

Date: 12 March 2014

Item 18: Structures and Tunnels Investment Portfolio

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**This paper will be considered in public**

## **1 Summary**

- 1.1 The Committee is asked to note this paper and to recommend to that the Board approve the increase in Financial and Project Authority being sought in relation to the Structures and Tunnels Investment Portfolio (STIP).
- 1.2 At its meeting on 26 February 2014, the Projects and Planning Panel considered a paper on the STIP and endorsed the authority requests.

## **2 Recommendations**

- 2.1 **The Committee is asked to note the paper and recommend that the Board:**
  - (a) **authorises an increase in Financial Authority of £38.0m to a total authority of £232.5m, funded from Management Contingency for the Structures and Tunnels Investment Portfolio (STIP); and**
  - (b) **authorises additional Project Authority of £48.6 m to a total authority of £136.8m, to allow the four projects that form Work Package 1 in the STIP to progress to detailed design and for advance works to commence, prior to construction contract award, and to start the main construction works on the Chiswick Bridge Refurbishment project, noting that Procurement Authority for individual contracts within the STIP will be sought in accordance with the levels set out in Standing Orders.**

## **3 Background**

- 3.1 Due to long-term underinvestment, some key tunnels and structures on the Transport for London Road Network (TLRN) are in very poor condition and represent a risk to network safety and reliability. Some assets already have load restrictions in place and reactive and minor works are no longer sufficient to maintain their function or serviceability. If not addressed, further restrictions will be essential to maintain safety and this will be at the expense of network reliability.
- 3.2 The STIP comprises strengthening, refurbishment or replacement of eight structures on the TLRN, which have been identified as having serious structural and/or safety risks. The STIP is pivotal in ensuring TfL meets the key objectives of the Mayor's Transport Strategy: delivering an efficient and effective transport system, reducing operating costs and bringing our assets up to a good state of repair.
- 3.3 On 27 March 2013, the Board approved award of an Early Contractor Involvement (ECI) Framework for STIP. The Board also requested the provision of further information on the criteria used to assess structural condition and a summary of the

current condition levels of TfL Surface assets. This has been included for information in Appendix 1 of this paper.

- 3.4 It is now clear that the original cost estimates that were developed to support the STIP business case was significantly understated and the Estimated Final Cost (EFC) of the eight projects within the STIP has increased substantially. Papers seeking an additional £47.9m of Financial Authority to cover the forecast increase in EFC from £194.4m to £242.3m were considered by the Projects and Planning Panel at its meeting on 9 January 2014.
- 3.5 Following a request from the Panel at its January meeting, and on the advice of the Independent Investment Programme Advisory Group (IIPAG), a value engineering exercise was completed which resulted in reductions in the cost increases now sought across a number of the projects, particularly the Work Package 1 projects, but also the Chiswick Bridge Refurbishment project. These cost reductions are valued at £10m across the STIP. The EFC of the eight projects within the STIP now stands at £232.5m and the additional Financial Authority sought is £38.0m. These costs are considered robust and have been confirmed by assurance reviews. A revised paper was then submitted to the 26 February meeting of the Panel where the Panel endorsed its onward submission to the Committee.
- 3.6 It is proposed to fund the additional increase in costs of £38.0m by a drawdown of Management Contingency, for which £64.0m was originally provided centrally in the business plan against the STIP. Transferring £38.0m would leave a residual balance of £26.0m, which is judged sufficient to cover the remaining risks.

## **4 Description**

- 4.1 The eight STIP projects have been split into three work packages and awarded to three framework contractors. They have been grouped into packages due to the similarity of structure types, geography or constraints. A location map is included as Appendix 2.
- 4.2 Work Package 1 comprises the replacement of four road-over-rail bridges (Upper Holloway Bridge on the A1, Power Road Bridge on the A406, Highbury Corner Bridge on the A1, and Ardleigh Green Bridge on the A127), all over Network Rail's Anglia network.
- 4.3 Work Package 2 comprises Chiswick Bridge refurbishment on the A316, replacement of the Woodlands Retaining Wall on the A406, and refurbishment of Fore Street Tunnel, also on the A406.
- 4.4 Work Package 3 covers the full strengthening and refurbishment of Hammersmith Flyover on the A4.
- 4.5 All of the structures are severely constrained in working areas and have substantive land and utility works that have a large impact on the programme, costs and risks. The Work Package 1 bridges in particular require the utility services to be removed and relocated from the structures before they can be demolished. The options of under-track crossings have been explored, but found to be more costly. Therefore, all four of the bridge replacements require the construction of a separate service bridge as part of the advance works. The diversions and construction of the service

bridges were not included separately in the original business case estimates and account for a significant element of the additional cost.

- 4.6 An overview of each of the projects and their specific complexities, along with the findings from the value engineering review are summarised below.
- 4.7 **Upper Holloway Bridge** – The project comprises the replacement of the main bridge deck during a single closure of the A1 and a Network Rail Christmas 2015 blockade. Value engineering has identified that opportunities exist to refurbish rather than replace the abutments which then allows for reduced temporary works costs and replacement of the deck during a single closure. This option is being progressed during detailed design and the EFC has been calculated with cost reductions of £4.3m on an abutment replacement option. There is also the potential for further cost reductions by coordinating the bridge closure with Network Rail closures for electrification works to the rail line under the bridge and these will be pursued prior to Gate 4. However, due to the advance booking requirement of rail possessions, the diversion of services and provision of a service bridge are required to commence during the detailed design stage. Relocation of rail signals, cabinets and station modifications to accommodate the new service bridge will also be required and these are reflected in the level of Project Authority being requested at this stage.
- 4.8 **Power Road Bridge** – The existing structure needs to be demolished in sections, with new bridge sections constructed adjacent with partial traffic diversion, although four lanes of traffic will be maintained throughout the construction. The footprint of the bridge is constrained by business and residential properties and the works necessitate the purchase of a property and temporary access to land. The property purchase is a risk, but this is expected to be satisfactorily resolved by April 2014. However, it was agreed during the recent assurance review that this risk should be included within the Quantified Risk Assessment and this has added £500k to the project EFC. There are services on both sides of the structure including high voltage electricity, a high pressure gas main, mains electricity, telecoms, cable television and a 30 inch diameter water pipe. The solution to minimising the impact of diverting these services is to leave the high voltage electricity cable in situ on the east side of the bridge with the remaining services being diverted on a new dedicated service bridge. Significant temporary works are required due to the complexity of the phased construction, which prevents disruption to road and rail services, while diverting or avoiding the significant utility services in and around the structure. A value engineering review has not identified any further opportunities for cost reductions at this stage, given the constrained nature of the site.
- 4.9 **Highbury Corner Bridge** – Both TfL and Network Rail own parts of the bridge structure and the entire structure will be replaced as it is both economically and logistically more advantageous. There are significant services within the bridge itself including a high pressure gas main, electricity cables, telecoms and a water main; all of which will have to be diverted into the station forecourt after this section of the deck is replaced. As with the other bridges in this Work Package, significant temporary works are required due to the complexity of the phased construction, which minimises disruption to road and rail services, while diverting or avoiding the significant utility services in and around the structure. A value engineering review has identified cost reductions of £1.4m by de-scoping a section of the structure that requires the demolition of a Network Rail building on the east side of the structure.

The main project objective of replacing the highway structure would be achieved while deferring the structural improvements on the footway for a short period. This would also de-risk the project.

- 4.10 **Ardleigh Green Bridge** – There are significant utility services within the bridge deck which are to be diverted on a dedicated service bridge which will be constructed as part of the advance works to de-risk the main works, shorten the programme and enable savings. The optimum solution revealed through a value engineering review relies on reducing the number of traffic lanes from two to one in each direction allowing the demolition and rebuild of the bridge in two halves. This negates the need for building a temporary two lane diversion and delivers cost reductions of £3.3m over alternative options, while shortening the programme and de-risking conflict with adjacent Crossrail works.
- 4.11 **Chiswick Bridge** is a Grade II\* listed structure. The planned works include concrete repairs to the internal bridge structure and the bridge parapet is to be reinforced with stainless steel and clad with salvaged Portland stone balusters or new replacements. Refurbishment works to the carriageway, footway and stairs as necessary are also planned. Temporary works are required to work on the river span soffit from a barge on the River Thames. River traffic will be maintained via the other two river spans. A value engineering review has identified cost reductions of £1.4m by de-scoping external concrete repairs.
- 4.12 **Woodlands Retaining Wall** – This structure retains the gardens of properties backing onto the A406 North Circular Road. There are a number of services running in the vicinity of the wall, including gas and electricity mains. The structure currently requires a temporary ‘catch frame’ to prevent the wall and overlying trees from collapsing onto the adjacent footway and the A406. The footway has been closed since 2010. The renewal works involve replacing the existing wall using either a ground anchor system or a gravity wall which is dependent upon the results of consultation with local residents. Confirmation of the lowest cost option will be reviewed once the landowner responses have been received. No additional authorities are sought for this project at this stage.
- 4.13 **Fore Street Tunnel** – Since construction the tunnel has suffered from water ingress. The planned works include replacing water damaged mechanical and electrical equipment, sealing the tunnel to prevent further water ingress and providing a water management system to protect the structure and equipment in the future. The project has undergone a value engineering review which challenged the scope and construction methods. Options have been explored, including reviewing the option of closing tunnel bores. The optimum solution has a series of night time closures, as previously proposed. No additional authorities are sought for this project at this stage.
- 4.14 **Hammersmith Flyover** – The works comprise post tensioning to the remaining un-strengthened eleven spans, the replacement of the bridge bearings and drainage system, and the waterproofing and resurfacing of the flyover deck. The works commenced on site on 28 October 2013 following approval by the Committee of the increase in Project Authority enabling the project to move into the construction phase on 17 October 2013. No additional authorities are required.

## **Early Contractor Involvement**

- 4.15 Under the STIP framework awarded in April 2013, ECI supports the designers and TfL to develop and de-risk solutions by considering construction and buildability aspects up front. The delivery is in two stages: Stage 1 (ECI Phase) is the development from concept to a sufficiently detailed design to allow the construction costs to be agreed and for any advance works to be undertaken. Stage 2 involves the completion of the detailed design and the main construction works. The ECI approach is based on open book accounting with tendered overhead and profit percentages and with all sub-contract packages subject to market testing. During the ECI phase on STIP, TfL and the designer (Ramboll-Parsons Brinkerhoff) have worked with the contractors to refine the construction works estimates and identify and allocate risk to the party most suitable to manage it. Supplier costs, material costs and scope have been robustly challenged to ensure value for money.
- 4.16 The designer has been engaged on all packages since November 2012, following a mini-competition through TfL's existing Engineering and Project Management Framework (EPMF).
- 4.17 The STIP project teams, comprising the designer, contractor, Network Rail and TfL (sponsor, commercial and delivery teams) have been co-located since April 2013. The core principles of the integrated team approach are to provide economic, optimal design solutions while minimising construction risk and seeking to minimise network disruption.
- 4.18 Following agreement of the Target (construction) Cost, it is intended that the design contract novates from TfL to the contractor. In the event that a Target Cost could not be agreed, the detailed design and main construction works would be tendered through the framework as a mini-competition for Design and Build (D&B) works.

## **5 Financial Implications**

- 5.1 It is clear that the original estimates developed to support the business case significantly understated key cost components, including staff costs, designer costs and surveys, ECI costs of contractors, utility works, land costs, and costs associated with Network Rail.
- 5.2 On the advice of the IIPAG, a value engineering exercise has recently been completed and has resulted in cost reductions of £10m across the STIP. The costs presented in this paper are considered robust with an appropriate balance between construction costs and minimising construction disruption.
- 5.3 The reasons for the errors in the original estimating have been reviewed and addressed for the estimates in this paper and measures taken to ensure lessons will be learnt across the portfolio and the wider Surface Transport business.
- 5.4 The robustness of the current cost estimates have been confirmed by assurance reviews and the staff, designer and ECI costs have been benchmarked favourably against industry averages. Utility, land and Network Rail costs have also been challenged and are based on actual quotations or professional evaluations provided to the projects. Utility costs are being proactively managed and centrally coordinated which is resulting in lower cost estimates at the detailed stage through shared trenches and reduced scope; as a result a 10 per cent reduction has been

assumed. Furthermore, the base construction costs are in line with benchmarking undertaken by Turner and Townsend.

- 5.5 The EFC of the STIP is now £232.5m; £38.0m in excess of the approved Financial Authority of £194.4m. The additional £38.0m sought can be funded from centrally held Management Contingency, of which STIP contributed £64.0m.
- 5.6 An increase in Project Authority of £48.6m is required to allow the four projects that form Work Package 1 in the STIP to progress to detailed design and for advance works to commence, prior to construction contract award, and to start the main construction works on the Chiswick Bridge Refurbishment project.
- 5.7 Work Package 1, the four bridge replacements, represents £36.1m of the forecast increase in EFC and will be subject to further assurance review prior to the award of the construction contracts and commencement of the main works. The projects' development through this current stage will allow further risk reduction as essential land permissions, track possessions and utility diversion costs are confirmed by third parties. During this stage the construction costs will also be refined as the detailed design packages will be competitively tendered as subcontract works.
- 5.8 Currently, the contractors have been appointed to the framework to deliver the EC1 and D&B phases. However, approval to move into the D&B phase will be subject to future submissions, at which point further authorities will be sought.
- 5.9 Table 1 below summarises the increase in Financial and Project Authority now sought across the STIP.

Work Package	Title	Financial Authority			Project Authority		
		Approved (£m)	Increase Requested (£m)	Total (£m)	Approved (£m)	Increase Requested (£m)	Total (£m)
WP 1	A127 Ardleigh Green Bridge ST-PJ315C – SC.2717	22.458	9.202	31.660	2.160	9.390	11.550
	A1 Upper Holloway Bridge ST-PJ316C – SC.2718	20.472	4.956	25.429	1.800	9.740	11.540
	A1 Highbury Corner Bridge ST-PJ308C – SC.2719	15.222	10.696	25.918	1.150	9.580	10.730
	A406 Power Road Bridge ST-PJ363C – SC.2470	22.249	11.261	33.511	1.750	10.220	11.970
WP 2	A406 Fore Street Tunnel ST-PJ365C SC.2471	23.773	(0.396)	23.377	1.540	0	1.540
	A316 Chiswick Bridge ST-PJ362C – SC.2469	7.869	3.483	11.352	1.680	9.672	11.352
	A406 Woodlands Retaining Wall ST-PJ361C – SC.2468	4.687	(0.230)	4.457	1.360	0	1.360
WP 3	A4 Hammersmith Flyover (Phase2) ST-PJ406C – SC.2527	77.703	(0.924)	76.779	76.779	0	76.779
<b>Total</b>		<b>194.433</b>	<b>38.049</b>	<b>232.483</b>	<b>88.219</b>	<b>48.602</b>	<b>136.821</b>

**Table 1 – Summary of the Increases Sought in Financial and Project Authority for STIP**

## **Risk and Management Contingency**

- 5.10 Financial Authority of £194.4m for STIP is already in place and reflected in the TfL Business Plan approved in December 2012. In addition, centrally held Management Contingency included a £64m allocation in respect of STIP, totalling £258.4m. The current EFC is £232.5m plus centrally held Management Contingency at £13.9m, totalling £246.4m. It is recommended that the difference of £12.1m is continued to be held in central Management Contingency to provide additional assurance that there is adequate financial cover for the STIP.
- 5.11 The total portfolio risk allowance, across all three work packages, of £34.5m represents an on-cost to construction costs of 22 per cent, or 15 per cent of portfolio EFC. The risk provision has been benchmarked and is in line with industry norms as confirmed through the assurance review. The reduced Management Contingency is calculated using the risk analysis and reflects an increased confidence in the robustness of the estimating and reduction in spread of risk to the cost pressures.
- 5.12 The Hammersmith Flyover (Work Package 3) works have commenced on site and the quantified risk analysis of £11.3m represents 15 per cent of EFC. This reflects the uncertainties regarding physical conditions of the structure and access arrangements; two key risks which TfL is best placed to manage and therefore have been kept outside the target cost contract.
- 5.13 Work Package 2 has a risk allowance of £4.0m, representing 10 per cent of EFC. This is in line with the lower anticipated risk exposure of the projects and the fact that two of the three projects within this work package have detailed design completed.
- 5.14 Work Package 1 (the four road-over-rail bridges) has completed concept design and is in the early stages of detailed design. There are some uncertainties regarding the cost of the utilities needing to be diverted and the remaining detailed estimates are expected soon, as well as risks around railway interfaces and possession planning. The risk allowance of 17 per cent of EFC reflects this and also takes into account unknowns around inflation factors and the value engineering cost reductions. The risk provision should reduce as the projects' develop through detailed design and the construction risks are better understood and mitigated.

## **6 Commercial and Resources**

### **Commercial**

- 6.1 TfL's commercial team has supported and assured each of the contractors' procurement of subcontracts during the EC1 phase. This has provided TfL with the opportunity to fully engage with the supply chain, and has resulted in 100 per cent visibility of subcontractor costs. The process is aligned to current best practice and utilised on other major infrastructure projects within the UK. Value for money has been and will be demonstrated through effective competition and robust negotiations with subcontractors.



## **Resources**

- 6.2 Existing internal TfL resources will be deployed to carry out the project and contract management of the works. These are included within the costs outlined in this paper and no additional resources are required. ECI design costs include both the Contractors and the Designers (Ramboll-Parsons Brinkerhoff).
- 6.3 In addition to the value engineering review, the STIP has recently been the subject of a thorough review of roles and responsibilities and as a result, measures have been taken to strengthen the experience of the project delivery teams and further reinforce the delineation between sponsor and delivery.

## **7 Benefits**

- 7.1 Delivery of the STIP has been aligned to Surface Transport's 10 Principal Outcomes on the TLRN. While the projects have been reviewed to meet all outcomes where possible, the STIP's principal outcome is to ensure network safety and reliability, while considering the needs of other transport modes.
- 7.2 The works associated with the STIP will avoid restriction or permanent closure of the structures which would be required in the short to medium term if the works are not carried out. In addition the provision of service bridges at these key pinch points will provide future provision for utilities.
- 7.3 The value of prevention of fatalities and serious injuries is estimated at £3.5m.
- 7.4 The STIP's core design and construction approach has been to seek to minimise the impact on the movement of people and goods by both road and rail, balanced against the overall project costs. All of the bridges could be rebuilt in a more disruptive manner and construction methods have been challenged alongside the project requirements, design life and scope, to determine the optimum value solution.

## **8 Views of the Projects and Planning Panel**

- 8.1 At its meeting on 26 February 2014, the Projects and Planning Panel considered a paper on the STIP and supported the recommendations to the Committee. The Panel was provided with details of recommendations and findings by the TfL Programme Management Office and the IIPAG. The Panel was satisfied with the management responses to the findings.

### **List of appendices to this report:**

Appendix 1: Structural Condition Information.

Appendix 2: Location Map.

### **List of Background Papers:**

None

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### Structural Condition Information





The condition of the structures and tunnels is assessed using nationally accepted inspection procedures. This data informs investment planning and intervention priority; it also enables comparison and trending of asset condition. Five condition categories are used for Transport for London Road Network (TLRN) highway assets: Very Good, Good, Fair, Poor and Very Poor – these are shown in Table 1 below for bridges. Table 1 also shows the percentage of structures and tunnels currently (2013/14) in each category and the projected quantity in each category by 2021/22 based on the published TfL Business Plan investment profile. Figure 1 shows how the quantity of assets in each condition category changes over the Business Plan period.

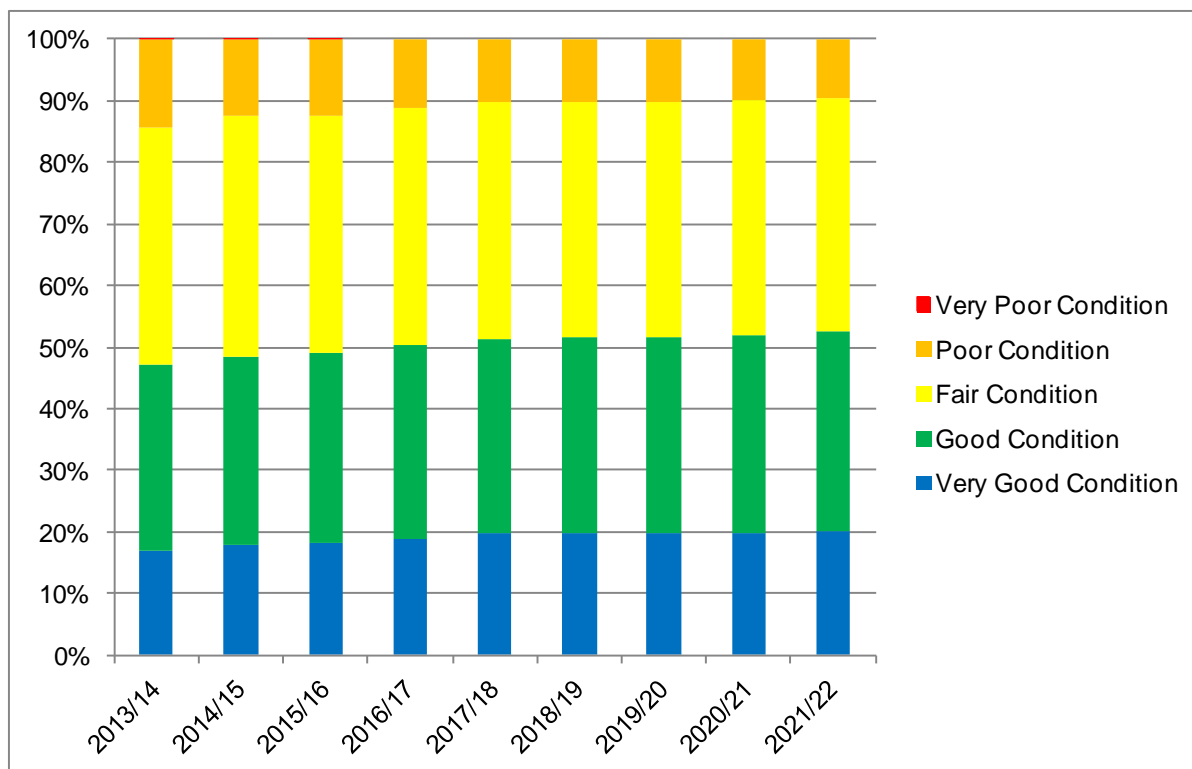
State of Good Repair (SOGR) is calculated using these condition categories; it is percentage of assets in the Very Good, Good and Fair categories. As such, SOGR in 2013/14 is 85.7 per cent and it is projected to be 90.3 per cent in 2021/22. The target range for SOGR is 90 to 95 per cent because deterioration and investment modelling has shown this to be a sustainable asset condition that maximises services and minimises whole life costs. This does not mean all the assets in the 5 to 10 per cent require immediate attention. While it is reasonable to assume that those assets classified as Very Poor require immediate attention, those in Poor may not. Instead, the Poor category indicates the asset needs to be considered in more detail and their intervention prioritised using the established Value Management process which takes account of condition, risk to safety, risk to network reliability, and whole life costs.

Figure 2 shows how SOGR for structures and tunnels changes between 2012/13 and 2021/22 for (i) the Business Plan investment; and (ii) an increased level of investment that would achieve a higher SOGR (93.7 per cent). Investment modelling indicates that the current level of Business Plan investment will achieve the lower bound of the SOGR range by 2021/22. Continued application of the value management process, updated condition information and subsequent revision of the investment modelling each business planning round will provide a firmer picture of the relationship between SOGR and investment need. The current investment profile indicates a stepped reduction in investment level post 2016/17 while still maintaining the minimum target level. It is intended that those structures identified to be in a state of poor or very poor be kept under review and the target percentage state of good repair refined.

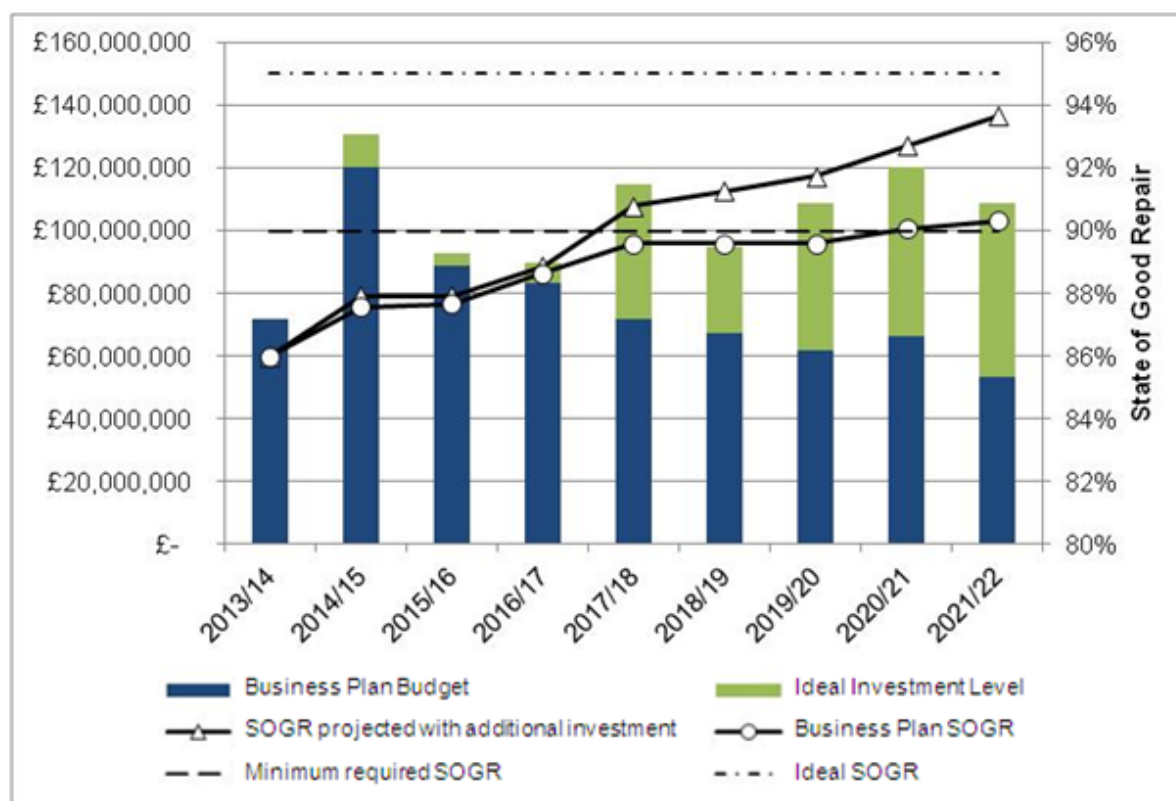
SOGR takes account of all component types, their importance and size, from main beams and columns to expansion joints, drainage and bearings. Therefore, while STIP represents major works and investment it only covers a small proportion of the total assets. Overall, STIP will improve SOGR by around 1 per cent to 1.5 per cent - the remaining improvement in SOGR (over 3 per cent) will be delivered by business-as-usual renewals to individual components like expansion joints. At the same time, once the STIP backlog is addressed, it is the right level of BAU capital renewals that will sustain SOGR and prevent STIP type peaks re-occurring.

**Table 1: Examples of condition categories for bridges**

Category	Description	Photograph	per cent of assets	
			13/14	21/22
<b>Very Good</b> BCI 90-100	No functional or structural defects	Any element or material in as-new condition	16.8	20.1
<b>Good</b> BCI 80-89	Some minor defects that have limited impact on the structure  Examples include localised flaking of paintwork and weathered or stained concrete		30.3	32.4
<b>Fair</b> BCI 65-79	Minor to moderate defects that may impact on the durability of the structure and function  Examples include small areas of exposed reinforcement and failed paint		38.6	37.8
<b>Poor</b> BCI 40-64	Moderate defects that are likely to impact on the function of the structure  Examples include significant areas of exposed reinforcement and exposed and rusting metal		14.2	9.7
<b>Very Poor</b> BCI 0-39	Major structural defects and some components on the bridge may be failed, requires attention		0.1	0.0



**Figure 1: Percentage of structures and tunnels asset in each condition category**



**Figure 2: Business Plan Budget against State of Good Repair**

## **Consequences of Delaying or Deferring Investment**

### **Ardleigh Green Bridge**

As the condition of the bridge continues to deteriorate the load carrying capacity will reduce. In addition to the current temporary measures the following actions will need to be taken to ensure the continued safety of those travelling by road and rail:

- Weight restriction – prohibiting vehicles above 7.5t and a further reduction in the speed limit from 40mph to 30mph (possibly lower) to reduce the risk of vehicle impact on the parapets; or
- Reduction in the number of running lanes from four to two
- Increased inspections and monitoring
- Installation of debris netting or crash decking below the bridge deck to prevent debris falling onto the tracks. This is likely to lead to service disruption and reliability issues on the railway
- Longer term, closure of the bridge.

### **Power Road Bridge**

The condition of the bridge is critical and loose concrete has previously fallen onto the tracks. The load carrying capacity is sensitive to the condition and as the reinforcement and concrete deteriorate it will reduce. In addition to the current temporary measures the following will be required to ensure the continued safety of those travelling by road and rail:

- Weight restriction – prohibiting vehicles above 18t and possibly in conjunction with a reduction in the speed limit from 40mph to 30mph (possible lower) to reduce the risk of vehicle impact on the parapets; or
- Reduction in the number of running lanes from four to two
- Installation of crash decking or netting to prevent debris falling onto the railway. This is likely to lead to service disruption and reliability issues on the railway.
- Longer term, closure of the bridge.

### **Highbury Corner Bridge**

The condition of the bridge is critical to the load carrying capacity. If the replacement works are not undertaken as planned then a weight restriction will need to be imposed limiting vehicles to below 7.5t, possibly in conjunction with lane restrictions. This will impact on the operation of the network and result in increased congestion and delays to journeys. Bus services will also need to be diverted.

### **Upper Holloway Bridge**

The condition of the secondary deck members spanning between the main beams is critical. The following actions will be required to ensure the continued safety of those travelling by road and rail:

- Weight restriction – prohibiting vehicles above 7.5t and possibly in conjunction with a reduction in the speed limit from 30mph to 20mph to reduce the risk of vehicle impact on the parapets; Reduction in the number of running lanes from four to two. This will require the removal of the bus lanes.
- Installation of crash decking or netting to prevent debris falling onto the railway. This may require restrictions on the operation of the railway due to substandard headroom clearance.
- Installation of improved barriers to prevent vehicle collision with the parapets. This will require removal of the bus lanes.

- Longer term, closure of the bridge.

### **Chiswick Bridge**

If the works do not proceed as planned, then the following measures will need to be implemented:

- Weight limit imposed impacting bus services
- Measures to prevent debris from dropping into the Thames and onto river traffic
- Install barriers to protect the parapets the available width of the footways
- Reduction in the number of traffic lanes to allow provision for cyclists which will be displaced from the combined footway/cycleway
- Reduction in amenity as crowds will be prevented from accessing the footways during boat race and other event days.

### **Fore Street Tunnel**

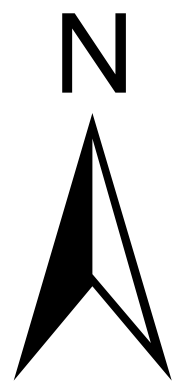
If the works do not proceed as planned, then the following measures will need to be implemented:

- More frequent and longer ad hoc maintenance and tunnel closures
- Disintegration of the carriageway deck slab
- Component failure of lighting, mechanical and electrical equipment
- Continued water damage of the fabric of the tunnel.

### **Woodlands Retaining Wall**

The existing structure has failed and is supported by a temporary steel frame, which occupies the footpath. If the works do not proceed as planned, the Woodlands temporary retaining wall would stay longer in place at a greater risk of collapse. Should this collapse of the frame lead to retained ground falling onto the A406, there would be lane closure and significant traffic disruption.





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