**	Initial draft for client review
13/12/21	1.1	Alex Dodds	**SC**	Final document for issue

Executive Summary

The seven-mile March to Wisbech railway, located in North Cambridgeshire, England (see Figures 1A to D below) was opened in 1847 with passenger services operating until 1968. Freight services continued to run until 2000. Since 2000 the line has remained in a mothballed, non-operational condition. Network Rail's Light Rail Knowledge & Development team has been requested to assess the potential for reopening rail passenger services on the line using light rail technology.

This report summarises the findings of that assessment.

Network Rail's light rail team considered the options for adopting suitable light rail technology and operational solutions. This was done without a constraint of complying with current national rail design and operating standards – other than at any interface with the current rail network.

The study concludes that there is potential for a light rail passenger operation between March and Wisbech. The assessment of suitable rolling stock types concludes that Tram; Tram Train; or Very Light Rail (VLR) vehicles could be used. The choice of rolling stock being subject to the specification of the short and long term service aspirations.

The factors influencing the choice of light rail vehicle include:

- Requirement to operate on the national rail network (e.g. to Peterborough, Ely, Cambridge);
- The multiplicity of level crossings on the route and vehicle's suitability to create a cost effective solution at each
- Opportunity to operate into Wisbech town centre using the highway network
- Future extension of the service to serve the Wisbech Garden Town development
- Consideration of passenger demand and thus vehicle size.

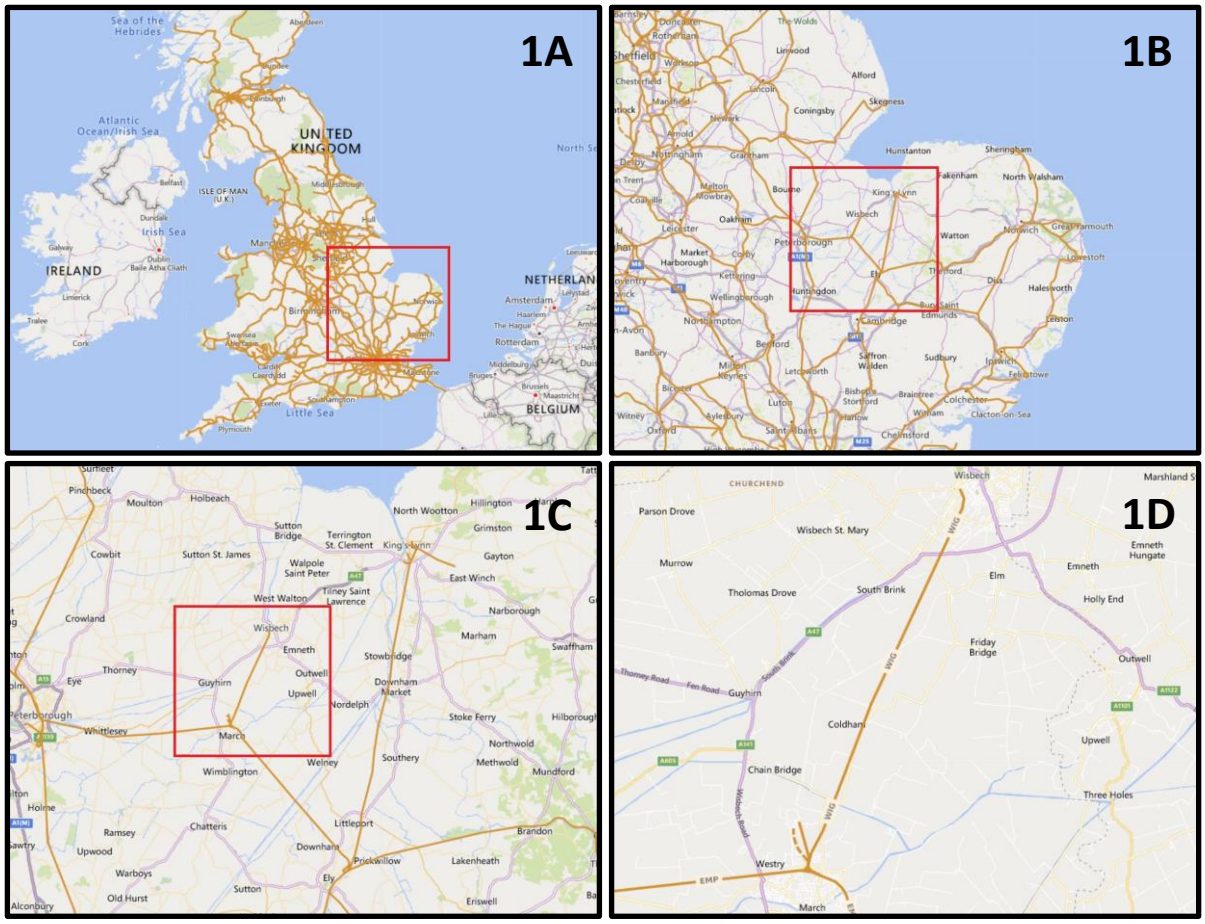
The study concludes that in consideration of the client's specification a Tram Train solution appears the best credible light rail option. Tram Train would enable future operation on both the national rail network and any on street operation into Wisbech town centre or to the Garden Town.

The next generation of Very Light Rail vehicles are an emerging technology, with the first demonstrator vehicle being showcased in Autumn 2021. Further development and engagement is needed with the manufacturers to explore the full potential, and limitations, of this new vehicle.

Key infrastructure aspects considered by the review include:

- The cost effective solutions for the numerous level crossings under light rail operation
- Options for an on street route into Wisbech town centre
- The location of a terminus station at Wisbech
- The required alterations at March Station and connections to the main line

At the client's request the report is largely a qualitative assessment of the potential for light rail on the March to Wisbech line. On the basis that light rail is considered a credible and feasible option further work is recommended to examine the options in more detail and to develop cost estimates to assist the business case for reopening the line.



Figures 1A to 1D – Map Series Showing the March-Wisbech Line in a UK, Regional, Area and Local Context

Contents

1 Introduction

Network Rail's Eastern Region directorate has requested the company's Light Rail Knowledge & Development team to assess the potential for reopening rail passenger services on the former March to Wisbech line using light rail technology. This report summarises the findings of that assessment.

The seven-mile March to Wisbech railway (known as the Bramley Line) was opened in 1847 with passenger services operating until 1968. Freight services continued to run until 2000. Since 2000 the line has remained substantially in Network Rail ownership in a mothballed, non-operational condition.

The reinstatement of rail passenger services between Wisbech and March (and possibly further afield) has been the subject of various local campaigns and studies. These given greater emphasis in recent years in the context of improving connectivity; reducing road congestion and tackling climate change through transport decarbonisation.

Recent studies to reinstate the rail connection have looked at options for conventional railway and light rail solutions, including on-street tram operation in Wisbech. To date the estimated cost of these solutions has been a limiting factor in the success of the case for reopening.

As part of the continuing evaluation of the case to reopen the line Network Rail's light rail team was asked to provide a high-level assessment of the "art of the possible" for light rail solutions. This assessment took a fresh look at the potential for light rail technology to enable a reconnection between March and Wisbech.

Network Rail's light rail team considered the options for adopting suitable light rail technical and operational solutions. This without constraint of current national rail design and operating standards – other than at any interface with the current rail network.

2 Background

The former March to Wisbech railway ran for approximately seven miles (10km) through the Cambridgeshire Fenland linking the two towns at either end.

The line was opened as a double track railway in 1847 with one intermediate station at Coldham (which closed in 1966). At one time the route continued beyond Wisbech to Watlington (on the line to Kings Lynn) and beyond March to St Ives.

The station at Wisbech was subsequently renamed Wisbech East to differentiate it from another station located at the north of the town on the former Midland and Great Northern line. Passenger services on the line ceased in 1968. The route was subsequently shortened with the Wisbech East station location being lost to residential development. Freight services continued until 2000, serving the Nestlé Purina and Metal Box facilities. Following the cessation of freight services, the rail corridor remains in Network Rail ownership. However following land acquisition by Nestlé (for expansion of its factory) the railway owned corridor terminates just beyond Weasenham Lane on the outskirts of the town.

Given the topography of the Fenlands the route had numerous level crossings for highways and footpath and farm access.

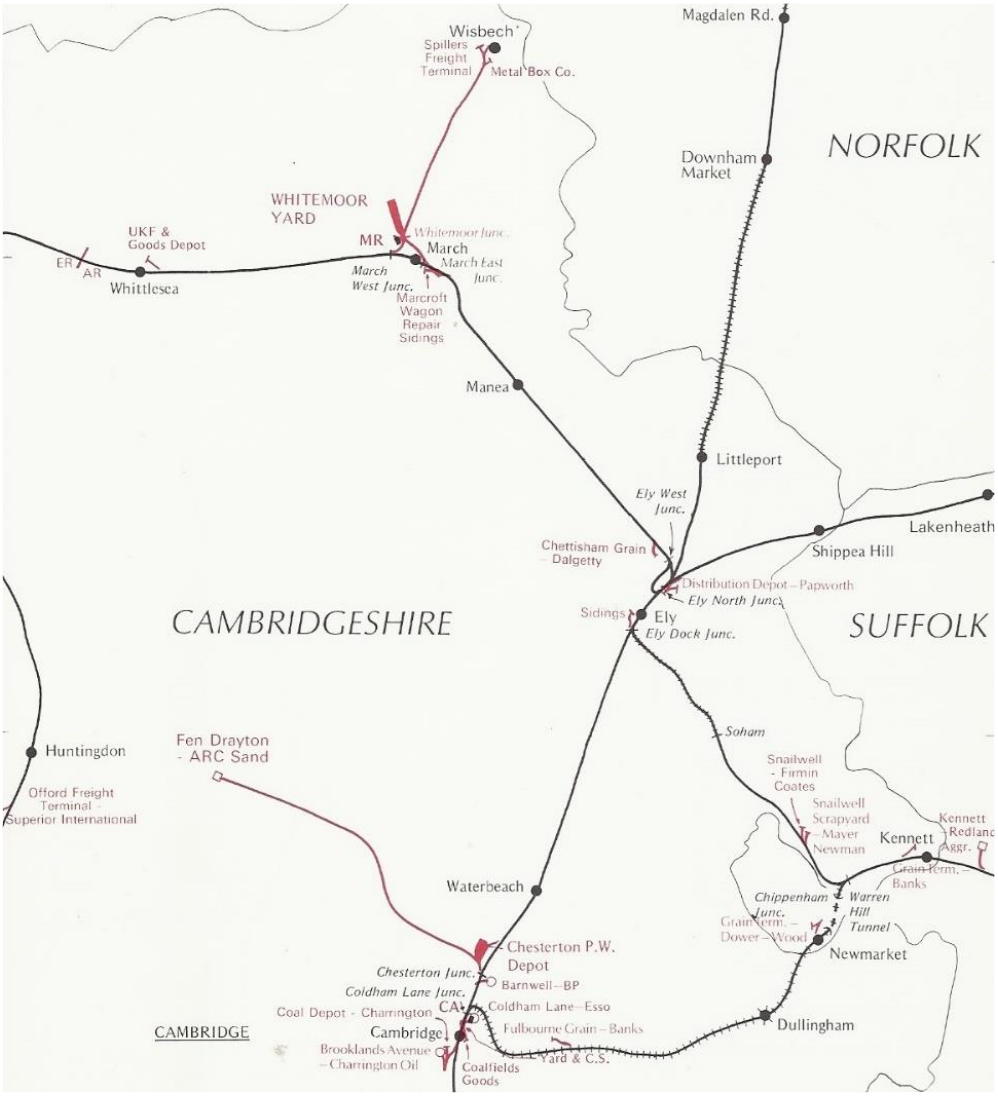


Figure 2: Map of Cambridgeshire late 1980s rail network (Source: Rail Atlas Great Britain & Ireland, Baker, 1988)

Figure 2 shows the residual March to Wisbech route from the late 1980s. Note the station is shown as having "unadvertised/excursion" status.

The reinstatement of rail passenger services between March and Wisbech has been the subject of various campaigns and studies in recent years.

These include:

- Wider Economic Benefits of a Rail Service Between March and Wisbech, Mott MacDonald & Cambridgeshire County Council (2014)
- Study into Re-Opening of March to Wisbech Rail Link, Outline Business Case, Mott MacDonald & Cambridgeshire County Council (2015)
- March-Wisbech Transport Corridor Low Cost Alternative - Tram-Train, Mott MacDonald (2019)
- March to Wisbech Transport Corridor Options Assessment Report, Mott MacDonald (2019)
- March to Wisbech Transport Corridor Full Business Case, Mott MacDonald (2020)

These studies have contributed to understanding the feasibility and options for reinstatement of rail passenger services (including assessment of light rail). These studies have included consideration of extending reinstated Wisbech services beyond March to Cambridge and Peterborough. However, there is limited or no capacity on the mainline for these additional services. It is understood that further investment on the existing network would be required to provide the capacity for new Wisbech services to operate through to Ely and Cambridge.

The most recent business case work concluded by discounting a Tram Train option in favour of a heavy rail solution with through running to Cambridge. However, the network capacity issues noted above are considered to make this option either too costly or impractical in the short/medium term.

Between 2009 and 2018 Network Rail, working with local partners, designed and implemented the UK's first Tram Train operation between Sheffield and Rotherham. From this experience Network Rail created a team as a dedicated centre of excellence for light rail knowledge. This team supports colleagues and stakeholders in the development of light rail schemes on or interfacing with the national rail network. This team brings a wealth of experience from delivering the Tram Train service and is using this to assess the case for delivering low cost innovative railway solutions.

In 2021 Network Rail's light rail team was invited to take a fresh look at reinstating rail passenger services to Wisbech in the context of the potential for light rail solutions. This to take the form of a high level consideration of "the art of the possible" and without constraints of conventional railway solutions. The assessment would concentrate on the creation of a dedicated service between March and Wisbech while commenting on the potential for that solution to enable through services to Peterborough and/or Cambridge.

3 Scope

The scope of the study was discussed with Network Rail's Eastern Region Strategic Planning team and agreed as:

- Examine the possibility of providing a rail service between Wisbech and March using light rail technology.
- Service options of 1 or 2 trains per hour in each direction.
- Services to be considered as self-contained to the route in short/medium term.
- Consideration for future through operation to either Peterborough or Cambridge and what infrastructure/vehicle/operating alterations may be required over the base solution.
- Study to consider suitable terminating location(s) in Wisbech.
- Output to be a short report reviewing the route and high level options to reinstating it using light rail technology. Report to provide a broad conclusion on the likely feasibility of a light option(s) and, where appropriate, indicate a preferred form of light rail solution.
- Report should highlight areas of opportunity where a light rail solution might enable a more cost-effective solution compared to heavy rail.
- Report should highlight any assumptions and risks in the solutions identified – for example in relation to compliance/deviation from industry standards.

4 Discussion and Findings

4.1 Service provision

Previous studies have identified a baseline service of 2 tph between March and Wisbech, which is the Client's base requirement. This is likely to be the maximum a heavy rail option would support. A Tram Train/light rail option could support additional service options depending on the final selection of route into the town centre and the location of the stops:

- A terminus at Weasenham Lane/the Purina factory could support 2, 3 or 4 tph depending on demand and location of passing facilities
- A terminus in the town centre at/near the Horsefair bus station could support up to 4 tph (subject to demand and passing facilities).
- The provision of a Park and Ride (P&R) facility at the A47 crossing could enable a supplementary service between the P&R stop and Wisbech town centre providing an opportunity to significantly reduce traffic into town. The combination of through and P&R shuttle services could provide up to 8 tph with 2, 3 or 4 going through to March
- The town centre operation would require significant traffic management to optimise the passage of the light rail service and enable a robust timetable.
- Through services to either Cambridge or Peterborough, although technically feasible with Tram Train, would require capacity upgrades on the Peterborough – Ely – Cambridge route. It should be noted that there are already existing services competing for limited train paths within the Peterborough-Ely-Cambridge corridor, and it may not be possible to deliver all of these without significant enhancements in route capability. This is however outside the scope of this report.

All the above options require further work to assess the overall timetable feasibility and the likely demand over the next 20-30 years to select the best option. A proposed "garden town" on the North side of the River Nene would provide further extension opportunities for the tramway, however these should be the subject of a separate study as part of the development of that scheme.

4.2 Infrastructure

The infrastructure requirements have been based on the following assumptions for Tram Train operation:

- Whitemoor Junction to Wisbech is designated as a tramway
- Whitemoor Junction to March remains heavy rail
- A railway to tramway operational rules interface is provided on the Wisbech side of Whitemoor Junction
- Tram Train services will use a reinstated Platform 3 at March station with option to reinstate the main line connection at the Ely end of the station
- The route will be a segregated tramway except in Wisbech where if required it would be an on-street tramway to the bus station terminus
- All level crossings on the original branch line will be designated as tramway crossings with appropriate highway controls

The formation and track bed are extant from Whitemoor Junction to Weasenham Lane on the outskirts of Wisbech and could be restored to double track for all or part of the route depending on initial and future timetable demands. While the formation for the most part seems in good basic condition, a full survey will be required to check the state of the embankments, particularly as most of the route is bounded by deep drainage ditches which may have resulted in scouring over the years out of use. Key requirements will be:

- Clear vegetation from track bed and trackside where sight lines may be compromised e.g. road crossings
- Restore drainage and prepare track bed
- Replace underbridge decks – the only underbridges on the route are over watercourses
- Relay track to tramway standards – note while 80lb rail would be suitable, Network Rail only bulk buys 113lb rail
- If double track, consider number and position of turnback crossovers to manage service perturbation
- All crossings will be tramway crossings with appropriate highway and tramway signalling control and with standard tramway signage
- All crossings should comply with LRG 1.0 – Tramway Principles and Guidance (TPG) (LRSSB, 2021) and associated light rail standards
- Any on-street sections should have embedded grooved rail and consideration given to innovative designs which minimise the need to move utilities
- Integrated highway and tramway signalling, and control will be required for the on-street sections
- The light rail vehicles are most likely to be high floor (to match those at March Station) and careful consideration is required for the location of on-street stops in Wisbech
- With exception of March Station, the other stops could be basic tram stops with 915mm high platforms.
- The platform/vehicle interface at all locations will be RVAR compliant and allow unaided level boarding to maximise accessibility. Foot crossings will be acceptable for any new stops on the original route.
- Consideration should be given to restoring double track from Whitemoor Junction into the disused platforms at March station with associated works to replace the missing tracks and possibly the former Junction at the East end.
- Signalling for the new layout will need to be installed which will require some changes to the existing scheme plan
- A new accessible footbridge is recommended at March. This will enable the service to offer end to end accessibility
- A servicing depot could be provided in the former engineers' sidings area at March alongside Platform 4

4.3 Rolling stock

There are numerous light rail rolling stock types and suppliers, with some vehicles currently in production/operation, and others in various stages of development. Given the status of vehicles in operation, and the flexibility of operation it offers, a Tram Train vehicle is considered the most appropriate light rail mode for the route. This is subject to confirmation of demand and desired journey time, as well as the type of service offered (e.g. segregated shuttle vs hybrid interface to adjacent urban centres). Tram Train enables operation on a line of sight tramway route, with passive provision to safely operate on heavy rail main lines in the future.

The current UK Tram Train vehicles in service are the Stadler Citylink Class 399 (low floor) in South Yorkshire; and the Stadler Citylink Class 398 (high floor) on order for Transport for Wales. Other manufacturers supplying Tram Train vehicles include Alstom and Siemens.

Figure 3 – Class 399 Citylink Low Floor Tram Train Operating in Sheffield (Photo: Ian Ambrose)

Figure 4 – Class 398 Citylink High Floor Tram Train Under Construction for Core Valley Lines (Source: Transport for Wales)

The March to Wisbech service is likely to have a journey time of between 15 and 20 minutes which will require 2 vehicles for the baseline service and up to 6 plus an operational spare for the maximum potential service frequency. This assumes a maximum speed of 60mph and suitable traffic management in Wisbech town centre to avoid congestion delays. This is a small order and better economy of scale might be achieved by joining with other Tram Train orders. The vehicle capacity will depend on the loading forecasts and the current vehicle length of 37-40m should be sufficient and the interior seating layout can be adapted to suit the customer preference. The route is sufficiently short to consider battery self-power rather than full electrification. Fast battery charging facilities to be provided at March and possibly the Wisbech terminus.

While Tram Train vehicles offer the greatest potential for service flexibility, alternative vehicle options should be considered in the context of efficiency, connectivity and cost of operation. The first of these is a standard tram vehicle. This would have lower capital cost than a Tram Train and still offer potential for street running. Tram does not offer the ability for future operation on the

main line railway. Using a standard tram may require additional control measures for the shared running between Whitemoor Junction and March station. Existing standard tram vehicles are available from multiple manufacturers, with designs built to accommodate various urban rail gauges. These come in both low and high floor configurations, offering the flexibility to accommodate pre-existing infrastructure constraints, such as high floor platforms. This has already been applied successfully in Manchester, where existing heavy rail lines have been converted to tramways.

Figure 5 – Bombardier M5000 High Floor Tram Operating in Manchester (Source: Tom Page/Creative Commons)

Another alternative vehicle is Very Light Rail (VLR). The 'first generation' of VLR vehicle was the Parry People Mover used on the Stourbridge Branch in the West Midlands. Multiple second generation vehicles are under development, with the focus of VLR innovation centred in the West Midlands. One of these is the 'Revolution' VLR vehicle, intended for use on lines like the Stourbridge Branch, where a low capacity/low cost shuttle service is implemented on a segregated heavy rail alignment. The vehicle is exceptionally light weight, with potential consequential savings on track form[1] and structures. Such a vehicle could be an alternative for the Wisbech branch if the operation were to be limited to a segregated shuttle between March and Wisbech.

One potential limitation of VLR over a tram vehicle is its inability to operate on street alignments. However the vehicles may require modification to do so, such as fitting of skirting, roll-under protection, and track brakes[2]. Without these modifications, it is likely that a VLR vehicle would be restricted to segregated operation on the Wisbech line. The vehicle's small size may be an issue, dependent on the passenger demand anticipated, and interface with existing connecting services from March. Like standard trams, the vehicles are unlikely to be able to interwork on heavy rail main line, confining them to operate a segregated shuttle between Wisbech and March. This would not preclude some form of limited exemption to operate over the short distance between Whitemoor Junction and March Station. There is the issue of level crossings on the route to consider, with VLR vehicles potentially requiring different levels of protection infrastructure, dependent on the extent

[1] Note any potential savings on track/track form may be offset against Network Rail's bulk buying for standard 113ib rail see Section 4.2

[2] A similar French design includes these features

of alterations made to the standard vehicle design[3]. Recent discussions with the manufacturer of the 'Revolution' VLR vehicle have indicated the potential to incorporate market requirements into a production vehicle. This could include various design amendments for the vehicle to be classed as light rail/tram or a Tram Train and operate under line of sight regulations.

Figure 6 –Revolution VLR High Floor Demonstrator Vehicle (Source: Simon Coulthard)

4.4 Level Crossings

Based on the number of level crossings on the route and when compared to a traditional heavy rail solution a full or hybrid light rail operation could cut the cost of project implementation and operation by a considerable factor. Many sites would be considered substandard for a regular interval heavy rail passenger operation, and with 7 active sites identified alongside 12 passive ones, the cost of crossing interventions/improvements alone could make or break the project business case. A detailed description of the status of each crossing is included in Appendix B.

A light rail option would permit application of lower cost minimum intervention installations, or retention of automatic installations at current sites. A full Tram Train option would offer the potential to remove standard railway crossing controls altogether and install signalised traffic light junctions at every hybrid light rail/road interface. This would however be subject to localised vegetation clearance and suitable risk assessment of each location on an individual basis.

[3] Given the assumptions on infrastructure in 4.2, designating the VLR vehicle as a tram train would overcome most of the issues as the route can be built to tramway standards. This will also simplify the vehicle approval process

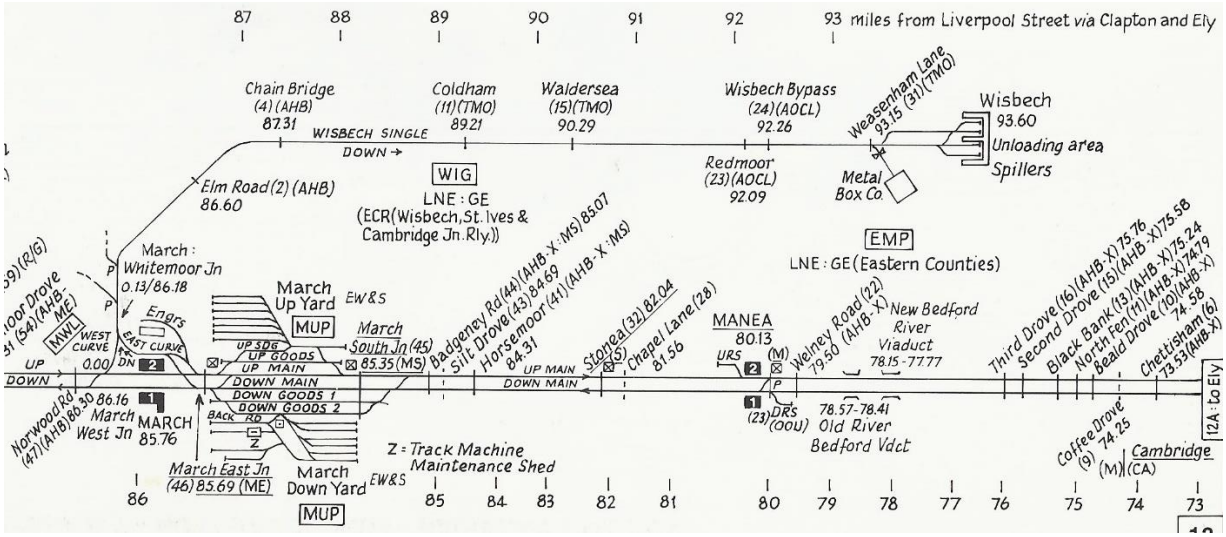


Figure 7 – Line Diagram of Wisbech Branch (Quail Map Company, 1998)

The nature of interventions required can be broken down into three specific crossing types:

- Active crossings intersecting major roads
- Active crossings intersecting minor roads
- User Worked Crossings

The level of infrastructure intervention required can be broken down for each in detail, however this would largely depend on the type of vehicle selected to operate the service, and the nature of modifications undertaken to accommodate locally specific infrastructure.

Active crossings Intersecting Major Roads

An example of this arrangement would be the Wisbech Bypass (see Figure 7 above). This was formerly an AOCL located on a busy main road. Such an arrangement would no longer be acceptable as a heavy rail solution, as the road has seen significant traffic growth, with high usage by HGVs. One option would be to create a grade separated solution in this location. Grade separation would be costly and add complexity. If this were to be undertaken, it is anticipated that the road would require elevating above the rail alignment. Not only would this cause significant disruption to road traffic during construction, but would also require substantial land take for the approach structures and significant aggregate for use as filler material. Concrete approach structures require less aggregate fill however these are generally more expensive to build, and raise environmental considerations from the increased use of synthetic material.

Application of a Tram Train or Tram option may offer a potential compromise solution. Tram vehicles fitted with track brakes already operate on a line of sight basis in urban and suburban areas, intersecting with major roads. Where an interface is created, road traffic lights are incorporated with tram signals to create a standard highway junction. This is treated just like any other road junction, with the exception that trams are often given priority over road traffic when approaching the site. Creation of a standard highway junction on the Wisbech bypass may be possible, and even practical utilising the powers of a light rail order for street interface operation. There is a need to clarify the legal status of the current crossing and the ability to reactivate a crossing at this location. Consultation with stakeholders such as the highways authority will be important.

Application of a VLR option may have a significant effect on the type of road crossing provided. By way of an example, an unmodified Revolution VLR vehicle would likely require some form of active crossing control at major road interfaces. Dependent on how such a vehicle was categorised (e.g. heavy rail, hybrid light rail, etc.), this could introduce a minimum requirement for road warning lights and half/full barrier protection. This has the potential to affect the type of solution implemented

on the Wisbech Bypass, given a standard rail crossing us unlikely to be feasible in the current context. Such installations could however be suitable for use at less busy sites such as Elm Road in March or Station Road in Coldham.

Low cost, simplified level crossing equipment is used on continental rail networks. Many European countries apply simplified barrier mechanisms at automated crossings effectively, without compromising on the operation of the railway and providing a suitable level of safety based on anticipated risk. Such equipment is occasionally imported for use in a UK context, however for non-railway applications, such as barriers protecting car parks, secure installations and lifting bridges. Siemens, Schweitzer Electric and Unipart Dorman, all offer some form of simplified modular signalling/crossing control arrangement, as part of their wider international supply portfolio. It is anticipated that with some limited development, this technology could be applied for use in a UK context, operating with light rail vehicles and speeds comparable to many secondary heavy rail passenger lines. An example of the Schweizer Electronic Flex crossing system, currently in use on the continent is shown in Figure 8 below.

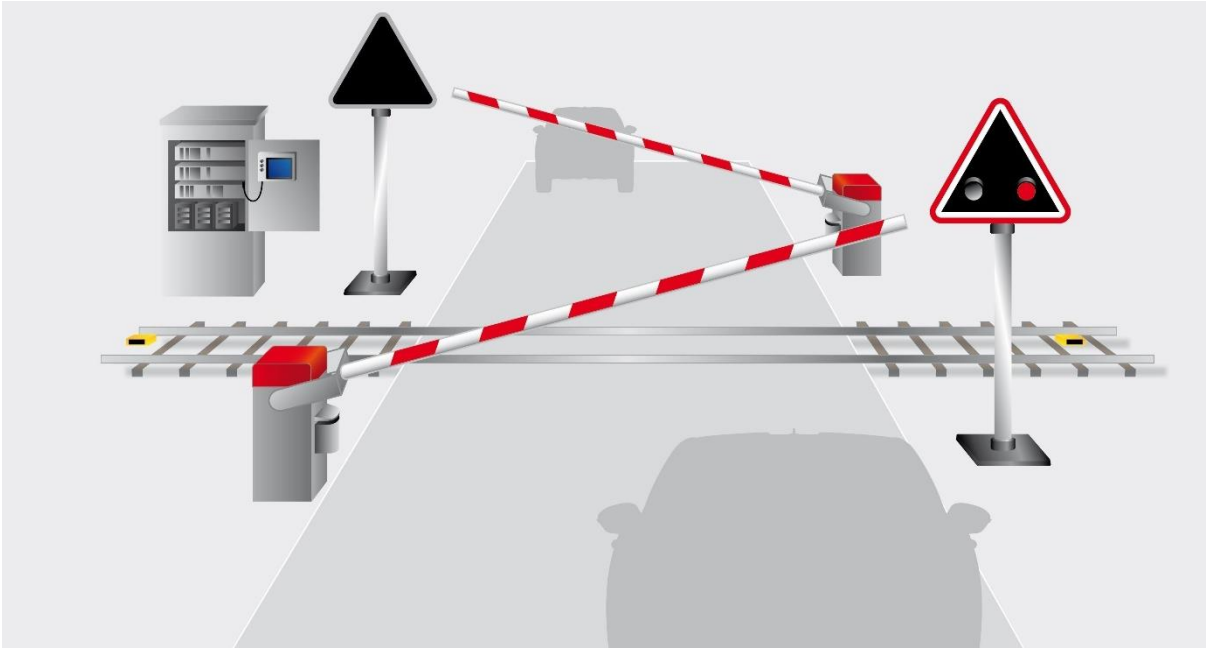


Figure 8 – Schweizer Electronic Flex Crossing System (Source: Schweizer Electronic)

Active crossings Intersecting Minor Roads

An example of this arrangement is Redmoor (see Figure 7). This was formerly an AOCL located on a quiet semi-rural/residential road.

Application of a Tram Train or Tram option offers the simplest road/rail interface solution in this instance. Given the poor sighting at the Redmoor crossing, it is anticipated that traffic lights would be required to facilitate a suitable interface. This would be treated as a standard road junction under current highway regulations. At locations where good sighting distance is available in both directions, it may be possible to incorporate a formalised road junction, without the need for an active traffic light system. Tram vehicles would operate on a line of sight basis over such crossings, with cars required to give way to approaching tram vehicles. This would be subject to individual risk assessment at specific sites, based on key local characteristics.

In the example of Redmoor, application of a VLR vehicle option would require more substantial crossing infrastructure. As per the major road example, this is assumed to be a form of active warning road lights as a minimum. Requirements for provision of barriers would require specific risk assessment for each location, largely dependent on local characteristics, anticipated rail vehicle line

speed, and road usage. A simple categorisation would be application of the same active warning lights as major road interfaces, minus provision of barriers. This does not however mean projects would be limited to a single type of warning light arrangement, as several types currently exist for different crossing applications. One example of this is the Schweizer Electronic Vamos crossing system, currently in use in the UK at User Worked Crossing installations (see Figure 9 below).

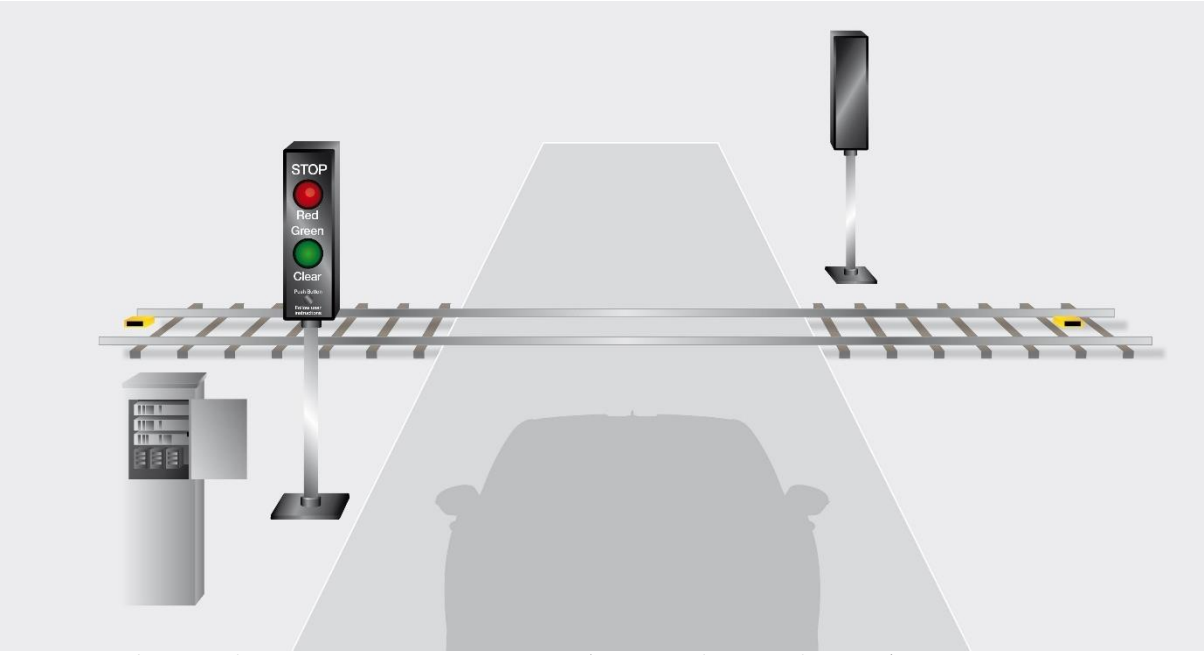


Figure 9 – Schweizer Electronic Vamos Crossing System (Source: Schweizer Electronic)

User Worked Crossings

An example of this arrangement would be Clarkes User Worked Crossing (see Appendix B1.2). This was a basic occupation crossing equipped with passive signage and metal gates. It is located on private land inaccessible to the public and connects agricultural land on one side of the crossing to a farm complex on the other.

Application of a Tram Train or Tram option could allow application of a basic signage based road interface solution, with give way indications for road vehicles. This would be dependent on current/anticipated usage of the adjacent fields, as there could be a risk of livestock accessing the rail alignment. Where fields are to be used for the purpose of grazing, etc. user worked gates would be a minimum requirement. Where gates are provided, it is anticipated that basic give way signage would be replaced with usage signage instructions, including details of penalties for not closing gates.

User Worked Crossings are standard on heavy rail infrastructure and it is not anticipated that such arrangements would differ greatly where a VLR vehicle option is applied on the route. There would need to be consideration of modifications to the VLR vehicle in terms of driver visibility, braking capability and impact protection. A worst case scenario would be a crossing with poor visibility in both directions, utilised regularly by long/slow vehicles. In a heavy rail context, this would normally be managed through the provision of telephones. Telecoms requirements add additional cost/complexity to projects, requiring alternatives to be considered.

One option is to provide a control centre/signal box number for users to call via a mobile phone. Given most of the crossing in question operate with nominated users, as opposed to general public, it would not be unreasonable to expect users to be equipped with mobile phones. Another covers use of remote GSM-R public call technology. This concept uses standalone solar/battery powered

GSM-R handsets installed at crossings, to provide contact with the signaller/controller in the event of poor mobile phone coverage. This technology is already in use successfully at several locations on the UK heavy rail network.

Figure 10 – Typical UWC installation on Wisbech Branch Route (Photo: Alex Dodds)

5 Optioneering

5.1 Minimum Intervention

Option Overview

Baseline optioneering for a light rail proposal assumes the Client base specification of up to 2 services each way per hour. To allow for expansion as allowance has been made for up to 3 services per hour. This assumes an approximate 20 minute journey time incorporating any additional intermediate stops. Requirements for infrastructure provision will ultimately be dependent on the attained journey time and service schedule, however as a minimum this would include a single/double platform station/tram stop on the edge of Wisbech town centre and an intermediate mid-point passing loop on an otherwise single track route.

The route would be largely self-contained, with a signalised interface at the southern end, where the freight only line to Whitemoor connects with the Peterborough-Ely through lines at March Station. Given this limited heavy rail interface, it is assumed that the service would be implemented as a Tram Train/hybrid light rail operation. With the heavy rail interface limited to a single interlocking transition, scope for utilising Very Light Rail vehicles may be possible, subject to application of route separation/lockout arrangements[4] provided in the Whitemoor Junction/March Station area. However, Tram Train rolling stock offers greater flexibility for service extension onwards from March on existing heavy rail.

Proposed Infrastructure

[4] Designation of the VLR vehicle as a tram train may avoid the need for this

The minimum intervention option reduces the cost of initial construction through limiting the infrastructure requirement. It is proposed that a station site located on the edge of Wisbech town centre be utilised for commencement of service. This option would require minimal land take and would run through a former industrial corridor up to a site south of the Nestlé Purina factory. The station would be located on the existing factory site staff car park. This would require relocation of these facilities elsewhere, however this would not be unfeasible due to the varying industrial land uses around the site (with some adjacent plots being semi-derelict at the time of writing).

It is recommended that the station site incorporates a single platform, limited light rail signalling infrastructure, a singe track and platform, with associated light rail based facilities. This initial option is outlined in Figure 11 below. As noted in the Option Overview, in the event a minimum intervention station option was not sufficient to meet anticipated demand, or proposed service schedule, scope exists for a second platform on the same site. It is recommended that provision be made for conversion of the single platform into an island, should future demand warrant (see Figure 11 below). This would require the initial build to be of a suitable width, possibly with platform copers pre-installed.

Provision of parking facilities is also recommended, due to the station's location within the wider urban area, and the potential for use of the town as a railhead for outlying rural areas in the vicinity. Options for a car park on the site are shown in Figure 11 and Figure 12. An alternative option to provide sufficient parking for rail users avoiding additional traffic through the town is to include a park and ride stop at the A47 crossing

One of the disadvantages of the Nestlé Purina site is the potential impact on pedestrian connectivity. In this instance the proposed site offers significant potential for enhanced pedestrian connectivity, with only minor intervention. There are five potential pedestrian corridors that could be constructed/enhanced to provide pedestrian connectivity in all geographic directions from the station. These are listed in clockwise order as follows:

- North footway skirting Nestlé Purina factory (main pedestrian connection to town centre)
- East connection to Victory Road and east side residential areas
- South connection to Weasenham Lane and industrial/commercial district
- South West pedestrian access via Oldfield Lane
- West connection to Cromwell Road through existing footway adjacent to Nestlé Purina factory

Figures 11 and 12 outline pedestrian access provision in brown, with potential light rail style pedestrian crossings denoted in yellow.

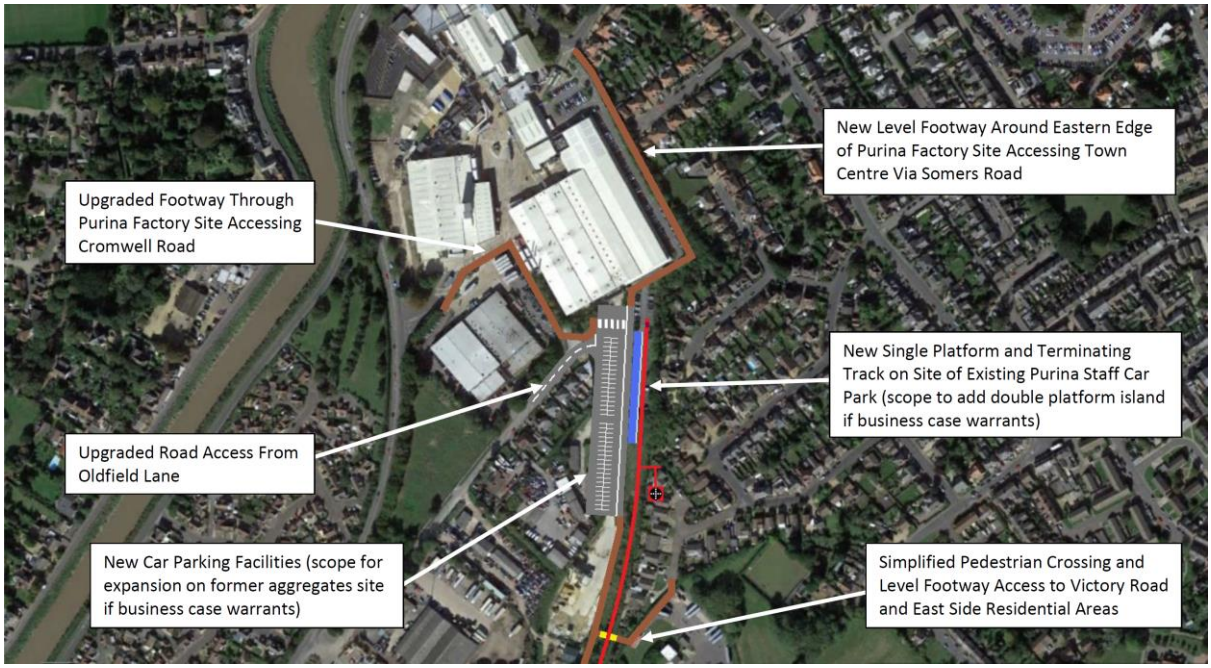


Figure 11 – Proposed Purina Factory Car Park Station Site

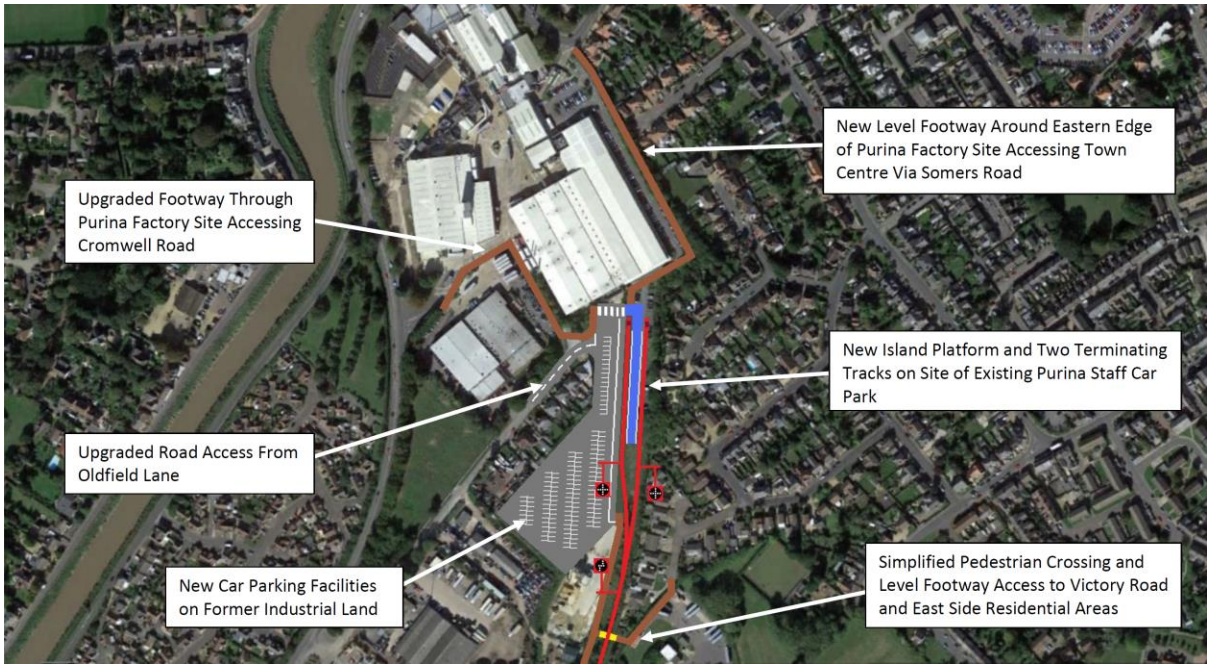


Figure 12 – Proposed Purina Factory Car Park Station Site

Regarding core route infrastructure a minimum light rail intervention for the route would incorporate a single track with a mid-point passing loop (outlined in Figure 13 below). This would allow for a minimum 20 minute peak service provision, assuming that trains would be scheduled to pass in the loop on an out and back basis. If additional contingency time, or extended layovers were required at Wisbech, a second platform would be required for operational flexibility and to accommodate potential service disruption. Signalling interventions include a simplified light rail based single line occupation system. This is similar to examples seen on tram networks throughout the country, with a specific example being the single track Meadowhall Interchange line on the Sheffield Supertram network (see Figure 14 below).

Figure 13 – Proposed Route and Coldham Regulating Loop Location

Figure 14 – Example Single Line Occupation Tramway Controls at Meadowhall Interchange, Sheffield (Source: Ian Ambrose)

Where light rail and heavy rail lines interface a signalling arrangement like that on the Tinsley Chord Tram Train connection in Sheffield is recommended. This incorporates a single main aspect signal on the approach to Whitemoor Junction. This would be designated as the transition point from light rail to heavy rail infrastructure. A corresponding train crew instruction sign would be provided in the opposing direction at the signal denoting 'Start of Line of Sight Infrastructure'. This would be the point that drivers switched to the light rail line of sight operation on the single track section. This arrangement is outlined in Figure 15.

It is recommended that an approach berth or annunciation be provided on the single line, to advise the Network Rail signaller of approaching light rail vehicles. Figure 17 outlines the simplified transition arrangements applied by the Sheffield Tram Train project. It is assumed that in this case, drivers would receive a cautionary aspect for movements towards light rail infrastructure, as is the

case on Sheffield Tram Train. The ownership, operation and maintenance responsibility of the light rail infrastructure will need to be agreed. With formal boundaries established if the light rail section is not the responsibility of Network Rail.

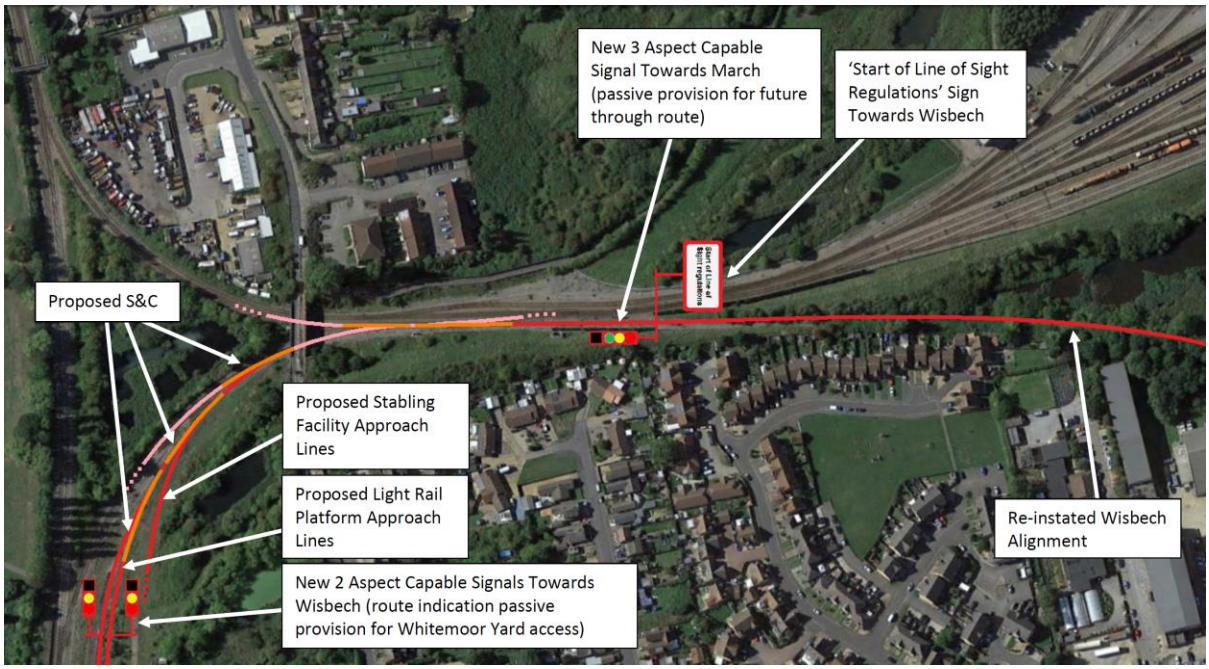


Figure 15 – Proposed March East Curve Connection

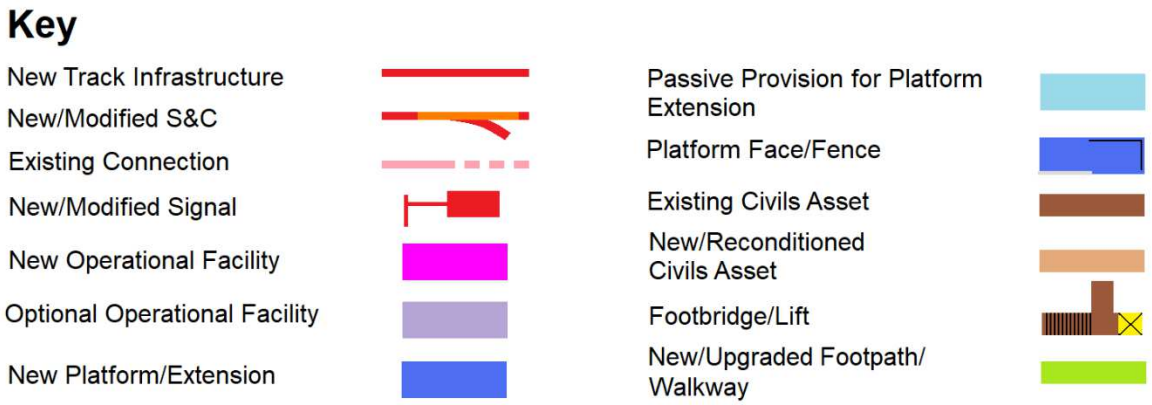


Figure 16 – Key to Aerial Image Overlay Diagrams (Figures 14, 18, 22, 24 and 25)

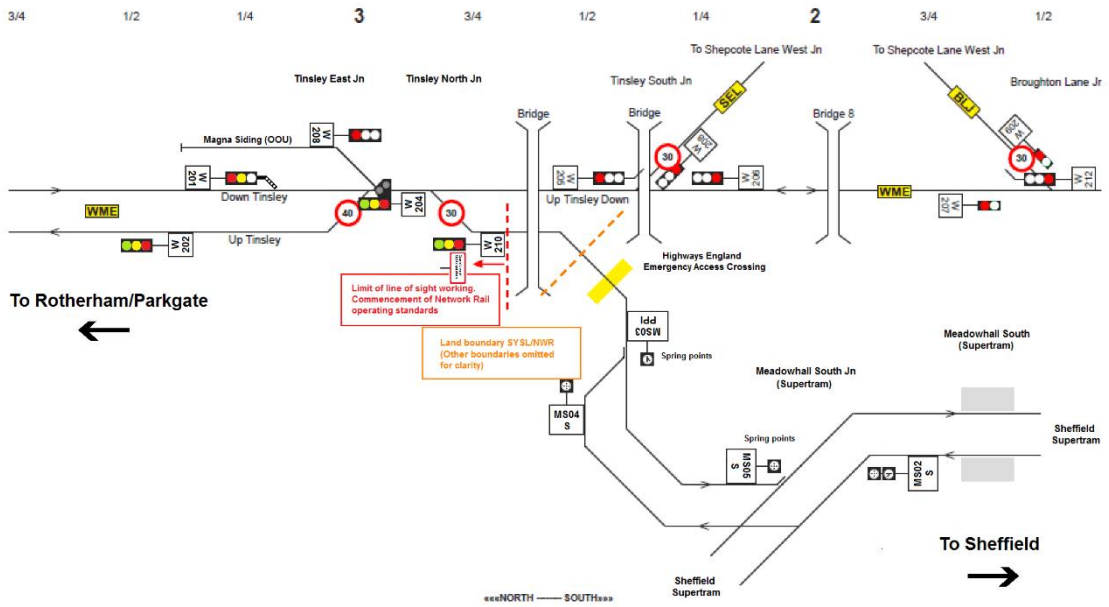


Figure 17 – Simplified Heavy Rail Interface Signalling at Tinsley Chord on Sheffield Tram Train Extension

Access to March Station is assumed to be via the existing West Curve connection to/from Whitemoor Yard. This would require limited shared running on heavy rail infrastructure, with the integrity of the interlocking providing suitable light rail vehicle separation. In addition to re-instating existing S&C towards the Wisbech alignment, a new turnout would be required from the curve towards a proposed platform and depot facility in the current disused area of March Station. Figure 18 shows the indicative layout for two platforms on the disused through alignment. Potential cost savings could be made through temporary frangible decking over the eastern end (shown in yellow), to permit passenger circulation and level access to the north side car park, without re-instating the currently disused portion of station footbridge.

Figure 18 makes provision for two platform lines; however one may be acceptable to reduce cost or align with the service specification. This would require as a minimum, full reconditioning of the current disused platform faces (dark blue) and associated remedial work to structures adjacent to circulation areas. A recent site visit noted severe deterioration in station canopies and supporting metalwork, which may require addressing separately as part of a wider package of station enhancements[5]. Passive provision is made for future platform extensions (light blue) if the business case warranted, or a single extended platform to hold up to two 35-40m vehicles. Signals shown are two aspect with route indication, however the latter may be dispensed with if only one route is to be made available towards the Wisbech branch.

The current land area north of the station site appears to be utilised by Network Rail/contractors for storage of materials and vehicle access. This may permit the optional construction of a two road stabling area for light rail vehicles, and optional maintenance shed (highlighted in pink in Figure 18). This would require re-allocation of maintenance/operational use into a smaller compound area east of the existing site. A standard Ground Position Light signal is assumed to be acceptable for such a facility in this instance

[5] Upgrade work to March station has been approved and is underway. Proposed access to the island platform needs to be confirmed

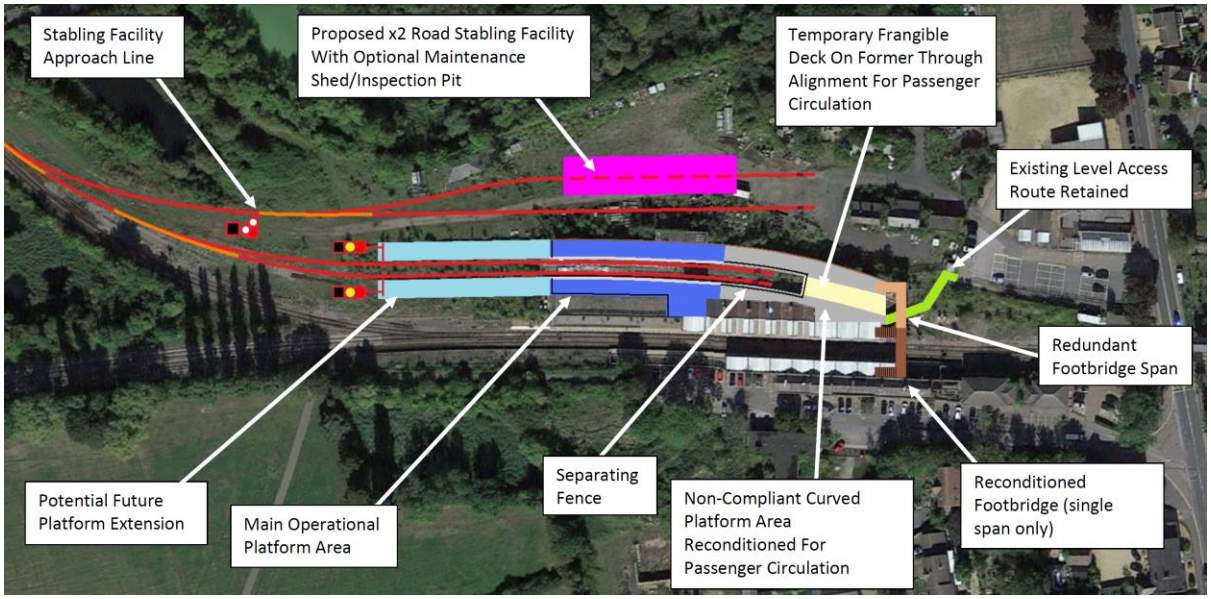


Figure 18 – Proposed March Station Terminating Platforms

Additional Requirements

Additional considerations for the proposed route include level crossings outlined separately in Section 4. Light Rail optioneering offers significant potential cost savings over heavy rail, due to the greater reliance on vehicle capability for managing road rail interfaces. Vehicles intended for tramway operation are normally fitted with track brakes, enhanced standard braking capability, improved driver visibility, and crash energy management. As such, level crossing equipment provision can be substantially reduced over equivalent heavy rail options. None of the existing level crossing equipment provided on the route would be satisfactory for a modern passenger operation, and it is proposed that each crossing be re-assessed for operation with a light rail hybrid service.

A minimum provision on tramway networks is un-signalled crossings. These simply incorporate advisory signage and assume standard road junction compliance. This may be acceptable for several of the user worked crossings on the route, however it is recommended that gates be retained for control of livestock from adjacent fields. Telephones are not normally provided on tramway crossings, however in this instance individual risk assessment may require some form of permission based crossing, in the event of frequent slow traffic/poor sighting/visibility. Technology exists to provide remote GSM-R solar powered communications to rural crossings, which may assist in improving safety without a disproportionate impact on cost. It should be noted that Signal Post Telephones are not proposed for light rail infrastructure, with all traffic based communications being managed by radio, preferably from a central control. Further detail on level crossing interventions can be found in Section 4.4.

Examples of light rail and simplified crossings are shown in Figure 19 (traffic light control interlocked with tram signal indicators) and Figure 20 (simplified light weight barriers).

Figure 19 – Standard Tramway Traffic Light Road Junction Crossing (Source: YouTube/MrCrompton 33012)

Figure 20 – Simplified Light Rail Barrier Crossing on Isle of Man Steam Railway (Source: YouTube/Perryd Pelle)

For a self-contained light rail service (March-Wisbech only) traction power is assumed to be battery. This would require as a minimum, charging points at both terminus stations, and provision of shore supply in any depot facility constructed. Two options are available for charging facilities including four foot mounted charging grids and overhead conductor bars. Currently no UK market Tram Train vehicles are equipped for four foot mounted charging grids, however the two vehicle types currently in production (Class 398 and Class 399) are both capable of overhead charging.

If a self-contained network is preferred other potential rolling stock could include Very Light Rail (VLR) vehicles. Examples such as the Revolution VLR can be provided with both battery and diesel powerpacks and are proposed to accommodate fast charging from lineside infrastructure.

5.2 Wisbech Town Centre Interchange

Option Overview

The application of light rail vehicles offers the opportunity for the service to run closer into Wisbech town centre. This would require street running to access a more central location and would potentially extend journey times beyond the assumed 20 minutes of a segregated edge of town station alignment. If the aspiration was to assume a minimum of 2, 3 or 4 tph (see section 4.1) this would require additional route capacity in the urban area to accommodate the extended journey time. Requirements for flexibility of operation, brought about by issues over service reliability/road traffic interface, may dictate a need for additional passing loops/double track infrastructure in the main route corridor.

As per the Minimum Intervention Option outlined in Section 5.1, the core route would be largely self-contained, with a signalised interface at the southern end, where the freight only line to Whitemoor connects with the Peterborough-Ely through lines at March Station. Given this limited heavy rail interface, it is assumed that the service would be implemented as a Tram Train operation, accounting for the extended street tramway interface at the Wisbech end of the route. This would also offer greater flexibility for service extension onwards from March on existing heavy rail if the business case warranted.

Proposed Infrastructure

The required infrastructure for a Wisbech town centre tramway connection would largely mirror that outlined in the Minimum Intervention Option in Section 5.1. The core route infrastructure and March Station options would be the same, excepting potential capacity based interventions associated with the operation of a street tramway service. The most notable difference is the addition of approximately 1.1 miles of unidirectional embedded rail double track street tramway between Weasenham Lane and Horse Fair Shopping centre (see Figure 21 below). This alignment has been identified as the most direct to the main shopping precinct however is only enabled by direct incorporation of the rail alignment into the existing two lane roadway.

Formal signalisation will be required at each major road junction dissected by the tramway alignment, with corresponding tram signal indicators specifically for light rail vehicle movements. There is scope for tram stops to be added along the line of route, in both high level and low level platform configuration. High level platforms offer greater flexibility for onward connection and are slightly more complex to implement in an urban environment. Space does exist in certain locations (such as land in front of the Nestlé Purina factory), where tracks could be gauntleted to provide a segregated high level platform stopping point for light rail vehicles in each direction.

One of the most significant interventions of this proposal would be the construction of a two platform terminus station at the Horse Fair Shopping Centre. This would break off from the street alignment, avoiding the Horse Fair Roundabout and terminating in the ground level of the existing Horse Fair multi-storey car park. Two platforms are assumed to be the minimum intervention in this instance due to the potential performance impact associated with street running discussed in the Option Overview.

A scissors crossover would be required to regulate traffic between the two platforms, and this would need to be clear of the active roadway, to avoid damage to the S&C. The only suitable alignment in this instance runs through part of the current Job Centre site, which would need to be partially re-developed to facilitate a segregated alignment. It is assumed that tram signals and points indicators would be installed as per standard installations for tramways in other mainland UK cities. Additional traffic management interventions, such as road traffic lights, junction stand backs and

yellow box hatching would be required on the approach to Horse Fair Roundabout, to ensure adequate traffic management in an already congested part of the town.

The existing Horse Fair multi storey car park structure may not incorporate suitable vertical clearance for Tram Train style vehicles. Thus, potential partial or full reconstruction of the upper parking deck to accommodate Tram Train vehicles below may be required. Construction of buildings and car par structures above active tramways is not uncommon, and scope may exist for incorporating 'air rights' development above the station site and above the partially demolished Job Centre site.

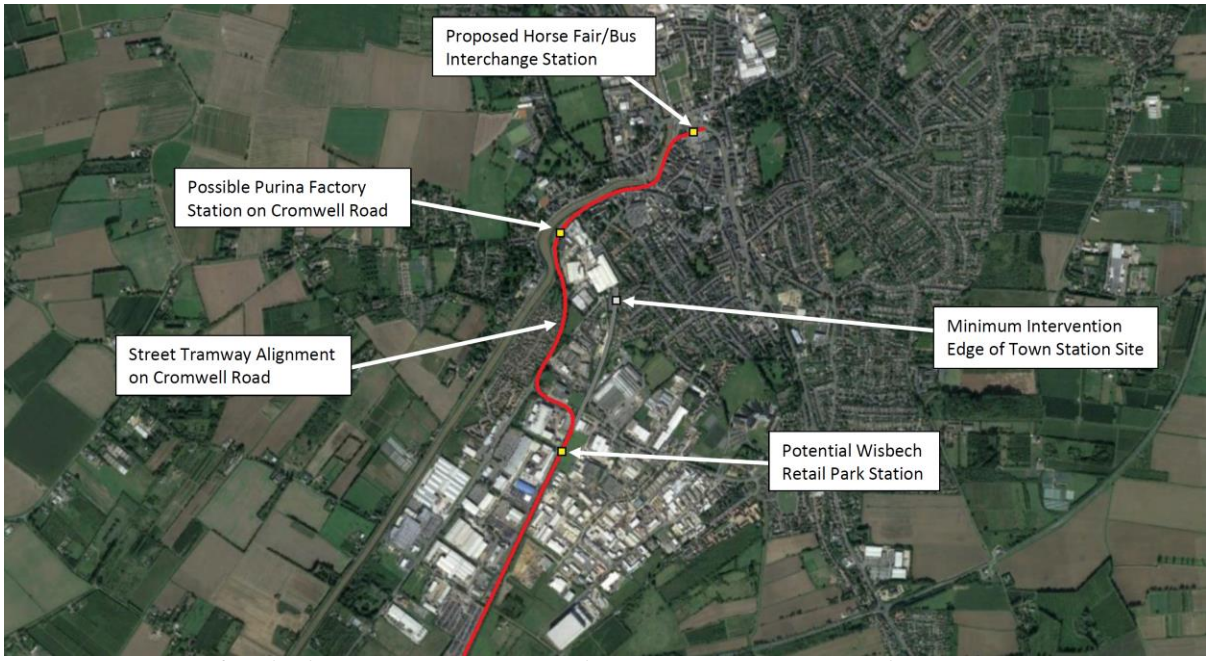


Figure 21 – Proposed Wisbech Street Tramway Route Alignment to Horse Fair Interchange

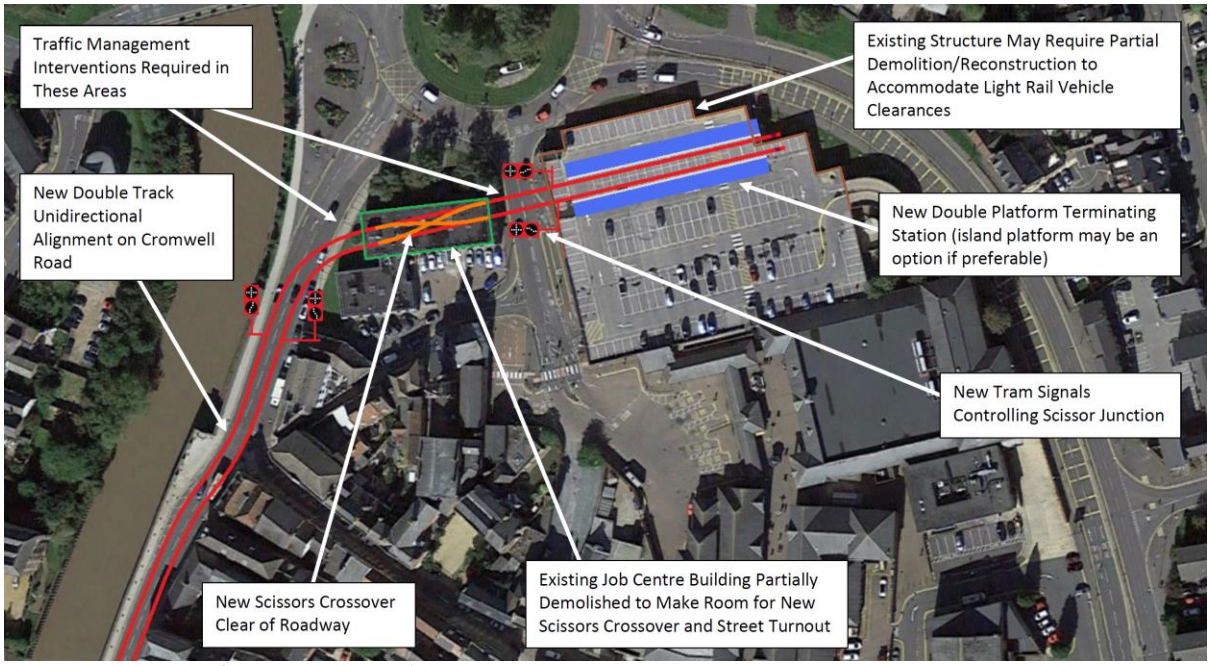


Figure 22 – Proposed Horse Fair Interchange Town Centre Station

As noted earlier in this section additional track infrastructure along the core line of route may be required, to provide enhanced service resilience for interface with a street tramway. It is assumed this would take the form of at least two regulating loops in each direction, between Chain

Bridge/Coldham South and Waldersea/Redmoor (see Figure 23 below). This would provide capacity to pass services at one third intervals along the route, and could be utilised both for contingency pathing, and future enhanced service if the demand warranted.

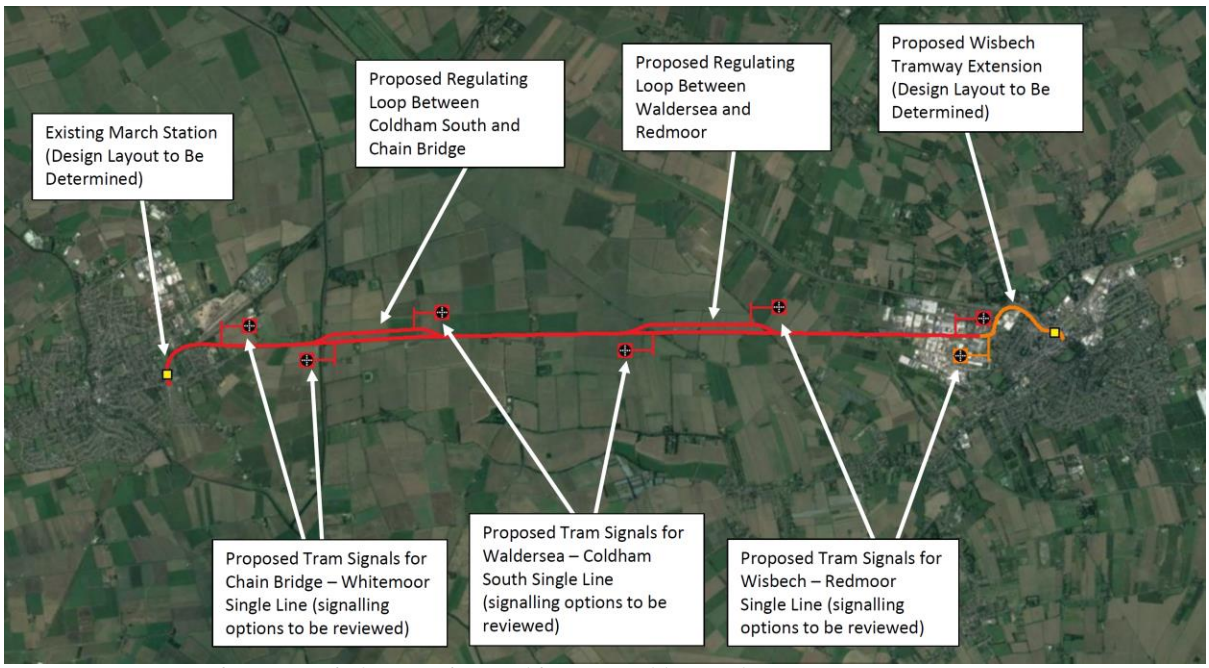


Figure 23 – Proposed Route and Chain Bridge/Waldersea Double Regulating Loop Location

Additional Requirements

Additional considerations remain largely the same for this proposal, as per the Minimum Intervention Option covered in Section 5.1. One of the key differences is anticipated to be the use of embedded rail on the street running sections of route. This would need to be taken into consideration from a procurement and installation perspective, as well as for long term maintenance of the asset. Such a small amount of a very specific infrastructure may add cost/complexity to the project, however larger combined procurement initiatives may be possible through industry organisations such as UKTram. The ownership, operation and maintenance of the on-street sections would need to be established.

Another key difference from the Minimum Intervention Option concerns rolling stock. Integration of a street tramway into the system operation requires the use of a tram or Tram Train type vehicle. For a self-contained network, some form of modified 'off the shelf' tram design may be adequate for the limited interlocking segregation proposed at the Whitemoor Junction. An example being the M5000 tram design used in Manchester. Where onward heavy rail connectivity is being considered in the long term the available option is a Tram Train

6 Future Considerations

6.1 Increase in Service Provision

Heavy Rail Connectivity Beyond March

While the client's baseline requirement is for a dedicated shuttle service between March and Wisbech there is the opportunity, and longer term aspiration, to extend the service beyond March to Peterborough, Ely and/or Cambridge. This section discusses the potential requirements at March to enable such a service extension.

As noted in Section 5 Optioneering, such service extension places a limitation on the type of rail vehicle that can be used in all feasible scenarios, namely Tram Train. Loading gauge restrictions and a lack of electrification limits any chosen vehicle to a battery hybrid option. Due to the presence of electrification on the fringes of the route (Ely-Cambridge, and Peterborough), it is recommended that consideration be given to a 25kV charging capability from overhead catenary. This does not rule out alternative ground based charging provision previously discussed, with charging grids installed in the four foot at the respective terminals. Alternative options exist for onward heavy rail operation beyond March; however these are limited to the semi segregated mode of operation outlined in the Minimum Intervention Option in Section 5.1.

March Station

An extended service enables opportunities for stabling and maintenance of Tram Train/light rail vehicles at existing depot facilities. This would avoid the stabling/maintenance facilities shown in Figure 25. Figure 25 highlights the key changes required to permit light rail vehicle access to the main running lines east of the station. It is assumed that the existing east end freight connection would remain in situ, with the platform lines being designated for Tram Train use only. This would require reconfiguration of the existing level access arrangements for the north side Platform 2.

As a minimum, this proposal recommends significant rehabilitation of the existing footbridge structure (shown in dark brown), which is not PRM compliant and in poor condition. To obtain full PRM compliance lifts would be required. This proposal recommends the construction of a new central footbridge on the site of the existing long stay car park, and former terminating bays in the central island (shown in light brown with lifts in yellow). This would provide a significant enhancement in overall station accessibility, in addition to PRM compliance, and may permit removal of the existing footbridge structure if the asset condition is poor enough to warrant[6].

More complex signalling arrangements would also be required for the new routes created, with a new single lead spur from the existing main lines connecting to up to two platform lines. In order to accommodate the new S&C on approach to the level crossing, the existing crossover S&C may require partial re-alignment to permit parallel movements. It is assumed that the platform spur would be served by an additional crossover east of the level crossing, within the limits of the existing goods loops. A minimum of two new two aspect signals would be required as starters for the proposed additional platforms, with consideration given to application of standard heavy rail overlaps. It should be noted that this would require changes to the main line interlocking along with additional indications/approach controls on signals controlling westbound movements towards the station.

The layout shown in Figure 24 covers future service provision eastbound towards Ely and Cambridge. It is recommended that consideration be given to service provision towards Peterborough. The site constraints of the existing station, and its defined location make the

[6] This may be partially resolved in the current station refurbishment programme. The plans for the footbridge need to be confirmed

question of westbound connectivity somewhat of a challenge. Figure 25 below outlines two potential proposals for a Peterborough service, with both requiring additional infrastructure intervention and potential operational compromise.

The first and most technically complex option would be for an additional spur line connecting one or more of the proposed re-instated through platforms at the western end of the station. This would require a platform reversal in March Station for services proceeding towards Peterborough. This would potentially add additional time to schedules and tie up a platform for the duration of the change procedure. The west chord would connect at the existing March West Junction, in order to utilise the existing crossover for the single lead freight curve and shorten the junction lead times on the main line. This would require enhancement to the basic proposed signalling provision, with one or more west facing signals requiring full aspect sequence and route provision.

It should be noted that while a second platform connection may be desirable in flexibility/ performance terms, this has the potential to add technical complexity/maintenance issues to the intervention. This is due to the requirement for up to two non-standard cast crossing diamonds on an existing track curve.

The second option covered in Figure 25 covers installation of a separate platform on the existing West Curve freight alignment to Whitemoor Yard (shown in blue). This would potentially free up capacity in the main station area for Cambridge services and terminating shuttles from Wisbech, while also permitting through journeys not requiring a reversal. This option would permit fewer signalling infrastructure interventions to enable a Peterborough service, with only minor alterations to the existing freight line required to install TPWS/AWS/overlaps to passenger standards. A walkway could be constructed across apparently unused land to reach the main station site, with PRM compliant access to the main station assumed to be via the proposed new footbridge structure in the centre of the site. An optional connection could also be included to Norwood Road to improve station accessibility if the business case warranted.

It should be noted that for the West Curve platform connection, standards limitations on station design may require some form of deviation or may limit application entirely. One of the key issues concerns platform stepping distances. These would be non-standard for any platform structure installed on a curve of that specific radius. It is however anticipated that any light rail vehicle used for the service would incorporate some form of retractable step system to mitigate this issue. This would render the platform unfit for use by standard heavy rail vehicles. Another standards issue to consider would be the issue of wayfinding within the station site. The West Curve is located some distance away from the main station complex, and even with a PRM compliant walking route, the location may be difficult to find for customers not used to the arrangements. Signage and wayfinding innovations can mitigate against such issues, however the distance between the two sites may be a challenge for persons with reduced mobility in general.

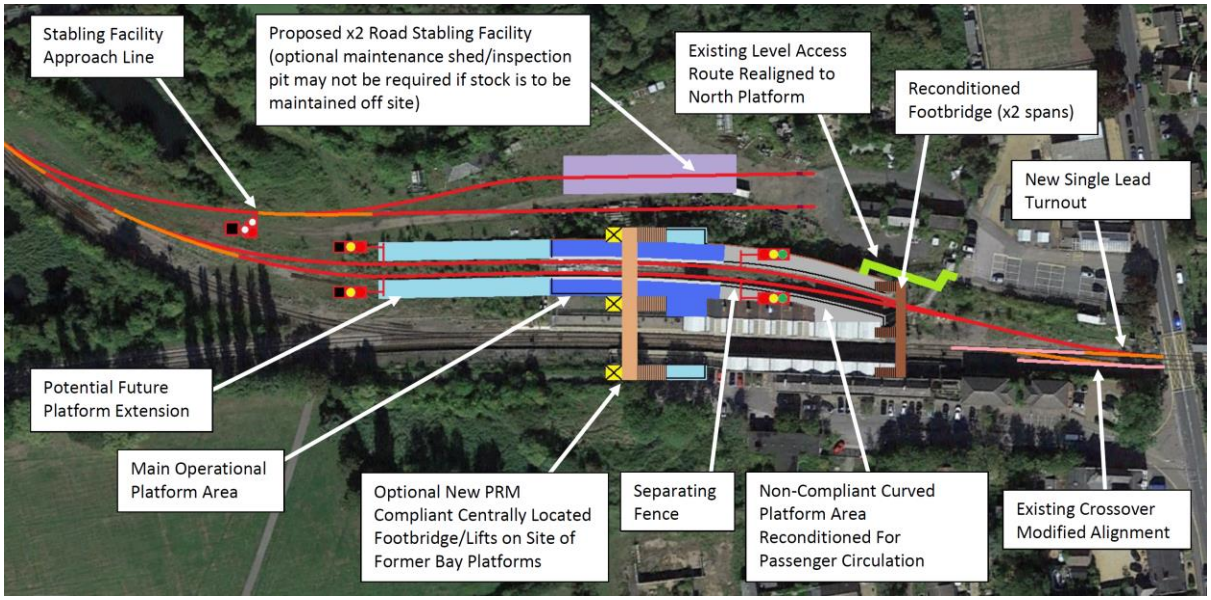


Figure 24 – Proposed March Station Additional Through Platforms

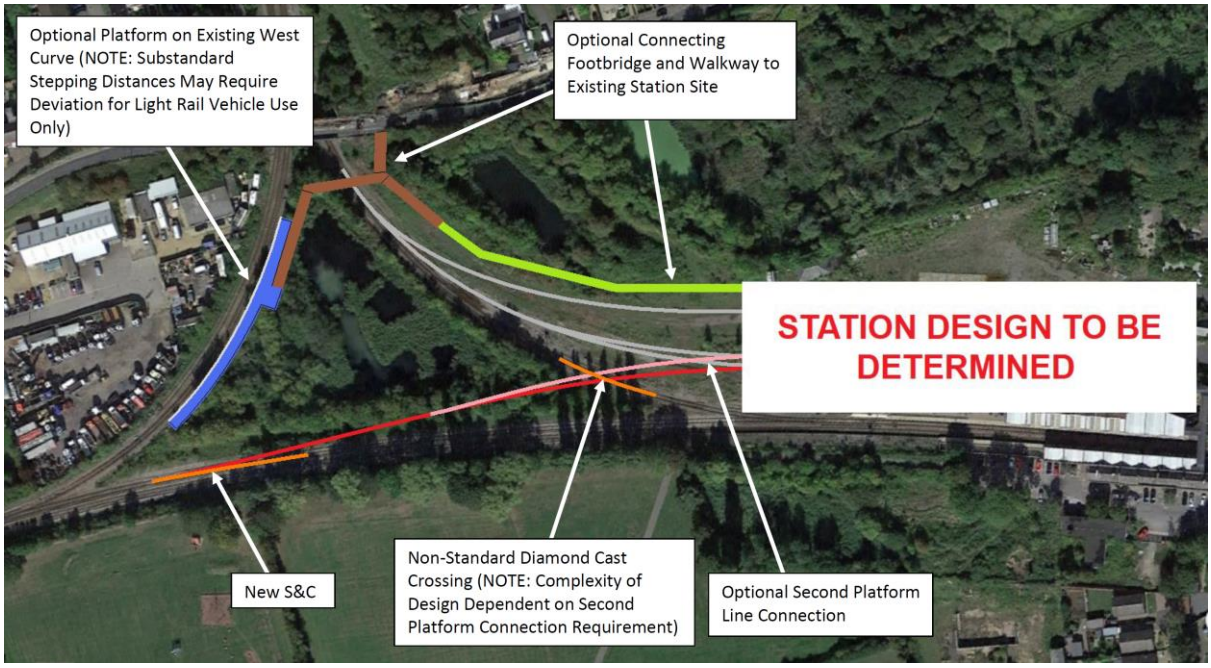


Figure 25 – Proposed March Station West End Access

Additional Considerations

A key consideration is the potential impact of the future West side Garden Town development proposed in Wisbech. The impact is currently difficult to quantify as detailed proposals are not advanced, however it is evident that passive provision for a western connection would be prudent. Figure 26 below outlines several potential high level route options, placed in the context of the detailed versions outlined in Section 5 Optioneering. From the West side Garden Town development perspective, this includes three potential routings for either a 'Y' shaped connection, separate terminating spur, or combination of the two to form some sort of 'loop' arrangement. This introduces the question of additional station stop provision on these routes and whether the business case for these would be enhanced by some additional requirement for route interchange.

It should be noted that Options 2A, 2B and 3A in Figure 26 all cover some form of tramway based street running as part of the high level proposal, limiting them to tram/Tram Train based vehicle applications. Option 1 (Core) and Option 3B do offer potential for other VLR/light rail vehicle types. This is covered with the caveat of a limitation on existing urban area penetration and does not rule out safeguarding of a segregated route through the proposed garden town district.

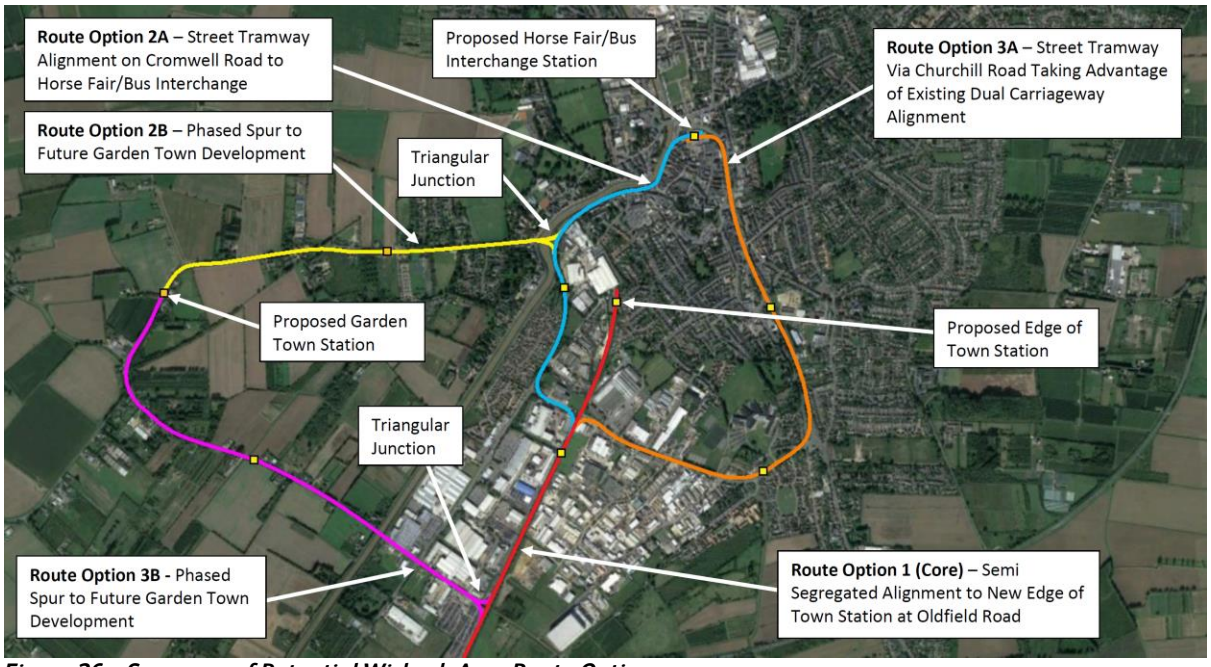


Figure 26 – Summary of Potential Wisbech Area Route Options

6.2 Heavy Rail Option

This section provides a summary of the requirements for a heavy rail solution. Its intent is to highlight the key areas of difference with the light rail options discussed elsewhere.

Operational standards and practices differ considerably between light and heavy rail systems, and this is particularly pertinent for train control and level crossings. The cheapest heavy rail option would be one that limits signalling intervention, which could be achieved through a system of One Train Working. One Train Working systems by nature are not suited to frequent passenger operations and could limit service options to hourly at best (assuming a 20 minute end to end journey time between March and Wisbech).

Adding additional capacity to a heavy rail single line would require formal signal interlocking protection where intermediate loops are provided. This could include some form of token working, or a fully track circuited single line section. Regardless, this would require provision of full heavy rail lineside signalling and supporting infrastructure such as TPWS and AWS. This in turn requires a robust signalling power supply to support system operation, along with a complex and extensive lineside cabling arrangement. There is also no guarantee that additional infrastructure would offer significant gains in capacity, due to the more stringent standards for train speeds and braking distances applied to heavy rail signalling design.

A crucial consideration when evaluating heavy rail options for route re-openings/re-instatements is the issue of level crossings. Current practice within the heavy rail sector is to seek closure/replacement of road/rail crossing interfaces where possible. Where crossings are retained as part of reopening projects, ORR best practice recommends application of full barrier crossings on main roads and/or urban/residential neighbourhoods. An example of such an arrangement is shown

in Figure 25 below. There are seven active warning crossing sites on the Wisbech branch. Most are of the TMO/AOCL variety which are either considered non-preferred by modern day regulatory standards, or unsuitable for passenger service operation. There may be scope to retain the two semi-intact AHB crossings on the route, subject to suitable risk assessment. Standard practice however is currently to install MCB-OD full barrier crossings, in lieu of older automatic types. These are some of the most expensive and technically complex crossings in the national portfolio, second only to crossings equipped with remote CCTV control.

Figure 27 – Typical Full Barrier Heavy Rail Level Crossing (Source: NR Media Centre)

Additional factors to consider cover station design and construction, largely driven by heavy rail accessibility compliance. Light rail station stops are generally cheaper to build and are subject to differing design standards and guidance. Within the station fabric, integrated CIS systems, help points, station phones and TRTS. There are also end of route infrastructure requirements to consider such as heavy rail compliant buffer stops, compliant overruns, train crew walking routes and lighting. Finally, train control is an important long term requirement of any project, and where this takes place from will have a significant impact on cost, complexity and level of impact/disruption to existing infrastructure. In the case of the Wisbech Line, March East Junction Signal Box would be a reasonable assumption for initial line control. This location is however planned for future re-control into a ROC facility, and as such any signalling changes applied would need to be incorporated as part of future re-signalling schemes.

6.3 The Role of Technology

Improvements in battery technology within the last decade have enabled electric rail vehicles with practical ranges available to the mass market. Within the rail industry, VivaRail has a simple battery vehicle with a stated range of approximately 40 miles between charges. Further developments are currently in progress and an enhanced battery system with a 60 mile range is anticipated at the time of writing. Additionally, most tram manufacturers offer battery hybrid options which currently charge from the OLE, and alternatives are under consideration.

Other manufacturers are developing rail based battery systems, with Stadler leading innovation on inductive charging systems for the new MerseyRail fleet of vehicles. In parallel, infrastructure companies have been developing methods of safely delivering charging current to rail vehicles, and Furrer & Frey is known to be developing at least two of these. One is an overhead retractable

charging system, currently being trialled for use on the Coventry VLR scheme, with the other being a four foot track mounted unit, currently being developed for use with the Revolution VLR vehicle.

One of the most important developments in the field of battery technology, after range, is the charging time capability. New 'fast charging' systems are currently being trialled or are under development in this field, with VivaRail currently offering an option for its battery vehicles capable of fully charging a unit in 10 minutes. Charging time is critical when considering service provision/options, as this greatly affects turnaround times and service recovery, in the event of disruption.

As the development of battery charging technology is moving apace with differing methods being trialled it will be important to understand the optimum solution as the vehicle and infrastructure specification is developed.

An important technological development within the rail industry relates to the future capability for interoperation of different types of rail vehicles. The current Level 2 crashworthiness standards for light rail vehicles have allowed operators like Tyne & Wear Metro/Stagecoach Supertram to run light rail services on shared infrastructure with heavy rail services. Both examples run with enhanced legacy signalling control provisions and associated safety systems ensuring traffic separation. Future developments in the field of Digital Railway technology are anticipated to bring additional flexibility to the control of legacy routes. One aspect of this covers application of ETCS operation to manage light/heavy rail vehicle separation. In effect, traffic separation on cab signalled vehicles could be 'programmed' based on vehicle type, with a 'virtual buffer' being placed around lower category light rail vehicles operating in the area. It is unclear at this stage how such technology would affect VLR vehicle operation on Network Rail main lines, however it may offer a practical/cost effective solution for limited heavy rail interfaces for future projects.

Another area of consideration is the current decarbonisation drive being promoted by the government. Rail has a potential role to play in transfer of freight. Early concepts have already been proposed for Freight VLR/Freight Tram Train vehicles, and consideration is already being given to practical routes these could be operated on. Light rail vehicles offer greater scope for urban penetration at an acceptable cost over heavy rail alternatives. Issues arise when interfacing with heavy rail main lines, and this highlights the need for effective transload capability and cargo transfer solutions. The Revolution VLR is being considered in a freight variant (see Figure 28 below).

Figure 28 – Proposed Freight VLR (Source: Transport Design International)

Further study will be needed to understand the feasibility of operating a VLR freight service on the Wisbech line, including any transhipment requirements at either end of the route.

7 Conclusion

This study has considered the suitability of light rail technology for the provision of passenger rail service between March and Wisbech. The study concludes that a light rail operation is feasible with several options of vehicle type available.

The potential vehicle options have been identified as:

- Very Light Rail
- Tram
- Tram Train
- Heavy Rail

Each vehicle option is dependent on the required service specification and influenced by the following key elements:

- Urban penetration within Wisbech town/Garden City development
- Location of Wisbech railhead
- Complexity of train control/signalling infrastructure
- Complexity of level crossing infrastructure/engineering intervention
- Provision of loops/regulating facilities within the corridor
- Station design/compatibility with existing infrastructure at March
- Cost/constructability considerations
- Onward connectivity to adjacent urban centres, e.g. Cambridge, Peterborough, etc.

Figure 29 is a summary of a comparative qualitative assessment of each vehicle option against the key elements. The RAG status provides an indication of the comparative complexity/degree of difficulty/whole system cost of each option. Note that VLR technology is at an earlier stage of development compared to the other modes. Further research is required to enable a greater level of assurance on the benefits of VLR compared to the other vehicle options.

	Tram	**Tram Train**	**Very Light Rail**	**Conventional Train**
Ability to access Wisbech town centre				
Compatibility with a future Garden Town extension				
Ability to service an edge of town Wisbech Station				
Comparative complexity of signalling control required				
Comparative complexity of level crossing interventions				
Complexity of station design/integration				
Ability to operate on the main line				
Comparative indicative capital cost				
Comparative indicative operating cost				

Figure 29: Indicative comparative analysis of possible rail vehicle types for deployment on the Wisbech to March line.

The comparative analysis indicates Tram Train as having the best potential for a light rail operation on the route. This is supported by the following key conclusions:

- The base service specification has a limited interface with heavy rail operations. This combined with the potential for a street tramway operation into Wisbech centre and the future possibility of for service extension onwards from March suggests a Tram Train would be an optimum solution.
- The number of level crossings on the route may make a full or hybrid light rail operation cheaper than a comparable heavy rail solution. Many of the current level crossing locations are considered substandard for a modern regular interval heavy rail passenger operation.
- Light rail vehicles operating on tramways are designed for highway interfaces (including track brakes and enhanced forward visibility). For these vehicles level crossing design can be optimised and the level of infrastructure required substantially reduced over equivalent heavy rail options.

The two development options outlined in Section 5 cover potential implementation of each light rail option identified, excluding heavy rail as outside the scope of this document. The Minimum Intervention option proposed in Section 5.1 is compatible with all light rail vehicle types assessed. This is due to its segregated nature and limited requirements for interoperation with heavy rail services. This would require novel operational process development and offers the most cost effective solution for enabling an initial service between March and Wisbech.

The use of any one vehicle type at commissioning should not preclude the future use of another. For example, initial deployment of a VLR vehicle would not preclude later application of a Tram Train. This assumes that a single floor height is selected for any vehicles used on the route. The Minimum Intervention option does not offer full urban penetration or connectivity with the existing bus interchange. This requires consideration of walkability of the station site from the town centre and how this and the applicable pedestrian routes are managed. This does avoid potential traffic congestion on the main north-south corridor into the town centre. It does not preclude phased development of additional light rail connections, as future travel needs are identified.

The Wisbech Town Centre Interchange option, proposed in Section 5.2 offers full urban penetration to the existing bus interchange. This is intended to take full advantage of light rail operational capability, and primarily focusses on application of a Tram or Tram Train vehicle solution. Further assessment is required of the capability of VLR technology to understand the potential of this mode to operate into the centre of Wisbech. The Tram Train option is a proven technology with the capability to operate on the main line, segregated light rail and on-street tramway routes. While this option may be more costly in initial outlay it offers greater flexibility for future system expansion.

8 Next Steps

This report has identified several actions that are recommended to be adopted as next steps in future development. These are summarised below:

Recommended Next Step 1

The legal status of all the former level crossings on the March to Wisbech line should be confirmed. Confirmation is required if the legal status needs to change if the route is to be used by light rail vehicles.

Establishing the existing rights and liabilities at each crossing will help inform the appropriate solution for each vehicle option.

Recommended Next Step 2

Options for the ownership, operations and maintenance responsibility for the route need to be identified and resolved prior to further development. This includes any on street system into Wisbech town centre or the extension to serve the Garden Town.

While Network Rail retains the freehold of the former railway alignment and associated land there are various options for the long term reinstatement of the route and service. Any extensions beyond the existing Network Rail land boundary create options for the delivery, operation and ownership of any assets.

Recommended Next Step 3

A detailed asset condition survey is required of the entire route. This will assist to confirm the level of remedial work required to reinstate any form of rail infrastructure. This survey to include March Station and the required alterations to create a fully accessible route to the Wisbech platforms.

The former railway infrastructure has not been fully maintained since the line was mothballed. A full asset condition survey will enable greater clarity on the scale and costs of any reinstatement of railway infrastructure.

Recommended Next Step 4

Continued analysis of the light rail rolling stock market and the opportunity for further development in areas such as stored energy and very light rail.

There are continuing technological developments in light rail that may provide further opportunities for the Wisbech to March route. The very light rail market is still emergent and the fully capability (and limitations) of this mode are not yet fully understood.

Recommended Next Step 5

Consider the requirements of providing a double track route between Wisbech and March.

The ability to provide a full double track route will confirm the maximum capacity of the route and determine the degree to which any future-proofing works are required should the initial phase of reopening be less than double track.

9 Appendices

Appendix A: Glossary

Acronym	Meaning
0m 00ch	Miles and Chains
ABCL	Automatic Open Crossing Locally Monitored
AC	Alternating Current
AOCL	Automatic Barrier Crossing Locally Monitored
AHBC	Automatic Half Barrier Crossing
AWS	Advanced Warning System
CIS	Customer Information System
DC	Direct Current
DfT	Department for Transport
DMU	Diesel Multiple Unit
DNO	Distribution Network Operator
EMU	Electric Multiple Unit
ETCS	European Train Control System
GRIP	Governance of Rail Investment Projects
GSM-R	Global Standard for Mobile communications - Railway
FOC	Freight Operating Company
FPC	Footpath Crossing
FTN	Fixed Telecoms Network
LRSSB	Light Rail Safety and Standards Board
MCB	Manually Controlled Barrier crossing
MCB-CCTV	Manually Controlled Barrier crossing – Closed Circuit Television
MCB-OD	Manually Controlled Barrier crossing – Obstacle Detector

OLE	Overhead Line Equipment
ORR	Office of Rail and Road
OTW	One Train Working
PRM	Persons with Reduced Mobility
ROC	Railway Operating Centre
ROGS	Railway and Other Guided transport Systems (Safety) Regulations
RSSB	Rail Safety and Standards Board
SEU	Signalling Equivalent Unit
S&C	Switches & Crossings
TfW	Transport for Wales
TMO	Traincrew Manually Operated (crossing)
TOC	Train Operating Company
tph	Trains per hour
TPWS	Train Protection Warning System
TRTS	Train Ready To Start
TSI	Technical Specifications for Interoperability
ULR	Ultra Light Rail
UWC	User Worked Crossing
VfM	Value for Money
VLR	Very Light Rail
WMG	Warwick Manufacturing Group

Appendix B: Route Level Crossing Assessment

B1 Level Crossings

This appendix provides a review of each of the main level crossings on the Wisbech line. The review is based on historic data and from a site visit conducted in June 2021. The site visit was a visual only survey of the current condition. The intent of this appendix is to provide an overview of the differing crossing types it is not a formal engineering assessment of current condition or future potential.

B1.1 Significant Road Crossing Interfaces

Elm Road Automatic Half Barrier (AHB) Crossing (WIG 86m 60ch)

This installation is located on the B1101 secondary road that runs between the Norwoodside district of March up to the Wisbech ring road. It should be noted that in this location the road name is Elm Road, however this changes multiple times on the alignment north of Friday Bridge.

An initial site assessment taken from historical imagery captured in 2018 identifies an elderly 'all in one' AHB installation, possibly from the 1970s, in poor condition. Original wooden laminate barrier arms are missing along with the entire Down side entry 'penguin' unit. The remaining incandescent light installations are in reasonable original condition. The "bomac" surface appears to have been recently removed and replaced with a patched tarmac fill. The rails remain in situ either side of the crossing with some light vegetation encroachment. Examination of imagery notes a former lineside speed sign on the Wisbech side of the crossing, denoting a former line speed of 25mph at this location.

The B1101 in this location appears in average surface condition with full road markings and standard lane width. The road has straight approaches on both sides of the crossing with street lighting either side. The road speed is 60mph at the crossing location and is bordered by a 30mph zone on the south side. Current good practice guidance for installation of new/upgraded level crossings for heavy rail project interventions, would likely recommend a full barrier MCB-OD Mk2/CCTV installation for this location as a minimum requirement. This would be subject to bridging/closure/diversion being discounted as practical options.

Figure AB1 – Elm Road Site Overview

Figure AB2 – Looking South Along B1101/Elm Road Towards March

Chain Bridge Automatic Half Barrier (AHB) Crossing (WIG 87m 31ch)

This installation is located on the B1101 secondary road that runs between the Norwoodside district of March up to the Wisbech ring road. This is north east of the Elm Road AHB crossing and intersects with an unclassified road at this location.

An initial site assessment identifies another elderly 'all in one' AHB installation, similar to the example at Elm Road, albeit in slightly better condition. Original wooden laminate barrier arms are partially/fully intact along with both integrated 'penguin' units. The incandescent light installations remain intact in reasonable original condition. The "bomac" surface also remains in situ, in remarkably good condition considering the time elapsed since abandonment. The rails remain in situ either side of the crossing with some light vegetation encroachment. This location presents a unique constraint being situated immediately next to the Twenty Foot River waterway. This restricts crossing equipment on the March side into a narrow strip between the road and riverbank, with the adjacent rail bridge running directly off the B1121 road.

The B1121 in this location appears in good surface condition with full road markings and standard lane width. The road has straight approaches on both sides of the crossing transitioning to a sharp diverging bend on the south side approximately 200m from the crossing. The road speed is 60mph at the crossing location, and lower advisory speeds may apply for the diverging bend on the south side. Current good practice guidance for installation of new/upgraded level crossings for heavy rail project interventions, would likely recommend a full barrier MCB-OD Mk2/CCTV installation for this location as a minimum requirement. This would be subject to bridging/closure/diversion being discounted as practical options.

Figure AB3 – Chain Bridge Site Overview

Figure AB4 – Looking South East Along B1101 Towards Wisbech

Coldham Traincrew Manually Operated (TMO) Crossing (WIG 89m 21ch)

This installation is located on the unclassified Station Road that connects with the B1101 at Coldham village. This is situated approximately half-way on the alignment between March and Wisbech, around 1.9 miles north of Chain Bridge AHB.

An initial site assessment identifies a former TMO crossing installation in remarkably good condition, considering the period of disuse. Both manual wooden gates and concrete posts were fully intact as of 2018, albeit somewhat overgrown. The original wooden "bomac" surface remains in situ, also in reasonable condition, with some historic light tarmac patching up to the outer sides of the rail. The rails remain in situ either side of the crossing with moderate to heavy vegetation encroachment. The Stop Boards relating to the TMO crossing operation also remain in place on their original posts. This location presents an interesting constraint being situated immediately next to residential properties in Coldham village. The two houses closest to the alignment appear to be relatively new build in comparison with other properties in the area. It is however unclear whether

these sites were developed subsequent to formal route abandonment. The presence of these properties could present a restriction on development of a formalised remote/automatic crossing layout, with lights/barrier equipment possibly encroaching on their party land.

Station Road in this location appears in average surface condition, with minimal road markings and narrow lane width. Most of the markings are in poor faded condition, with the crossing stop marker on the Up side having been lost under a recent resurfacing effort. The road has straight approaches on both sides of the crossing however markings on the Down side only apply for 50m immediately before the crossing itself. The road speed on the Coldham village side is 30mph with the speed increasing to the 60mph national limit on the north side of the crossing immediately beyond the gates. Current good practice guidance for installation of new/upgraded level crossings for heavy rail project interventions, would likely recommend a full barrier MCB-OD Mk2/CCTV installation for this location as a minimum requirement due to the residential nature of the location. This would be subject to closure/diversion being discounted as practical options.

Figure AB5 – Coldham Site Overview

Figure AB6 – Looking West Along Station Road

Waldersea Traincrew Manually Operated (TMO) Crossing (WIG 90m 29ch)

This installation is located on Long Drove unclassified Road connecting Ring's End and Friday Bridge. This is situated approximately one mile north of the Coldham TMO crossing on the geographical rail alignment.

An initial site assessment identifies a former TMO crossing installation in remarkably good condition, considering the period of disuse. Both manual wooden gates and concrete posts were fully intact as of 2018, albeit somewhat overgrown. The Down side gate appears in markedly better condition than the Up side as the adjacent site is used by a heritage organisation.

The original alignment appears to have been installed with dock tramway style check rails with no "bomac" surface present. This arrangement remains in original condition however the flangeways have become degraded and blocked with debris over time. The rails remain in situ either side of the crossing with moderate to heavy vegetation encroachment north of the crossing. The south side remains clear, presumably due to intervention from the heritage operation. The Stop Boards relating to the TMO crossing operation also remain in place on their original posts. The sharp angle of this crossing could present a restriction on development of a formalised remote/automatic crossing layout, with lights/barrier equipment potentially located some distance from the actual alignment.

Long Drove Road in this location appears in average surface condition, with no road markings and substandard lane width with passing places. The road has straight approaches on both sides of the crossing however there is a slight kink on the Up side alignment, that could present a challenge for sighting unless some level of vegetation clearance was applied. The road speed is assumed to be a 60mph national limit in the absence of any other evident restriction signage. It is unclear what good practice guidance would recommend for this location, given the unclassified nature of the road and the immediate rural surroundings. As noted earlier any MCB-OD Mk2/CCTV installation at this location would require significant work to alter the alignment of the roadway and may have been one of the factors for not installing an AHB/AOCL originally. As referenced previously, any crossing control intervention would be subject to bridging/closure/diversion being discounted as practical options.

Figure AB7 – Waldersea Site Overview

Figure AB8 – Looking North East Along Long Drove Road

Redmoor Automatic Open Crossing Locally Monitored (AOCL) (WIG 92m 09ch)

This installation is located on the unclassified Redmoor Lane that runs between the South Brink district of Wisbech down to Begdale. This is approximately 2 miles north east of the Waldersea TMO crossing.

An initial site assessment identifies an elderly ABCL installation in moderate to poor condition, and with most original equipment largely intact. All four incandescent light installations remained intact as of 2018, in reasonable original condition. The original AOCL indicator lights are also intact in both directions. The "bomac" surface has been completely removed as part of recent resurfacing, with the edge kerb stones being all that remain as an outline. The rails appear to have been severed on both sides as part of this work. Beyond the severed points, the rails remain in situ either side of the crossing with some light vegetation encroachment. This location presents another unique constraint being situated immediately next to a form of drainage culvert on the north side of the crossing. This restricts crossing equipment on the Wisbech side into a narrow strip between the road and the edge of the culvert, with the adjacent rail bridge running directly off Redmoor Lane. The original REB installation is still present on the Wisbech side of the alignment however, this is not in a secure condition and appears to have been gutted of operational equipment.

Redmoor Lane in this location appears in moderate to poor surface condition with partial road markings in similar condition and narrow lane width. The road has straight approaches on both sides of the crossing. The road speed appears to be a 60mph national limit on both sides of the crossing, however the presence of residential properties in the area suggests that lower advisory speeds may be aspirational at some point in the future. Current good practice guidance for installation of new/upgraded level crossings for heavy rail project interventions, would likely recommend a full barrier MCB-OD Mk2/CCTV installation for this location as a minimum requirement. This would be subject to bridging/closure/diversion being discounted as practical options.

Figure AB9 – Redmoor Site Overview

Figure AB10 – Looking West Along Redmoor Lane

Wisbech Bypass Automatic Open Crossing Locally Monitored (AOCL) (WIG 92m 26ch)

This installation is located on the A47 Wisbech Bypass road that runs around the east side of Wisbech town. This is approximately 0.5 miles north of the Redmoor AOCL crossing.

An initial site assessment identifies the remains of another elderly ABCL installation in very poor condition, with most original equipment missing. All four incandescent light installations were missing as of 2018, with only the combination AOCL indicator light post and fittings remaining. The "bomac" surface has been completely removed as part of a recent resurfacing effort, with most traces of the original alignment being limited to a tarmac patch outline. The rails appear to have been severed on both sides as part of this work. Beyond the severed points, the rails remain in situ either side of the crossing with some moderate to heavy vegetation encroachment. The original REB installation is still present on the March side of the alignment and appears to be in a secure condition (although condition of interior components is unknown).

The A47 Wisbech Bypass in this location appears in moderate to good surface condition with full road markings, as would be expected of a major A road. The road has reasonably straight approaches on both sides of the crossing with the east side approach curving gently off to the north, without affecting sigh lines. The road speed is 60mph on both sides of the crossing, and direct observation indicates the route is used by several commercial and heavy goods vehicles. Current good practice guidance for installation of new/upgraded level crossings for heavy rail project interventions, would likely recommend a full barrier MCB-OD Mk2/CCTV installation for this location as a minimum requirement. This would be subject to bridging/closure/diversion being discounted as practical options. Given the A47's current designation, it may well be possible that a new heavy rail crossing installation would be unacceptable from a risk ranking point of view.

Figure AB11 – Wisbech Bypass Site Overview

Figure AB12 – Looking East Along A47 Wisbech Bypass

Weasenham Lane Traincrew Manually Operated (TMO) Crossing (WIG 93m 15ch)

This installation is located on Weasenham Lane unclassified Road connecting the B198 in the west to Churchill Road in the east. This is situated in an industrial estate area approximately one mile north of the A47 Wisbech Bypass AOCL crossing, on the geographical rail alignment.

An initial site assessment identifies a former TMO crossing installation in moderate to poor condition in line with the period of disuse. A single manual wooden gate and concrete posts remained intact on the Up side as of 2018. The Down side gate is missing completely, and no traces of the original post locations remain.

The original alignment crossing the roadway has disappeared completely, and there is no evidence of tarmac patching at the crossing site itself. This suggests that the road was resurfaced in its entirety at this location, since the original crossing structure was removed. The status of the rails south of the crossing is unknown due to substantial overgrowth between industrial units, however these are assumed to remain based on analysis of satellite imagery. The rails have been removed to the north of the crossing site, with only a dirt track and corrugated barrier indicating where the original alignment led. No other visible infrastructure remains, although this could feasibly be obscured by vegetation growth on the south side of the crossing.

Weasenham Lane in this location appears in average surface condition, with full road markings and standard lane width, albeit the markings are somewhat faded. The road has straight approaches on both sides of the crossing, however there is a gentle curve to the south on the Up side alignment which would not likely affect sighting. The road speed is assumed to be a 30mph limit for a built up industrial area, in the absence of any other evident restriction signage. Current good practice guidance for installation of new/upgraded level crossings for heavy rail project interventions, would likely recommend a full barrier MCB-OD Mk2/CCTV installation for this location as a minimum requirement due to the heavily commercialised/industrial nature of the location. This would be subject to closure/diversion being discounted as practical options.

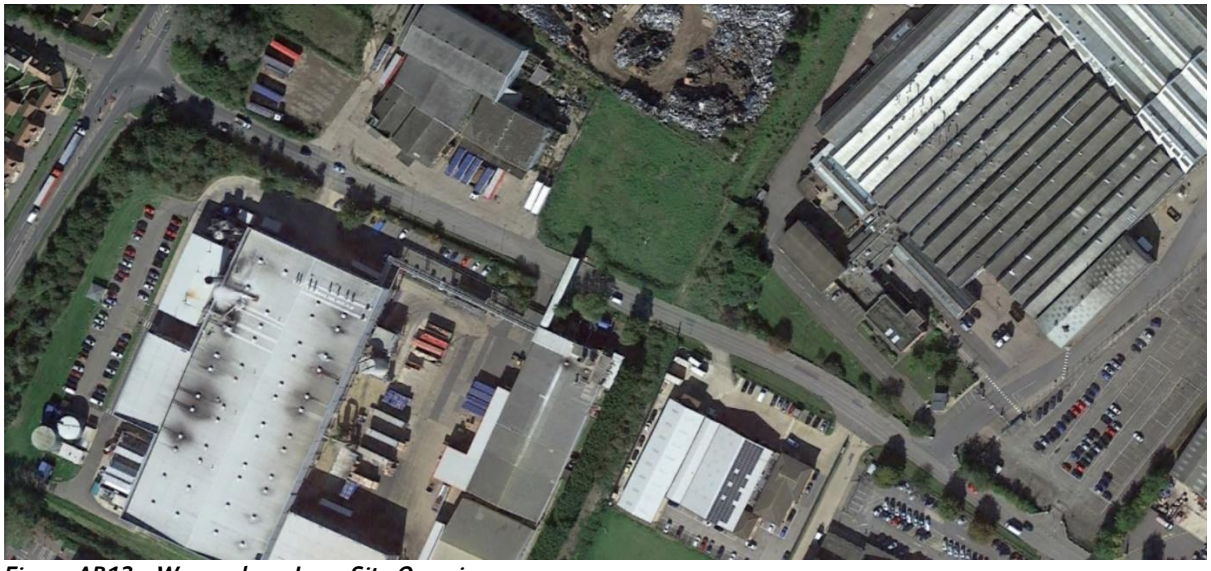


Figure AB13 – Weasenham Lane Site Overview

Figure AB14 – Looking West along Weasenham Lane

B1.2 User Worked/Footpath Crossing Interfaces

Clarkes User Worked (UWC) Crossing (WIG 86m 48ch)

This location falls between Whitemoor Junction and Elm Road AHB. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and wooden crossing boards spanning the track. It is unclear if these are still actively maintained by the rail authority. The crossing appears to connect a local farm on the Up side of the alignment to adjacent fields on the Down side. The nearest identifiable landmark defined on Ordnance Survey map resources is Three Corner Cut.

Figure AB15 – Unnamed User Worked Crossing Site Overview

Sheldrach User Worked (UWC) Crossing (WIG 87m 10ch)

This location falls between Elm Road and Chain Bridge AHB crossings. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and a dirt road alignment spanning the track. It is unclear if these are still actively maintained by the rail authority. The rails appear to remain in situ. The crossing appears to connect a local farm on the Up side of the alignment to the

B1101 Elm Road on the Down side. This appears to be the primary vehicular access for Elm Tree Farm as defined on Ordnance Survey map resources.

Figure AB16 – Unnamed User Worked Crossing Site Overview

Fishers User Worked (UWC) Crossing (WIG 87m 54ch)

This location falls between Chain Bridge AHB crossing and Coldham TMO crossing. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and a dirt road alignment spanning the track. It is unclear if these are still actively maintained by the rail authority. The rails appear to be missing or buried under dirt. The crossing appears to connect a local farm on the Up side of the alignment to adjacent fields on the Down side. This appears to be secondary vehicular access for Chain Bridge Farm as defined on Ordnance Survey map resources.

Figure AB17 – Unnamed User Worked Crossing Site Overview

Ballast Pit User Worked (UWC) Crossing (WIG 88m 21ch)

This location falls between Chain Bridge AHB crossing and Coldham TMO crossing. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and a dirt road

alignment spanning the track. It is unclear if these are still actively maintained by the rail authority. The rails appear to remain in situ. The crossing appears to connect a local farm on the Up side of the alignment to adjacent fields on the Down side. This appears to be secondary vehicular access for Rutlands Farm as defined on Ordnance Survey map resources.

Figure AC18 – Unnamed User Worked Crossing Site Overview

Crellins and Heads King User Worked (UWC) Crossings (WIG 89m 69ch and 90m 21ch)

These locations fall between Coldham and Waldersea TMO crossings. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and a dirt road alignment spanning the track at both locations. It is unclear if these are still actively maintained by the rail authority. The rails appear to remain in situ, although are heavily overgrown at the northernmost site. The crossings appear to connect a local farm on the Down side of the alignment to adjacent fields on the Up side. These appear to be secondary vehicular access for Fourscore Farm as defined on Ordnance Survey map resources.

Figure AB19 – Unnamed User Worked Crossings Site Overview

Co-Op No. 1 and No. 2 User Worked (UWC) Crossings (WIG 90m 42ch and 91m 00ch)

These locations fall between Waldersea TMO crossing and Redmoor Lane AOCL. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and wooden crossing boards/dirt road alignment spanning the track. It is unclear if these are still actively maintained by the rail authority. The rails appear to remain in situ at both locations. The crossings appear to connect local farms and Bet Drove on the Up side of the alignment to adjacent fields on the Down side. The nearest identifiable landmarks appear to be Lillypool House, and Jew House Cottages as defined on Ordnance Survey map resources.

Figure AB20 – Unnamed User Worked Crossings Site Overview

Crooked Bank Road and Holly Bank User Worked (UWC) Crossings (WIG 91m 32ch and 91m 42ch)

These locations fall between Waldersea TMO crossing and Redmoor Lane AOCL. Analysis of satellite imagery does not indicate gates or crossing infrastructure at either location; however the southernmost site is heavily overgrown. The rails appear to remain in situ at both locations. The crossings appear to connect local farms and Belt Drove on the Up side of the alignment to adjacent fields on the Down side. The two crossings appear to serve formally defined tracks, these being Crooked Bank and Narrow Drove respectively, as defined on Ordnance Survey map resources.

Figure AB21 – Unnamed User Worked Crossings Site Overview

Broad Drove User Worked (UWC) Crossing (WIG 91m 78ch)

This location falls between Waldersea TMO crossing and Redmoor Lane AOCL. Analysis of satellite imagery indicates the presence of gates either side of the rail alignment and wooden crossing boards spanning the track. It is unclear if these are still actively maintained by the rail authority. The rails appear to remain in situ. The crossing appears to connect local farms on both sides of the alignment along a local dirt road known as Broad Drove. The nearest identifiable landmark appears to be Whitehouse Farm on the Down side, as defined on Ordnance Survey map resources.

Figure AB22 – Unnamed User Worked Crossing Site Overview

New Bridge Lane Footpath (FPC) Crossing (WIG 92m 44ch)

This location falls between the A47 Wisbech Bypass AOCL and the Weasenham Lane TMO crossing. The site appears to be a former road alignment that was historically downgraded to permit foot/cycle traffic only. Bollards and concrete blocks have been installed to restrict vehicle access, which appear to be a recent addition, possibly installed when the rail alignment was tarmacked over. This crossing is not listed on the historical Quail map shown in Figure 2, so the downgrade may have occurred on construction of the A47 Wisbech bypass, with traffic diverted accordingly.

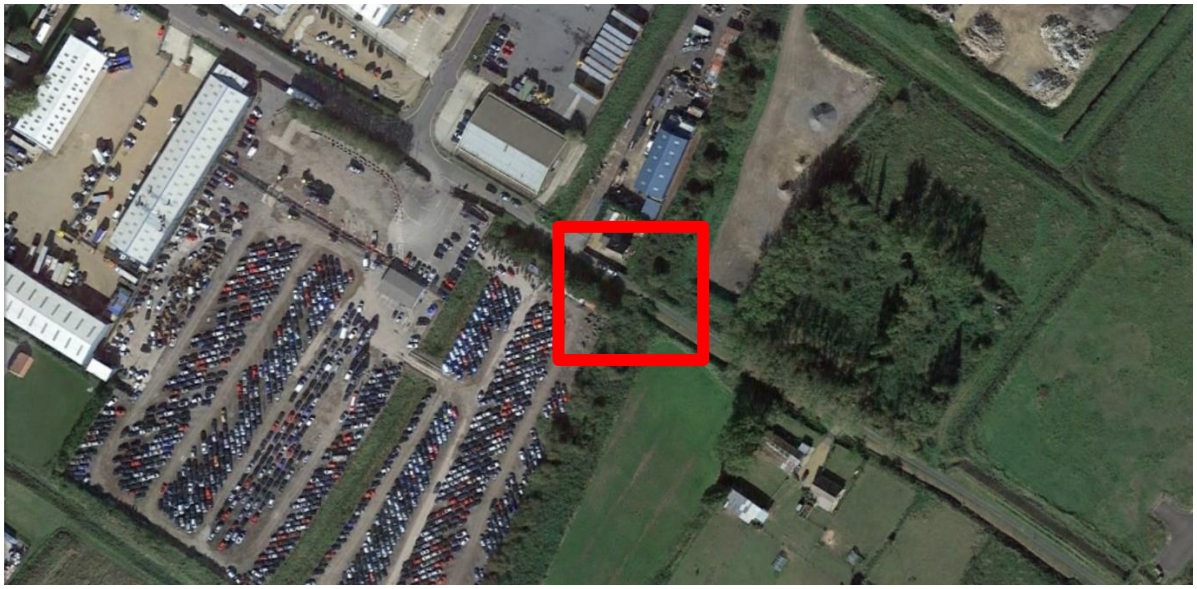
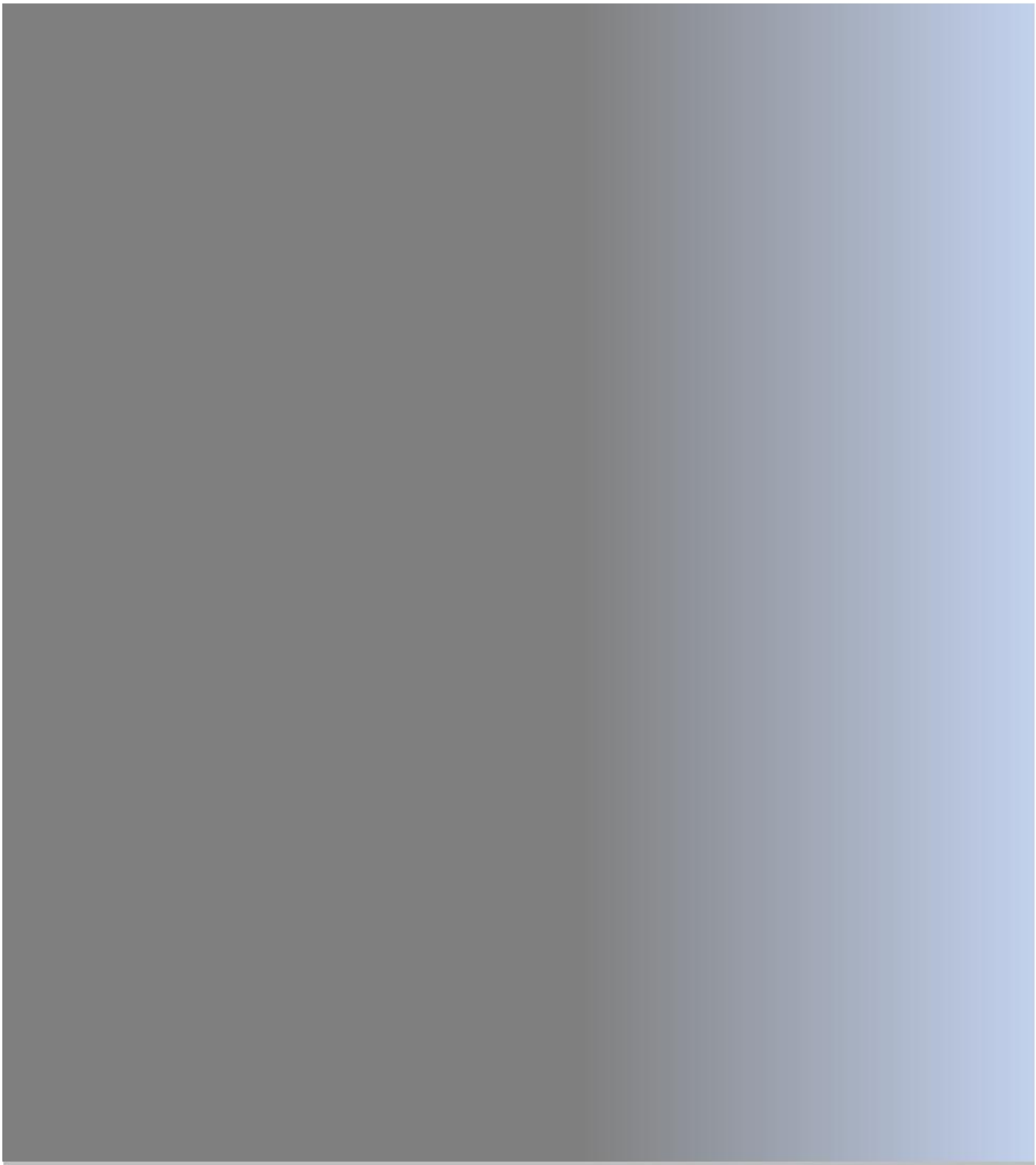


Figure AB23 – New Bridge Lane Site Overview

Figure AB24 – Looking East Along New Bridge Lane



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