

Feasibility Appraisal  
in respect of  
The Subway  
at the  
Royal Shrewsbury Hospital  
for and on behalf of  
The Shrewsbury and  
Telford Hospital  
NHS Trust

August 2015



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## Executive Summary

This report provides an appraisal of the various options considered to be available to The Shrewsbury and Telford NHS Trust (SaTH) in relation to the below ground duct/subway at the Royal Shrewsbury Hospital site. Previous technical reports have been prepared by Couch Consulting Engineers and Martech and this report makes reference to their findings.

The report only considers the below ground duct/subway which is external to the main building and extends from the boiler house to the former maternity building. For reference purposes this is known as sections 1, 2, 3, 4 (part) and 9. Johnson Fellows have inspected all of these sections in order to gain an appreciation of the structural inadequacies, and the building services that are located within.

We would concur with the aforementioned reports in that these sections of the below ground duct/subway are suffering from concrete decay in the form of carbonation which has resulted in corrosion of the reinforcement, exacerbated by chloride attack from road salts washed in through failed joints in the structure. From a visual perspective this does not appear too onerous to the naked eye but it must be appreciated that the carbonation is widespread, rendering the structure susceptible to collapse.

We have already advised that Capital/Operational Estates team at SaTH that the full length of the below ground duct/subway is in need of emergency propping and this should be introduced without delay. Indeed this was also recommended by Couch Consulting Engineers in March 2015. Johnson Fellows have prepared specifications for tendering purposes in this respect. At the same time, additional signage should be erected to confirm a weight limit of 8 tonnes per axle. This will inevitably result in heavy goods vehicles being temporarily diverted around the other estate road giving access to the complex.

Johnson Fellows have considered four principle options within this report:

- Permanent propping (in conjunction with temporary propping)
- Relocation of all building services and infilling the subway with aerated concrete
- Provision of a new structural raft over the subway
- Provision of a new access road

There are sub-options to each of the main options but this report recommends that permanent propping is provided to the below ground duct/subway extending from the boiler house to the former maternity building which should be executed in conjunction with the temporary propping. In addition, the main service road from Mytton Oak Road should be re-surfaced and a structural water proofing system introduced over the below ground duct/subway to reduce the effects of chloride attack.



## 1.0 Introduction and Background

- 1.1 Johnson Fellows LLP are instructed by SaTH to undertake an appraisal of existing reports, inspect the below ground duct/subway and consider various options in terms of a strategic solution to the failing structural condition of the subway. We received instruction from the Capital Projects team, following a tendering exercise via MultiQuote on 8<sup>th</sup> July 2015 and have been meeting with Derek Bolton and Tom Cullinane every Friday morning since to discuss progress, strategy and the merits of various options. The report prepared by Couch Consulting Engineers was included in the MultiQuote procurement package but we have subsequently requested and received the report prepared by Martech.
- 1.2 Johnson Fellows are familiar with the complex where Andrew Rowson has worked on and off the site over the last 33 years. We are aware that the former maternity building was the first building to be constructed on the new Copthorne Hospital site, later known as the Royal Shrewsbury Hospital North, RSH (N,) complex and this was built in the late 1960s. The Royal Shrewsbury Hospital South, (RSH (S)), complex was located on the opposite side of Mytton oak Road, where this site comprised single storey buildings emanating from the 1940s period with subsequent later additions. With the exception of the William Farr House, which is occupied by Shropshire Community Trust, the remainder of the site has been demolished and redeveloped for residential purposes.
- 1.3 Obviously prior to demolition the site was fully decommissioned including all below ground services the most prevalent of which included the steam main which originally connected between the maternity building on the RSH (N) site to the RSH (S) site. The next building to be constructed on the RSH (N) site was that of the pathology building which was built in the early 1970s. Looking back, it is evident where some strategic planning was implemented as the former maternity building and pathology building are linked by the underground duct/subway including associated building services.
- 1.4 The remainder of the RSH (N) site was developed in the mid 1970s, hence the below ground duct/subway was extended from pathology to the new boiler house, and thus is considered to be in the region of 40 years old. As discussed in a later section of this report, the below ground duct is suffering from decay which potentially is attributable to poor design, poor workmanship and insufficient cover between the roof of the subway and road way over.
- 1.5 Andrew Rowson can recall inspecting the subway in the mid 1980s where the steam main was suffering from the lack of maintenance where many joints were 'blown', thus releasing steam, which is obviously very hot and creates a humid environment. It is anticipated that this scenario was established to various extents for a good many years and is a contributory factor to the decay of the concrete structure.
- 1.6 For clarification purposes, the steam main emanates from the boiler house and extends below ground under the service road in sections 1, 2, 3 and 4 (part). Sections 4 (part) 5, 6, 7 and 8 extend below the main hospital complex and are outside the scope of this report. It is however recommended that a similar survey and report is commissioned for these sections so that a long term strategic plan is adopted. The steam main then enters section 9 which is below the main service road and connects between the pathology and former maternity buildings.
- 1.7 Johnson Fellows are aware that asbestos containing materials, believed to be asbestos insulating board (AIB), is present in sections 5, 6, 7 and 8 and an ongoing programme is in hand to remove/encapsulate these ACMs. Hence, at the time of our inspection these sections were sealed off and again we would reiterate are outside of the scope of this report.
- 1.8 No such ACMs are deemed to be present in sections 1, 2, 3, 4 (part) and 9 (previously removed), but as a precautionary measure any persons gaining access to the below ground duct/subway in these locations should wear disposable PPE at all times including FFP3 masks, disposable overalls, hard hats and steel toe capped Wellington boots.
- 1.9 It should be noted that formerly the RSH (N) complex extended to the north up to the boundary with Shelton Hospital which all formed part of the former Shropshire Health Authority site. The site has shrunk considerably as local NHS Trusts have evolved over recent years and thus the site is now land locked with little space available for future development. Indeed, Shelton Hospital has now been replaced by the Redwood Centre which is located adjacent to the boiler house on the RSH site and Shelton Hospital has been purchased for further residential development.
- 1.10 In preparing this report, Johnson Fellows have utilised the services of our preferred consultants as follows:

### **Building Services**

QODA Consulting  
21-23 Birmingham Road, Sutton Coldfield, Birmingham, B72 1QA  
[mike.smith@godaconsulting.com](mailto:mike.smith@godaconsulting.com)

### **Structural Engineers**

Latter Ramsay Consultants  
35-38 Guild Street, Stratford upon Avon, Warwickshire  
CV37 6QJ,  
[mike@latterramsay.co.uk](mailto:mike@latterramsay.co.uk)

## 2.1 Visual Inspection Survey

- 2.1 With prior arrangement with Steve Lewis, SaTH Mechanical Services Manager, Johnson Fellows undertook an inspection of the subway in sections 1, 2, 3, 4 (part) and 9 extending from the boiler house to the former maternity building. We were accompanied by one of the fitters, David Howels and our inspection took place on the afternoon of Thursday 6<sup>th</sup> August 2015.
- 2.2 We would point out at this stage that upon visual inspection of the below ground duct/subway, the structural defects are very sporadic and in isolated locations. No defects were found to be potentially the cause of imminent collapse independently, but overall the subway roof in particular is clearly showing signs of long term deterioration and thus, a solution to provide long term strategic support and/or diversion is fundamentally essential.
- 2.3 During our inspections we found the whole length of the subway to be relatively clean where it is evident that improvement works have been undertaken over recent years. We discovered that the steam main is currently adequately supported and well insulated with no real defects apparent other than a leaking joint at the far end of section 9 near the staircase leading down from the former maternity basement, this was reported to Estates at the time.
- 2.4 If we consider each section of the subway in turn, it can be observed via photograph 2 in Appendix A that severe spalling and corrosion of the reinforcement is apparent to the soffit of the roof section in isolated locations within section 1 nearest the boiler house. Similarly, in section 2 via photographs 4, 5 and 6 it is clear where there is insufficient cover to the reinforcement and the carbonation process has caused significant spalling.
- 2.5 Photograph 51 shows access chambers to the roof of Section 2 which are located in the service road between the boiler house and Estates Department (Appendix B). The same photograph show air vents within the verge which were introduced when the subway was extended between the boiler house and main building (section 4). There is a distinct lack of natural ventilation in sections 1, 2, 3 and 9 which form the original part of the below ground duct/subway.
- 2.6 Section 3 of the subway extends across what is now the main staff car park located opposite pathology and pharmacy. The staff car park was redeveloped and extended as part of the Treatment Centre project approximately 10 years ago. We would anticipate that during reconstruction of the car park that some structural inadequacies became apparent and thus, temporary propping was introduced due to heavy plant and machinery working over. The extent of the propping is quite limited and shown on photographs 10 and 11 of the Appendix C. This would appear to be providing adequate support but we have already advised SaTH that this should be substituted for a single prop system, to aid integration.
- 2.7 The photographs in Appendix C show section 3 to be clean and relatively clear of building services, where we would reiterate that the steam mains extend via section 4 through the network and then enters section 9 by pathology.
- 2.8 Appendix D shows section 4 of the subway and this extends from near the Estates department into the main hospital complex. This is vulnerable to heavy loads imposed by articulated lorries and HGVs where the subway crosses the main services road at the top of the bank, and indeed leading towards the boiler house due to the necessity of HGVs needing to service the boiler house itself.
- 2.9 Section 9 of the subway is by far in worse condition where compared to sections 1, 2, 3 and 4 (part) forming the pinnacle of this study. As can be seen in Appendix E, F and G, the photographs clearly identify local deterioration due to the effect of carbonation. Whilst this phenomenon is only identifiable where physical deterioration is apparent, it should be noted that carbonation is widespread to the whole of the structure and may not yet be evident on the surface.
- 2.10 Photograph 22 of Appendix E shows a large deposit of general debris which has accumulated at the junction with the subway leading to pathology. This requires removal immediately and is included in the temporary propping scheme. Photograph 20 also shows the poor condition of the fire barrier in this location. We would recommend that each junction of the subway is provided with at least 60 minute fire protection but this will be subject to liaison with SaTH's consultant fire safety officer.
- 2.11 At the junction of sections 3 and 9 of the subway a further access hatch is provided. This is shown on photograph 50 of Appendix E and photograph 15 of Appendix D where the subway roof only measures about 350mm in thickness.
- 2.12 Photographs 27, 29 and 36 in Appendix F show the poor condition of the gas main pipe and the pipework support system. This is in need of immediate repair and ongoing maintenance. This is further demonstrated via photographs 46 and 47 in Appendix G. Photograph 43 of Appendix F also shows a sump pump arrangement which would appear to be in full working order. However, a similar pump is not working in section 3 of the subway, thus, approximately 250mm of standing water is present. This has also been reported to Estates.
- 2.13 Appendix H also identifies the vast amount of building services located in the below ground duct/subway particularly in section 9. These include the steam main, the gas main (unlabelled), the condensate pipe, various electrical cables and data and telephone distribution. Oxygen supply pipes are also located in sections 1, 2, 3 and 4. Further poor fire compartmentation is evident at the far end of section 9 where the door to the former maternity building is rotten and provides little or no fire resistance.

### 3.0 General Observations – Previous Reports

3.1 We are in receipt of the report prepared by Couch Consulting Engineers reference C6463 dated 30 March 2015, the contents of which are self explanatory and have largely been verified by our own inspection. This report is not intended to regurgitate verbatim the CCE report but to outline the main characteristics:

- *Damage to the concrete due to cracking and spalling of the surface is an indication that the carbonation has penetrated to the reinforcement allowing corrosion of the bars to take place. The expansive corrosion reaction blows the surface of the concrete. Where concrete has spalled to reveal the reinforcement corrosion of the bars is accelerated due to their exposure to atmosphere and water containing chlorides.*
- *An examination of the exposed corroding reinforcement showed the surface to be deeply pitted with some lamination of the steel and full section loss in isolated places. The pitting corrosion is a good indication that chlorides are present in the environment. Chloride ions exacerbate steel corrosion causing pitting and a more rapid deterioration compared with a normal damp atmosphere.*
- *At present the spalling of the soffit and surface damage to the concrete is in isolated areas. However, it should be noted that once the carbonation has reached the reinforcement a degree of corrosion can take place before the concrete is affected; this is referred to as latent corrosion. Surface cracking is generally the first indication of internal problems followed ultimately by spalling of the surface. The manifest problems indicated by spalling concrete and cracking represent only a proportion of the actual corrosion in the structure with the remainder hidden below the surface. With time the spalling and damage will spread to all areas where carbonation has reached the reinforced bars. Half-cell readings from Martech survey would tend to confirm this.*
- *Corrosion of reinforcement caused by carbonation of the surrounding concrete is an accelerative process and more and more latent corrosion will become manifest as surface cracking and concrete spalling with time. Given the extent of the current damage it is reasonable to deduce that some areas that currently appear to be sound will have latent corrosion that will eventually give rise to spalling and cracking damage.*
- *The shallow depth of the subway below ground level has also caused a number of problems for the structure. The soffit is affected by external temperature changes that cause condensation in the subway when the warm humid air generated by the steam mains make contact with the cold roof. This is an extensive problem along much of the standing water in the base of the subway. As water is part of the chemical process involved in the corrosion of reinforcement in carbonated concrete this is accelerating the deterioration of the structure.*

- *The location of the subway below roadways at shallow depth makes the subway vulnerable to any water penetration through the asphalt. Salts used for ice prevention on the roadway can be washed onto the subway. Any small failure in the waterproofing or the construction joints is likely to be attacked by salt laden water.*
- *From consideration of the above items it is clear that the subway is subject to major problems with water ingress, carbonation, condensation and chloride attack of reinforcement causing deterioration of the structure. If left unchecked deterioration will continue and accelerate with time and would eventually lead to a collapse of the subway causing major disruption to the hospital.*

3.2 We believe the above findings and recommendations proposed by CCE to be sound where it is fundamentally important to provide temporary propping to the full length of the below ground duct/subway (sections 1, 2, 3, 4 (part) and 9 as a matter of high priority (emergency) all as we have previously advised SaTH. The CCE report takes into account the findings of the intrusive investigations and laboratory analysis undertaken by Martech in their report dated 12<sup>th</sup> August 2012 reference 12076.

3.3 Due to the poor condition of the subway, the risk to SaTH is enormous (severe) and thus we would take this opportunity to outline these risks and recommendations for temporary propping all as the email from Andrew Rowson to Derek Bolton and Tom Cullinane of 17<sup>th</sup> August 2015:

- This obviously puts SaTH at risk due to the potential for the roof to partially collapse due to heavy vehicles and a regular stream of cars passing over on a daily basis. The risks include severe injury/fatality as the subway is greater than 2m in depth.
- Should an incident occur then there is risk to the hospital being severely jeopardised in providing continuous acute services as the steam main will be damaged and although incorporates isolating valves, the infrastructure is very old and inevitably there will be difficulties encountered in isolation, diversion and temporary re-provision particular if the supply to the steriliser in Pathology is affected.
- Should an incident occur then there is further risk of severe disruption as the mains electricity cables and or data cables could become damaged, there is risk of explosion if the gas main and or oxygen pipes become damaged.

## General Observations – Previous Reports Continued/....

- Having inspected the subway, and become familiar with the aforementioned reports, I would advise that the risks are SEVERE and thus it is necessary to provide temporary propping to the full length of the below ground subway extending from the boiler house to the former maternity building. Using the same references as the reports, this includes section 1, 2, 3, 4 (part) and 9. This will help stabilise the roof structure of the subway and mitigate against potential catastrophic disaster should the subway remain unprotected.
- These works should be implemented urgently (emergency situation) where I am in the process of providing a brief specification in order to obtain tenders during the course of this week with a view of the works commencing next week. At this stage my initial estimate of costs for these works are £100,000 plus vat and fees.
- At the same time the weight limit to the access road from Mytton Oak Road should be reduced to 8 tonne per axle all as the previous recommendations within the CCE report where increased signage should be erected.

We have received subsequent instruction to prepare specifications and obtain a minimum of three tenders for these works via MultiQuote. Potentially, we may also be instructed to manage the works.

## 4.0 Conclusions and Option Appraisal

Johnson Fellows have identified four principal options available to SaTH in order to maintain the site as a major regional strategic centre for acute and administrative healthcare services.

### 4.1 Option 1 – Permanent Propping

- 4.1.1 On the assumption that the temporary propping will be in place by the time the preferred long term options is implemented, this option advocates the introduction of permanent propping. This will include the introduction of 2 no. longitudinal beams to the complete length of the subway, supported by cross beams under and a central universal column (post) at 3m centres. All of these materials are to be high grade/heavy duty galvanised steel and bolted together for ease of installation. The permanent propping system can be installed in sequence to replace the temporary propping where it is fundamental to incorporate adequate fillets between the cross beams and posts to maintain rigidity. This detail is included in Appendix J.
- 4.1.2 The permanent propping system will have a recurring revenue cost as a planned preventative maintenance (PPM) system should be introduced where a consultant structural engineer will need to inspect the propping and provide a report on an annual basis. This however is deemed to be insignificant in terms of the overall capital scheme.
- 4.1.3 Once the permanent propping system is installed and signed off by a consultant structural engineer, it will be necessary to introduce artificial and emergency lighting to the complete length of the subway with LED lighting controlled by presence/absence defectors to comply fully with BS 7671 2008 and BS 5266 Pt:1 2013.
- 4.1.4 In addition and in consultation with SaTH's consultant fire safety officer, at least 60 minutes fire protection should be provide at each junction of the subway and at junctions with the boiler house, pathology and the former maternity buildings.
- 4.1.5 To prevent potential immediate failure the defective building services support system should be thoroughly overhauled and repaired where isolated defective components should be spliced with galvanised steel, the system should be thoroughly prepared and redecorated throughout. The same applies to the gas main pipe which also requires labelling.
- 4.1.6 A drainage survey should also be undertaken to determine if any drains are a contributory factor to the poor condition of the subway and obviously any recommended repairs should be immediately implemented. At the same time, the sump pump in section 3 should be replaced immediately and a PPM system introduced.



## Conclusions and Option Appraisal Continued/....

- 4.1.7 All of the access covers should be replaced for robust/sealed types to prevent surface water ingress. At the same time, natural ventilation should be introduced to the full length of the subway to reduce the effects of condensation.
- 4.1.8 SaTH should also expedite the asbestos removal works in section 4 so that the capital works planned for sections 1, 2, 3, 4 (part) and 9 can be implemented at the earliest opportunity.
- 4.1.9 Once the temporary propping is in place, the access road should be re-graded. That is to say that all of the existing bitumen macadam should be removed, the substrate base thoroughly prepared and a proprietary structural water proof membrane introduced incorporating a 20 year insurance backed warranty together with high density, water proof bitumen macadam surfacing.

### Cost Plan

Total Cost	£ 700,000
Contingency Sum	£ 70,000
Professional fees	<u>£ 77,000</u>
	£ 847,000
VAT	<u>£ 169,400</u>
Total	<b>£1,016,400</b>

## 4.2 Option 2 – Relocation of building services and infilling of the subway with aerated concrete

- 4.2.1 This option is quite comprehensive but seeks to eliminate the structural issues associated with the subway in perpetuity. We do not necessarily agree with the re-provision of a new below ground duct/subway as advocated by CCE but more over to determine what building services are required for the long term and plan a conduit system to suit.
- 4.2.2 SaTH have confirmed a desire to decentralise and phase out the steam mains distribution throughout the complex. This option provides the ideal opportunity to kick start a decentralisation programme over say a 10 year period. This however could be accelerated pending securing future funds. Decentralisation entails the provision of small boiler packages around the site so that eventually the central boiler house can be de-commissioned and even completely demolished, pending the requirements for future development.
- 4.2.3 Based on the assumption that the maternity building will not require a steam main (redundant at present), then this option suggests the provision of a boiler package and stand alone steam generator to serve the sterilizer in pathology. Space heating and hot water will then be served by a gas fed boiler package for pathology and the former maternity building. This will facilitate the removal of the steam main in section 9. The option will introduce energy efficiencies immediately and help to reduce maintenance liability of the structure/services.

- 4.2.4 It is more complicated in sections 1, 2 and 4 to relocate services where we would advocate the introduction of an overhead gantry system extending from the boiler house to the main complex in the vicinity of the catering department/generator house. All services can then be relocated where in the future, the overhead gantry system could be decommissioned as the decentralisation programme is phased in.
- 4.2.5 The other services currently located in sections 3 and 9 could be relocated over the flat roofs of the existing building to terminate at the junction of the aforementioned overhead gantry and main building. A similar project has been carried out quite recently for the chilled water supply that feeds pathology.
- 4.2.6 Once all of the services have been relocated and the below ground duct/subway decommissioned, it can then be totally infilled with structural grade aerated concrete. From a logistical perspective this would need to be undertaken in a controlled manner where pockets of the subway should be infilled in sections, which is a similar method of underpinning. Permanent shuttering could easily be provided in order to create pockets but it will be necessary to create additional access points for pumping/casting purposes. It will also be necessary to enforce a high level of quality control to ensure full compaction, so that the subway roof does not settle overtime, but this option does alleviate the structural problems associated with the subway once and for all. This option however does depend on the strategic long term plans for the complex.
- 4.2.7 Whilst the first phase of decentralisation is included in this report, future phases have not been explored in detail, but as a ball park figure we would suggest that this would be somewhere in the region of £2,200,000 (net).

### Cost Plan

Total Cost	£2,200,000
Contingency Sum	£ 220,000
Professional fees	<u>£ 242,000</u>
	£2,662,000
VAT	<u>£ 532,400</u>
Total	<b>£3,194,400</b>

## Conclusions and Option Appraisal Continued/....

### 4.3 Option 3 – Provision of a new structural raft over the subway

- 4.3.1 This Option is feasible but is highly disruptive to the day to day running of the site. Whilst options 1 and 2 will impact on the services roads, it is feasible to temporarily divert traffic around the site in order to gain access to the staff car park, central stores, boiler house, estates department, pharmacy and pathology. Option 3 deals with the structural failings of the subway from the topside where it is proposed to form a structural footing down each side of the subway and then form an independent raft or cantilevered slab to span between the footings. Due to the shallow depth of make up between the subway roof and road surface, the raft would actually replace the road and form a structural substrate in which to drive over.
- 4.3.2 This Option would not provide a long term solution independently as it will either be necessary to relocate all services within the subway and decommission the subway where access would be forbidden or to maintain the temporary propping system including a PPM system and carry out other improvements as suggested in Option 1 including lighting, pumping, fire compartmentation and repairs to the support system and gas main. Should it be preferred to decommission the subway then in the fullness of time the existing roof would collapse and fall inwards but this would not affect the new structural component over (concrete road).
- 4.3.3 In our opinion it is not feasible to permanently divert traffic around the site and put the main arterial service road out of action as this will cause significant logistical problems which would escalate over time resulting in poor performance by SaTH and potential breach of contract with its suppliers and or client base.

#### Cost Plan (based on decommissioning the subway)

Total Cost	£1,750,000
Contingency Sum	£ 175,000
Professional fees	<u>£ 192,500</u>
	£2,117,500
VAT	<u>£ 423,500</u>
Total	<b>£2,541,000</b>

### 4.4 Option 4 – Provision of a new access road

- 4.4.1 As can be seen on the aerial view overleaf, there are several options in order to provide an alternative access route particularly for heavy goods vehicles. If either of these options are deemed acceptable we would advocate that the temporary propping is maintained including a PPM system together with all of the other maintenance works as identified in Option 1. The existing access route should then only be used for cars and light commercial vehicles.
- 4.4.2 **Route 1 (red)** utilises the existing road network around the site where access to the A458 can be made from the Shrewsbury Bypass (A5). It will be necessary for all suppliers to be notified of this change of route to the complex where inevitably there will be initial difficulties. The route however does extend through an estate road giving access to a nearby housing development, but also extends to the recently constructed Redwood Centre. It is envisaged that local residents will complain about the use of this route, but nonetheless it is deemed to be a public highway. Consultation however, is fundamental with the Highways Department of Shropshire Council.
- The other factor associated with Route 1 is the need to construct an extension to the road behind the boiler house to give access to the main access road associated with the hospital complex. This piece of land is outside of the ownership of SaTH. For reference purposes the new roundabout is shown in Appendix K.
- 4.4.3 **Route 2 (blue)** is the possible use of part of Racecourse Lane from the newly constructed roundabout on the B4386 which serves the new housing development currently being constructed by Taylor Wimpey. This will include the widening of part of Racecourse Lane, widening of the current road which gives alternative access/egress to the boiler house and Redwood Centre and a similar extension of the road to Route 1 to connect to the hospital complex. For reference purposes the new roundabout is shown in Appendix K.
- 4.4.4 **Route 3 (orange)** is a possible connection to the same roundabout as identified with Route 1 where a small section of Racecourse Lane would require widening and then access made via a new road at the rear of the residences and staff car park to the same point as the hospital complex as suggested in Routes 1 and 2. This however will require careful/innovative design.

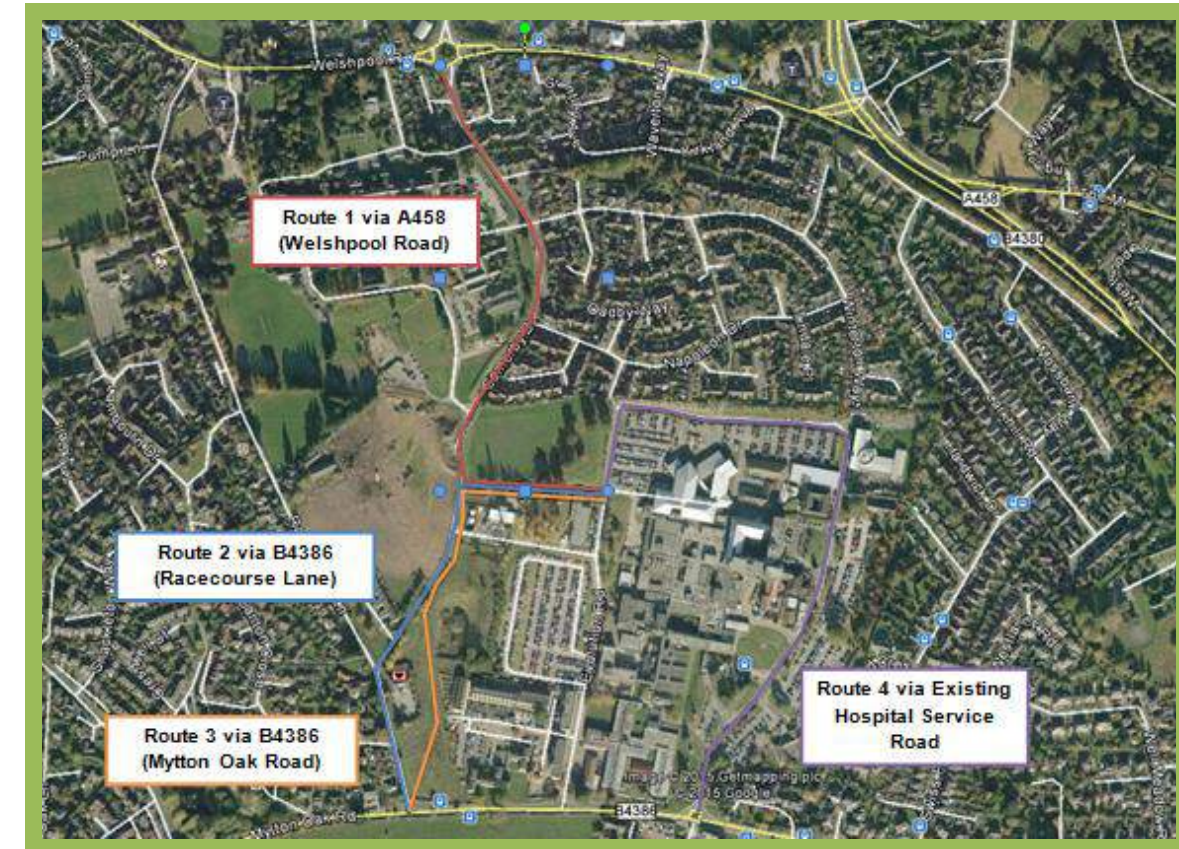


## Conclusions and Option Appraisal Continued/....

4.4.5 **Route 4 (purple)** does not rely on the purchase of land and construction/extension of new roads, but utilises the existing alternative 'front of house' road to the hospital complex. This route is not without difficulties as it will create congestion to allow articulated lorries/HGVs to manoeuvre slowly around the site, where traffic could potentially back up significantly when helicopters land and take off and the access road is temporarily closed, thus causing potential problems for ambulances. Manoeuvring around tight corners such as by the Conference Centre and the mini roundabout by the Treatment Centre will also be difficult and these tight spots will require widening to some extent. This route will also increase health and safety issues associated with the pedestrians gaining access to and from the public car parks to the main buildings particularly OPD, A&E and the ward block, hence additional safeguards will need to be introduced such as Pelican Crossings, guarding, improved lighting and signage. This route is deemed satisfactory as a temporary measure, but not on a permanent basis.

**FOR THE REASONS STATED ABOVE, WE DO NOT BELIEVE THAT OPTION 4 IS FEASIBLE AND SHOULD BE REJECTED**

4.4.6 For quick reference purposes, the options are identified in the table contained in Appendix L.



## 5.0 Recommendations

This report recommends the implementation of the Option 1 which is a 'quick fix' option to stabilise the below ground duct/subway and at the same time to introduce other maintenance improvements together with resurfacing the access roads to prevent further long term deterioration. This option has the benefit of being easy to implement and the obvious advantage of being the most cost effective. Should SaTH decide to invest with expediency then there is every chance that these works could be completed in this financial year, provided instruction is given to consultants during September 2015.

It should be borne in mind that the following enabling works form part of the overall works associated with Option 1:

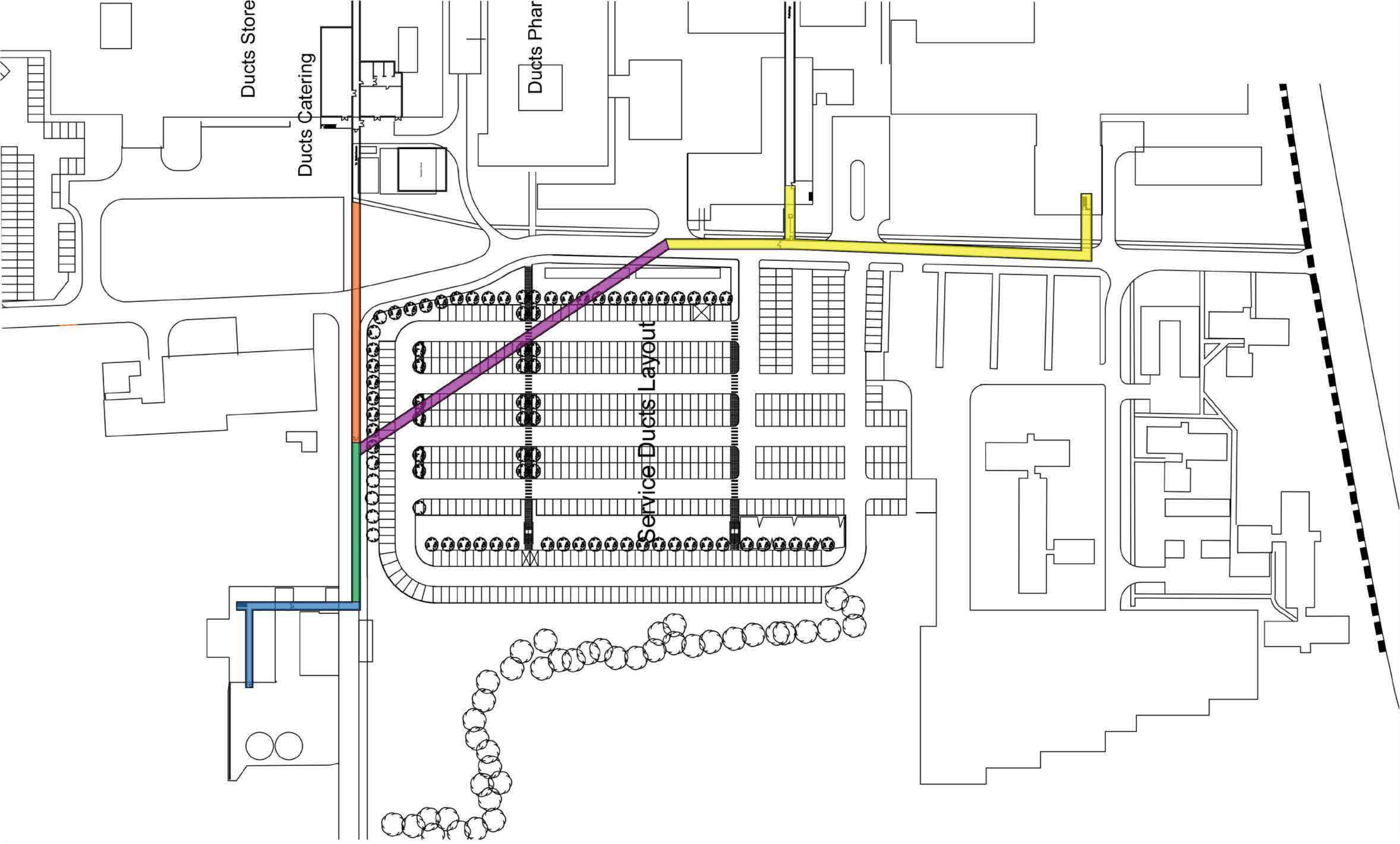
- Undertake a structural inspection and appraisal of the below ground duct/subway under the main hospital complex (sections 5, 6 7 and 8), cost excluded.
- SaTH should continue with asbestos removal/encapsulation to sections 4 (part), 5, 6, 7 and 8, cost excluded.
- Fire compartmentation providing at least 60 minutes fire resistance should be introduced at each junction of the subway and a PPM system for maintenance purposes.
- The defective sump pump in section 3 should be replaced immediately and a PPM system introduced.
- Sections 1, 2, 3 and 4 (part) and 9 should be provided with artificial and emergency lighting.
- The building services support system (brackets) should be thoroughly overhauled and redecorated together with the gas main.
- A drainage survey should be commissioned to determine if the below ground drains are a contributory factor (remedial works excluded).
- The access covers should be replaced for weather proof components and natural ventilation should be introduced to reduce the effects of condensation.
- The bitumen macadam surfacing over the subway should be removed, a structural water proof membrane introduced and high density water proof bitumen macadam surfacing.

However, the best long term strategic option is that of Option 2 which kick starts the decentralisation of the site where a new boiler package would be installed within pathology and would serve pathology and the adjacent former maternity building. We understand that SaTH are committed under contract with ENERGY but with this option the base line would be maintained so that SaTH would not be subject to any financial penalties and this would give plenty of time to consider the long term viability of the complex and begin to design further future phases for decentralisation. This will provide a much improved form of energy efficiency with localised gas boilers and chlorifiers /plate heat exchangers being provided as opposed to large boilers located in a central position (boiler house). Although not included within this cost option, this part of the site would lend itself for redevelopment in this future, particularly as the site is land locked and has little alternative space for expansion.

This report does not support Option 3 as it is considered to be too disruptive in terms of the day to day operational activities of the complex where it will be necessary to temporarily divert traffic via the main front of house area of the site, which introduces significant health and safety issues.

Option 4 is also not supported as the alternative routes are either partly or fully outside of the ownership of SaTH and thus, the associated land purchase is deemed to be prohibitive. A long term option to divert traffic around the front of the complex is not deemed to be acceptable due to health and safety issues and associated improvements required, where the building services within the below ground duct/subway would still require ongoing maintenance.







# Section 1

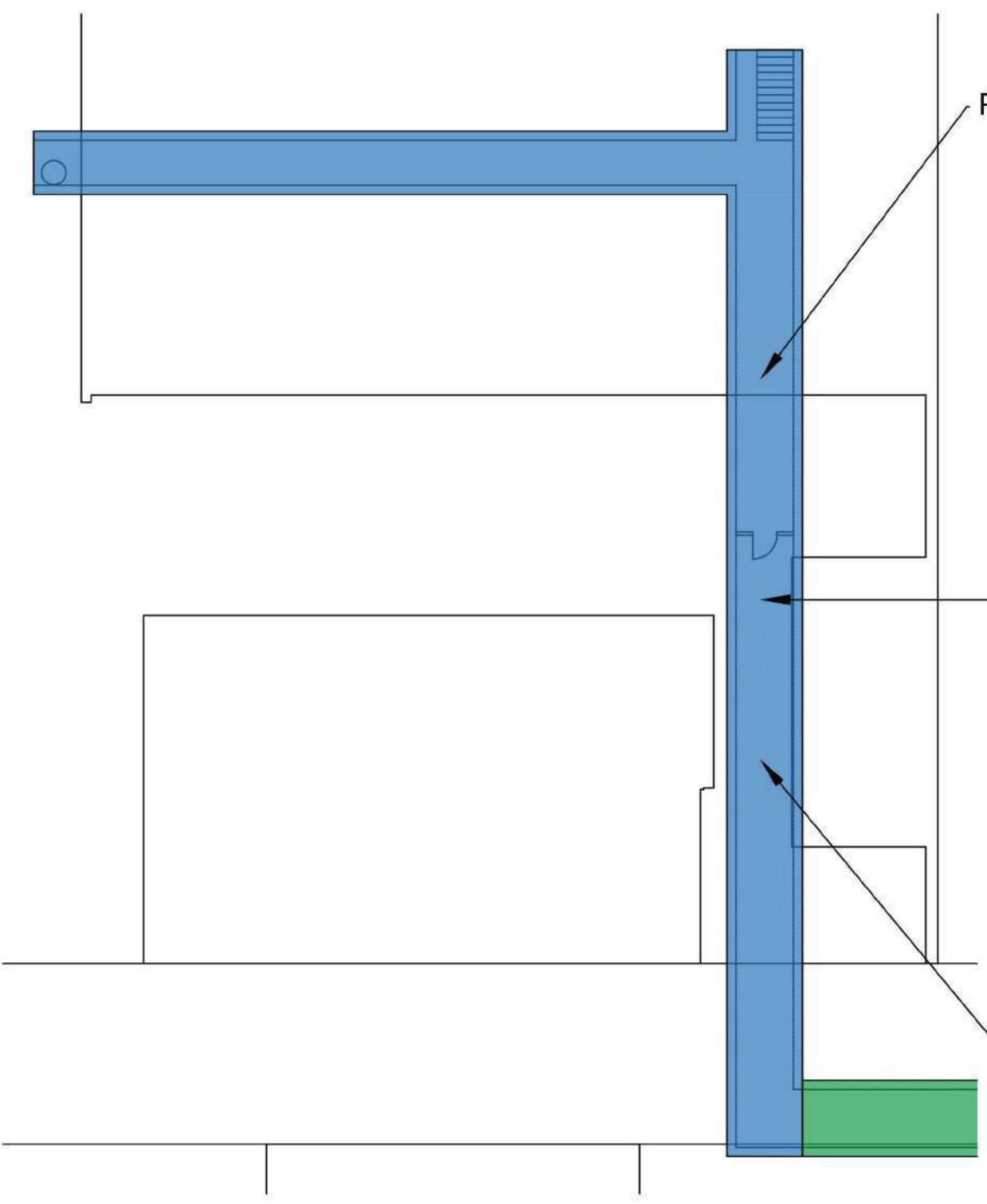


Photo 1 - Localised Spalling



Photo 1

Photo 2 - Localised Spalling and exposure of rebar



Photo 2

Photo 3 - Water main, Gas Main and Steam Main



Photo 3

# Section 2

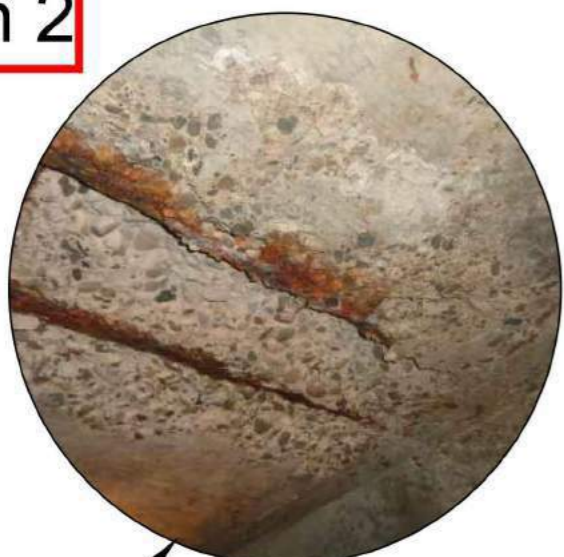


Photo 4

Photo 4 - Localised rebar exposure due to insufficient cover



Photo 51

Photo 51 - Access point to boiler house road

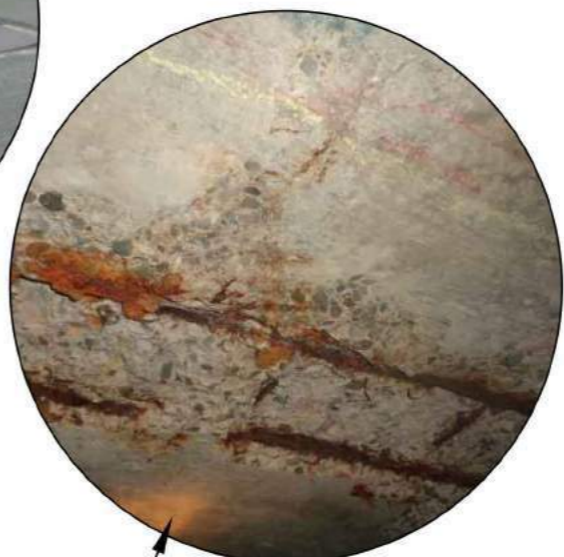


Photo 5

Photo 5 - Localised rebar exposure due to insufficient cover

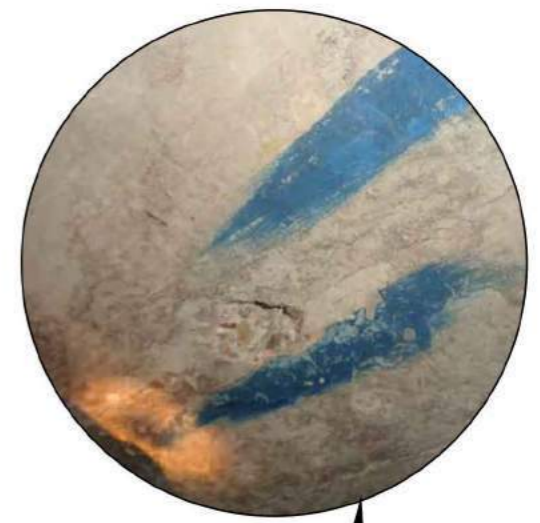
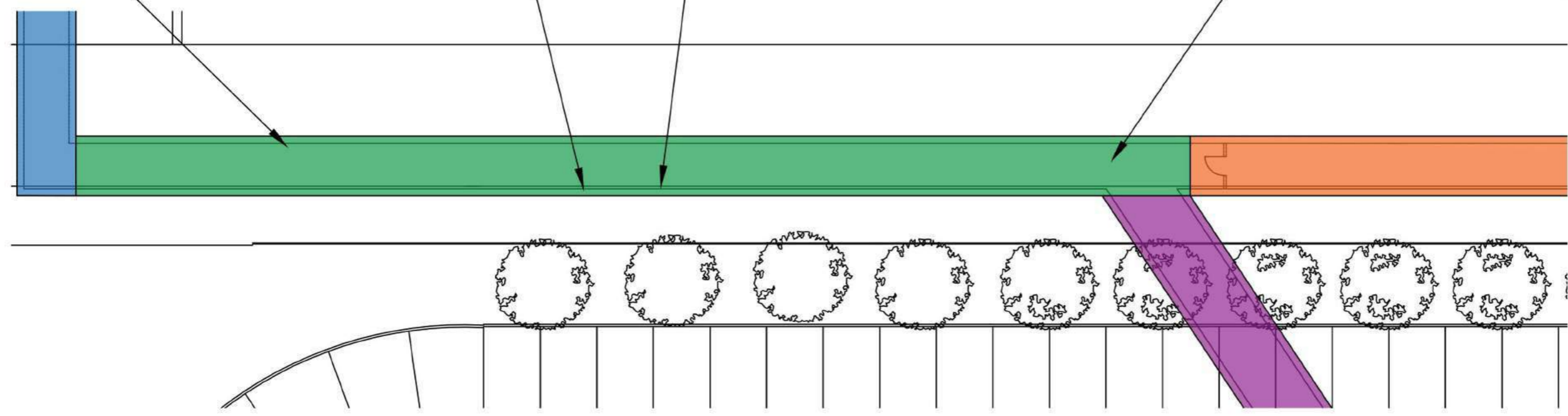


Photo 6

Photo 6 - Localised Spalling





# Section 3



Photo 9

Photo 9 - Relatively clean subway across staff car park

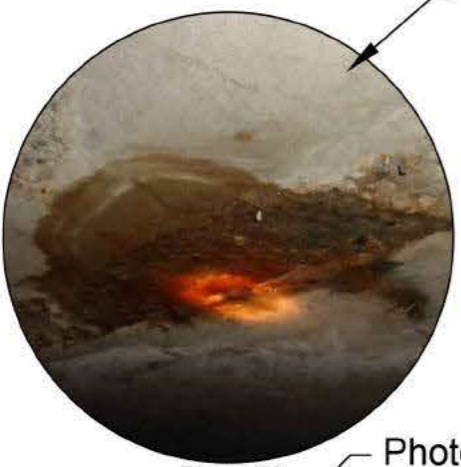
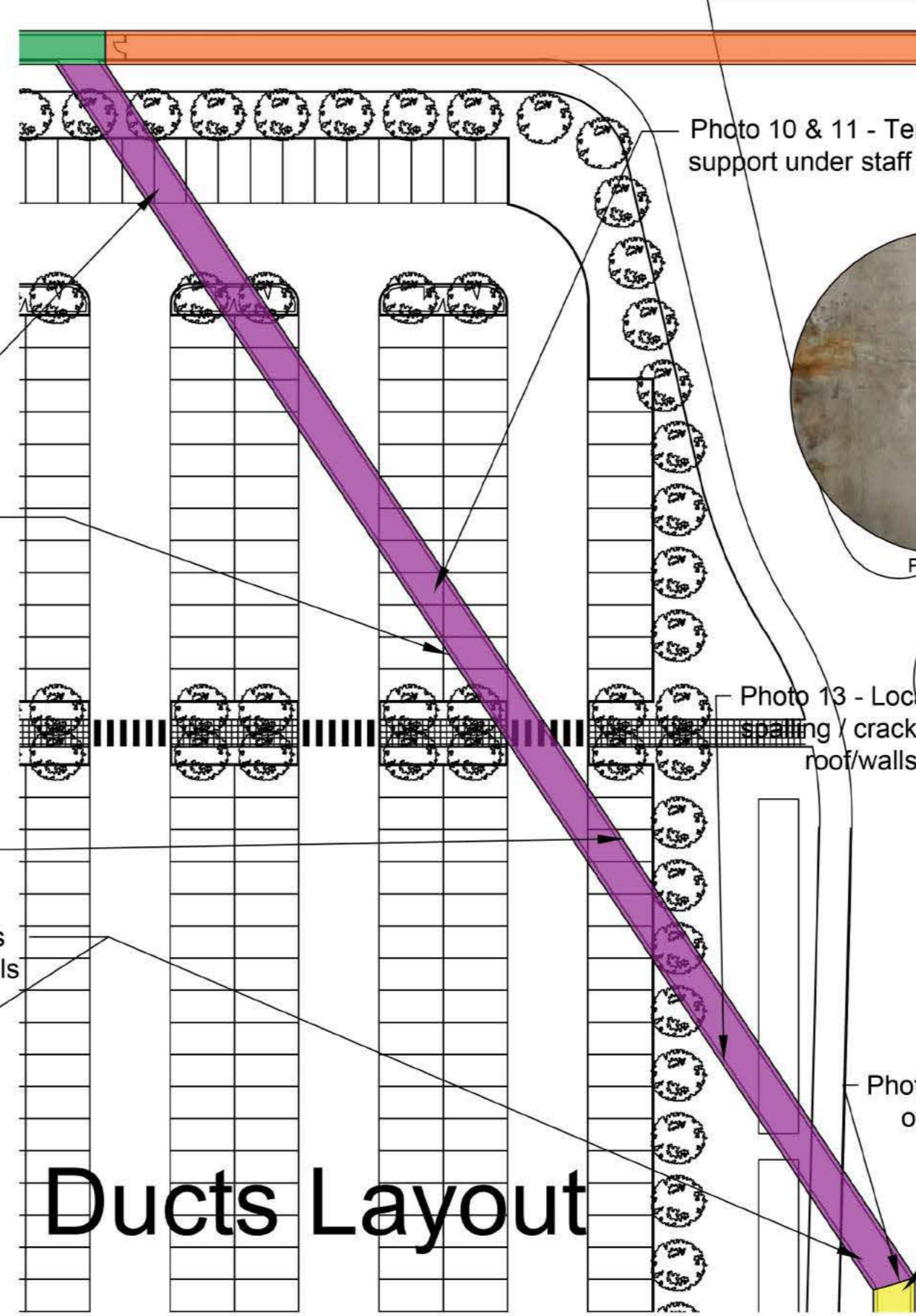


Photo 12

Photo 12 - Localised spalling to roof of duct

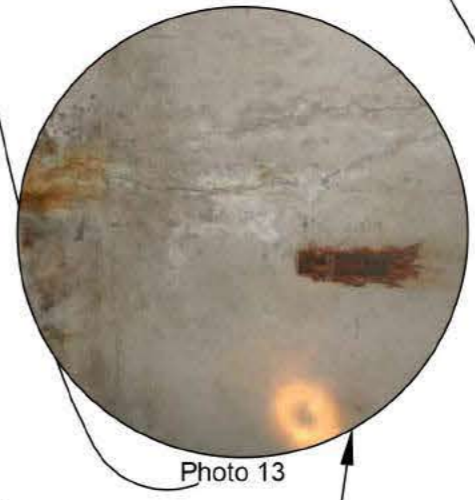


Photo 13

Photo 13 - Localised spalling / cracking to roof/walls



Photo 10

Photo 10 & 11 - Temporary support under staff car park



Photo 11

Photo 14 - Rusting Support system

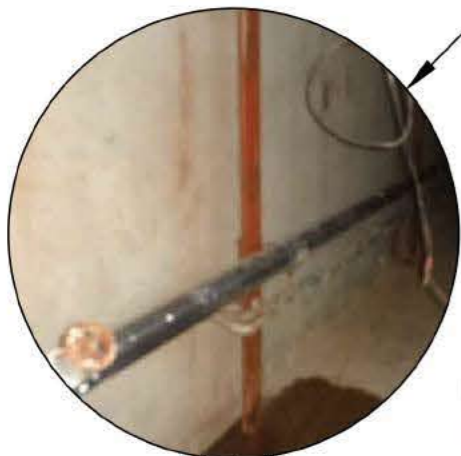


Photo 14

Photo 17 - mains cables at low levels



Photo 17

Photo 15 - Underside of access hatch



Photo 15

Photo 50 - Access point under footpath

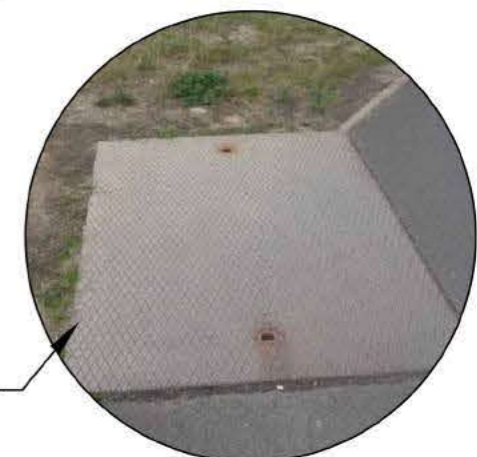


Photo 50



# Section 4

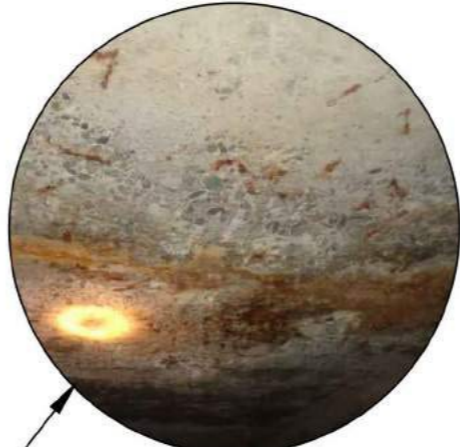
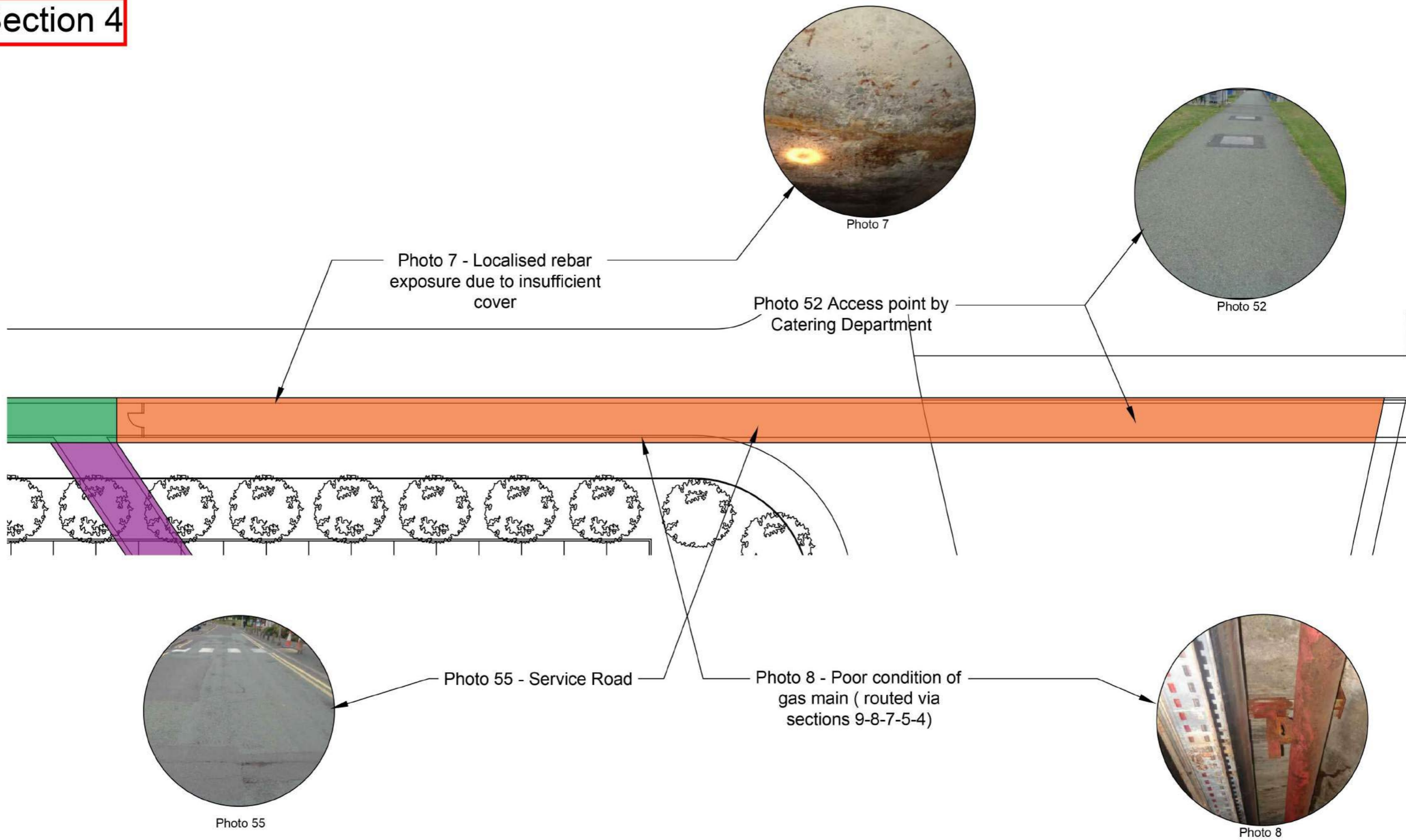


Photo 7



Photo 52



Photo 55



Photo 8



# Section 9

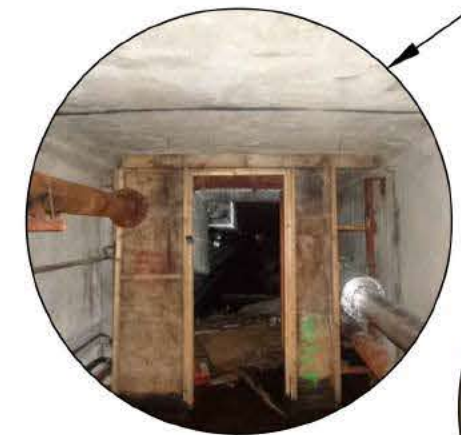


Photo 20

Photo 20 - Poor fire barrier



Photo 21

Photo 21 - Poor Movement joint to roof



Photo 22

Photo 22 - Debris in subway at junction with Pathology and 100mm of ground water



Photo 24

Photo 24 & 25 - Condensate pipe and cold water service pipe



Photo 25

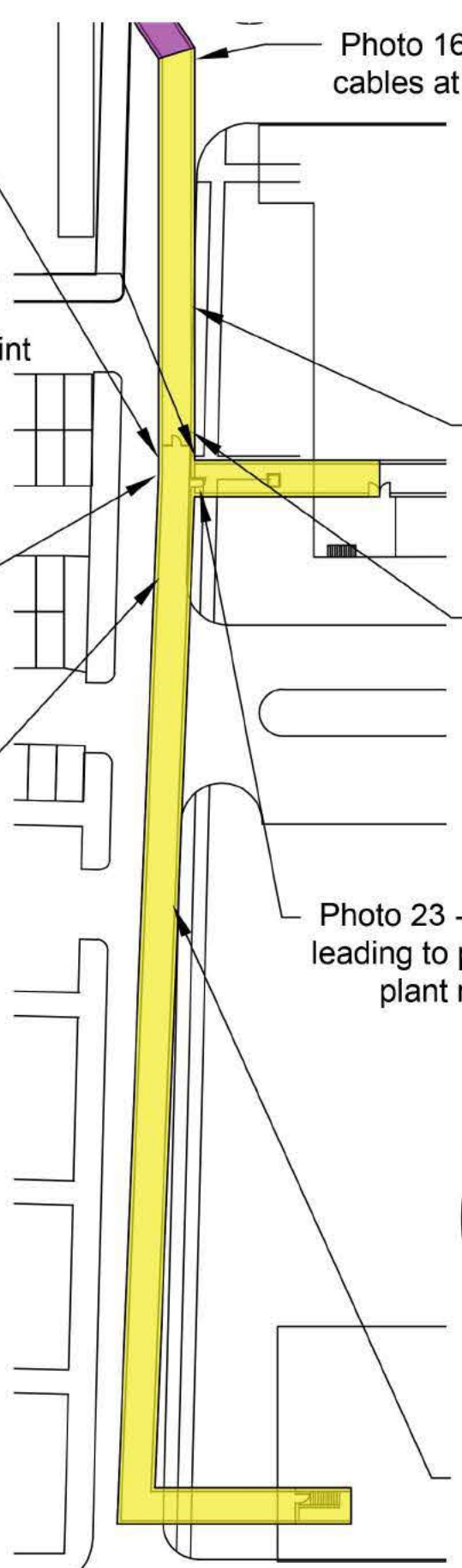


Photo 16 - Mains cables at low level



Photo 16

Photo 18 - Redundant steam pipe



Photo 18

Photo 19 - Redundant gas main (re-routed at high level)



Photo 19

Photo 23 - Subway leading to pathology plant room



Photo 23

Photo 26 - Localised spalling and leakage to day joint



Photo 26



# Section 9



Photo 28



Photo 53



Photo 32

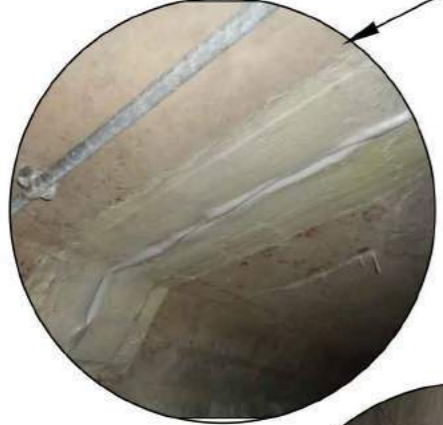


Photo 33

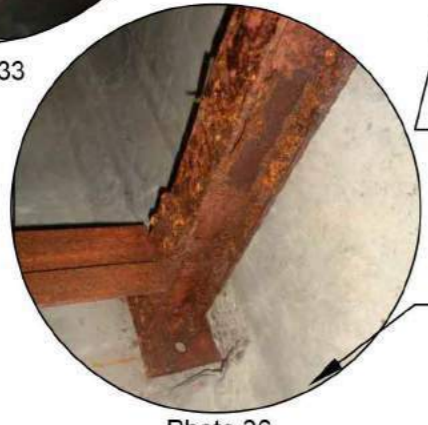


Photo 36

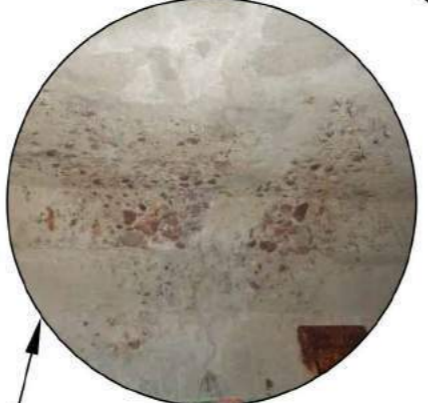


Photo 34

Photo 34 - Localised spalling

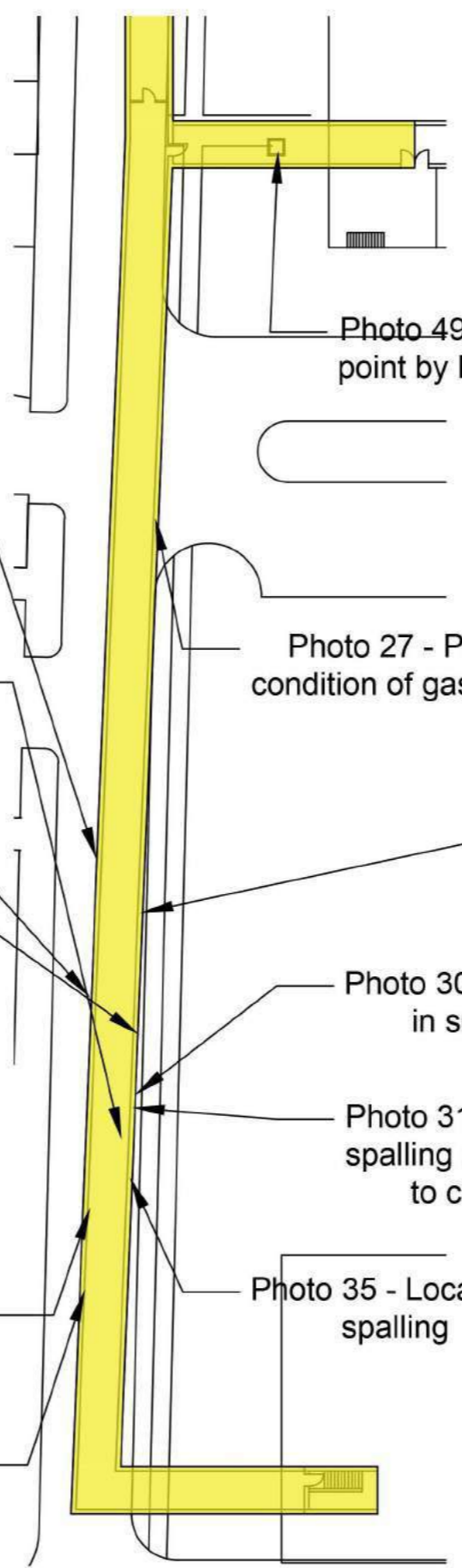


Photo 28 - Subway leading to maternity

Photo 53 - Service Road

Photo 32 - Services in subway

Photo 33 - Localised previous repairs

Photo 36 - Rusting service support system

Photo 49 - Access point by Pathology



Photo 49

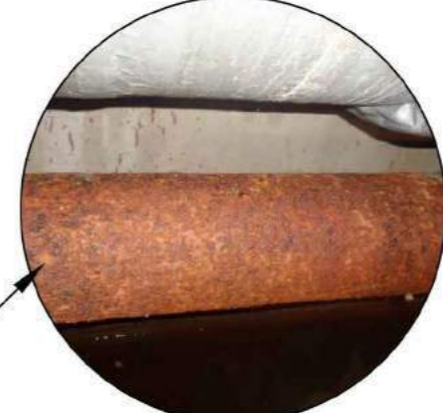


Photo 27

Photo 27 - Poor condition of gas main



Photo 29

Photo 29 - No sump pump installed (Standing Water)



Photo 30

Photo 30 - Services in subway

Photo 31 - Localised spalling and leakage to clay joint

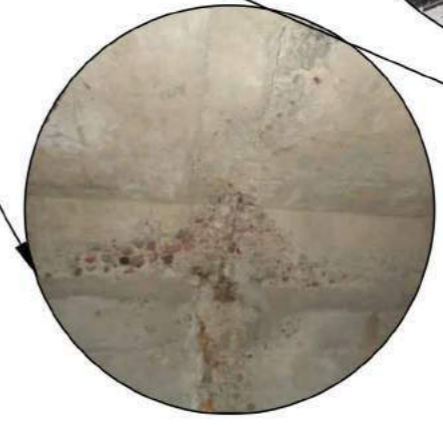


Photo 35

Photo 35 - Localised spalling

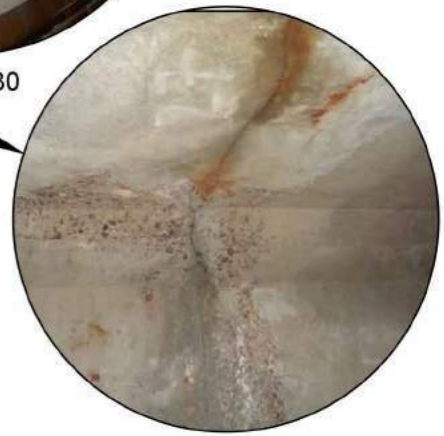


Photo 31



# Section 9



Photo 54 - Service road

Photo 54



Photo 48



Photo 47

Photo 47 & 48 - Poor condition of gas main and support system



Photo 43



Photo 46

Photo 46 - Calcium build up on service support

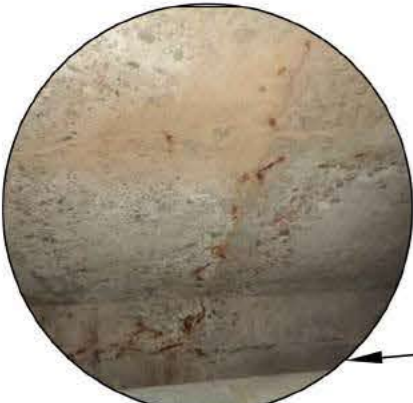


Photo 38

Photo 38 - Localised Spalling

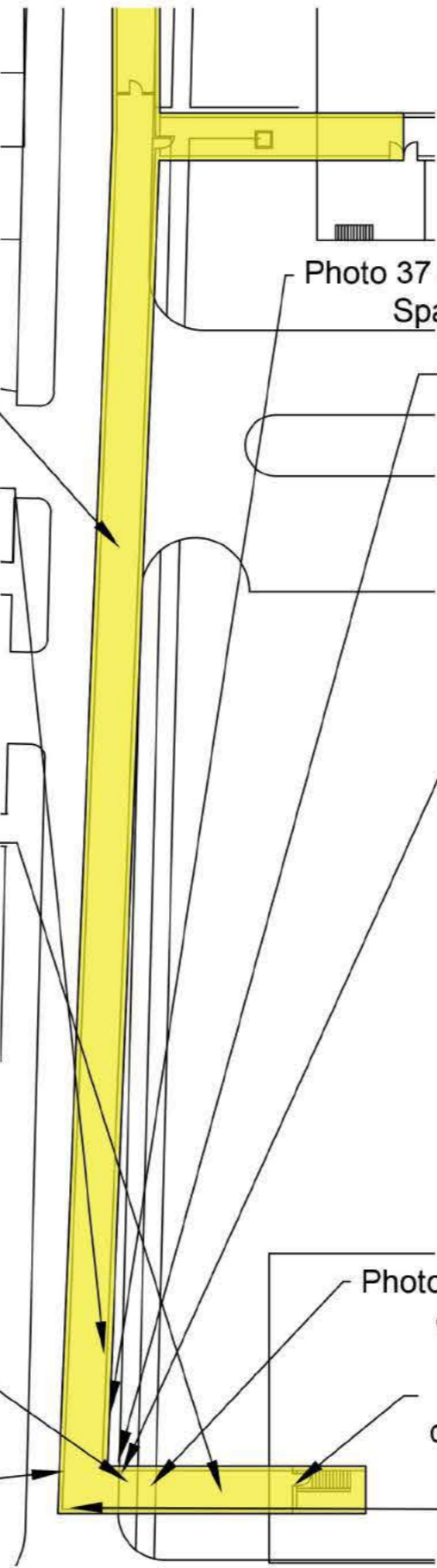


Photo 37 - Localised Spalling



Photo 37

Photo 39 - Services in subway



Photo 39



Photo 40

Photo 40 - Localised spalling at junction with subway to maternity

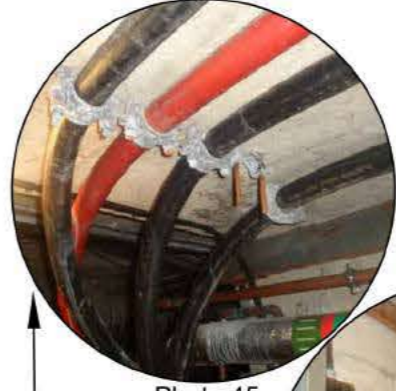


Photo 45

Photo 45 - Mains cables

Photo 44 - Poor condition of fire door to Maternity staircase



Photo 44

Photo 41 & 42 - Localised spalling at junction with subway to Maternity

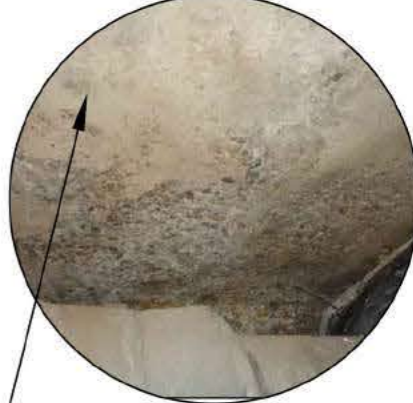


Photo 41



Photo 42



# Cross Section (Taken from archive drawing)

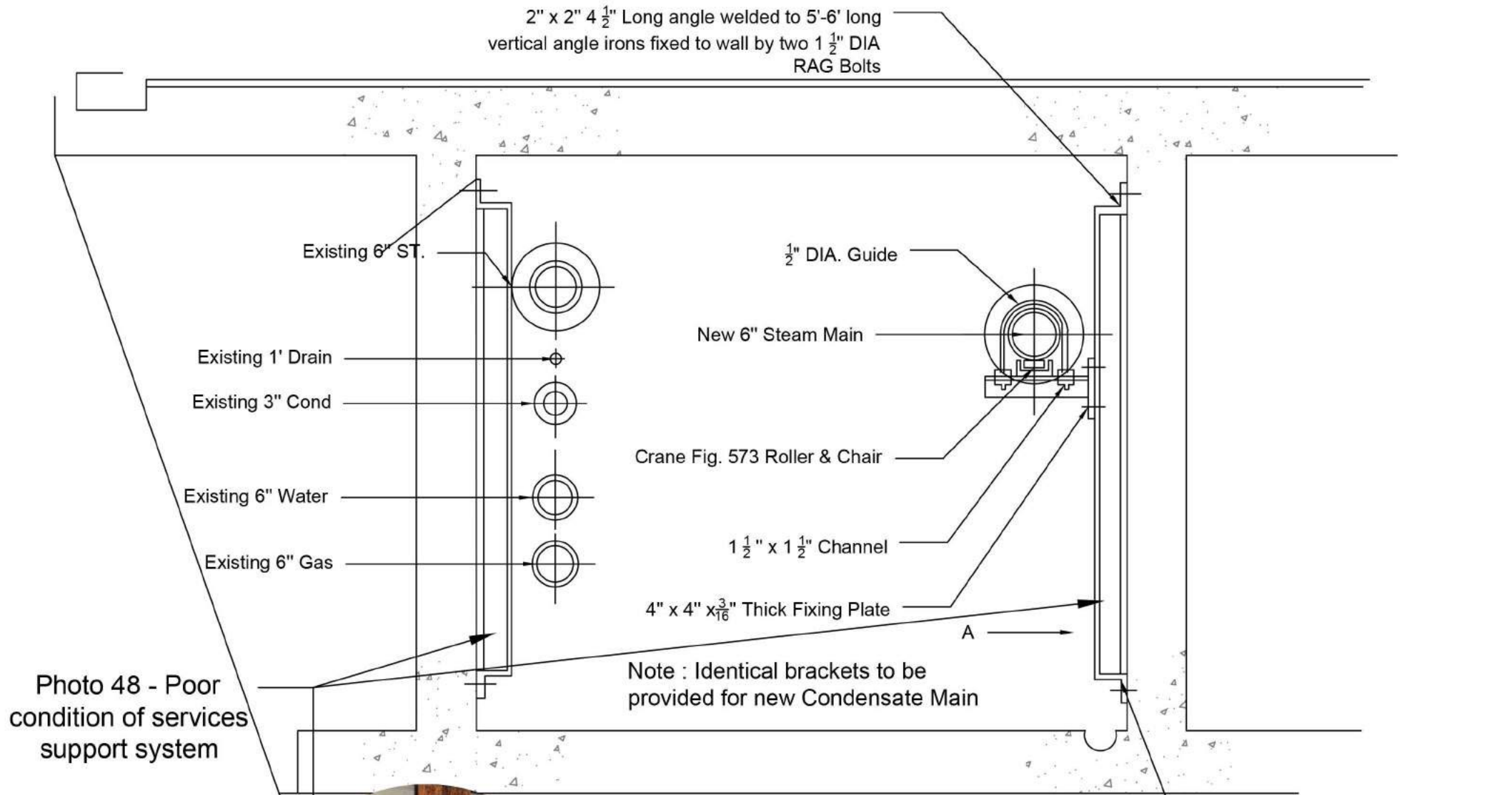


Photo 48 - Poor condition of services support system

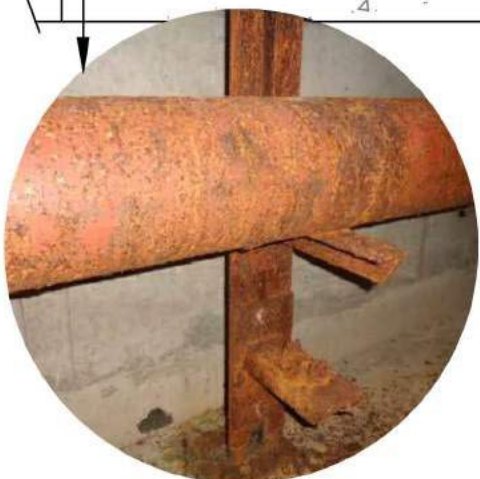
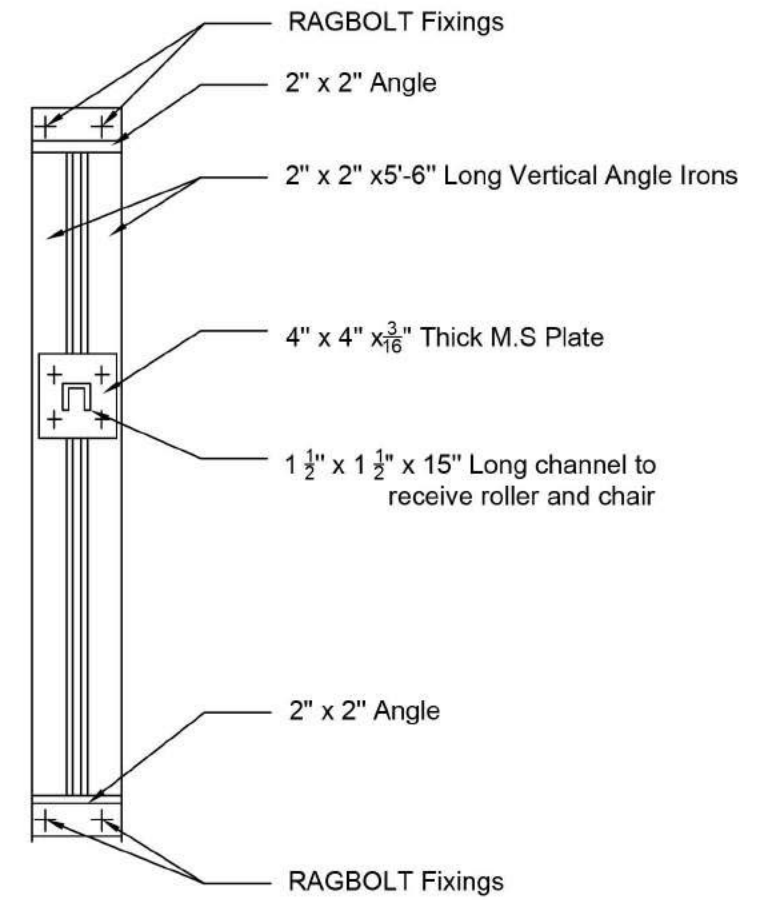


Photo 48

TYPICAL CROSS SECTION THROUGH EXTERNAL SUBWAY SHOWING SERVICES SUPPORT SYSTEM

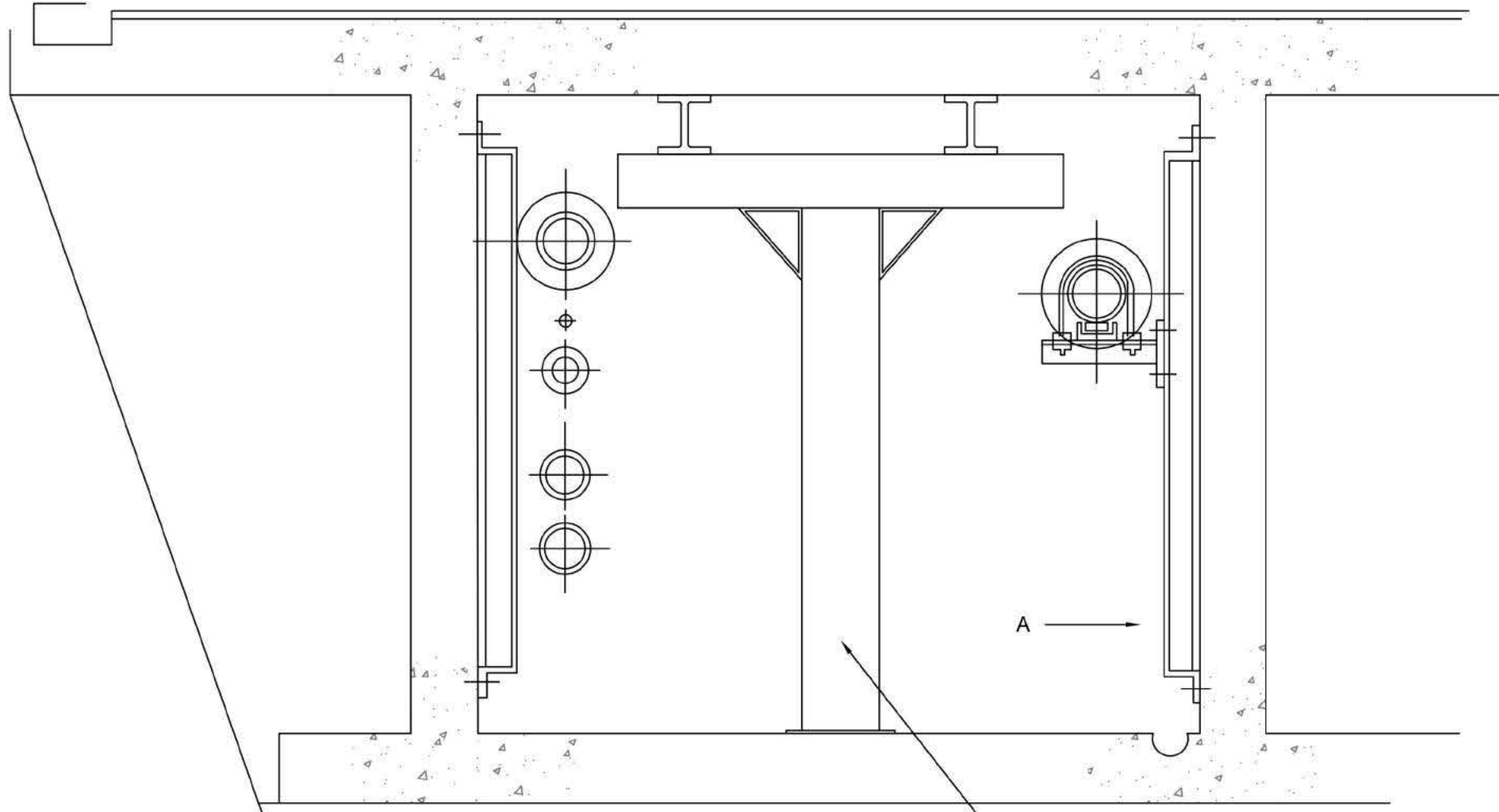
2" x 2" 4 1/2" Long angle welded to 5'-6" long vertical angle irons



ELEVATION OF PIPE IN VIEW OF ARROW A

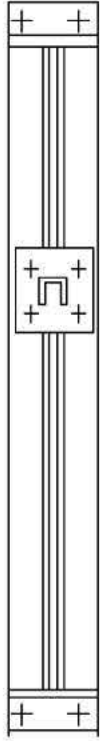


# Cross Section Proposed



Permanent propping with longitudinal beams, cross beams and ports at 3m centres

TYPICAL CROSS SECTION  
THROUGH EXTERNAL SUBWAY  
SHOWING SERVICES SUPPORT  
SYSTEM



ELEVATION OF PIPE IN VIEW OF  
ARROW A



- GENERAL NOTES**
1. **DO NOT SCALE.** (EXCEPT FOR PLANNING PURPOSES)
  2. ALL DIMENSIONS ARE IN MILLIMETRES
  3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT CONTRACT DRAWINGS
  4. ALL LEVELS ARE IN METRES (A.O.D.)

**KEY:**

- PRIVATE LAND BOUNDARY (LAND REGISTRY)
- WATERCOURSE
- TREES TO BE ASSESSED FOR REMOVAL
- EXTENT OF PUBLIC HIGHWAY IN VICINITY OF ROUNDABOUT



THE EXISTING HEDGE WILL BE REMOVED TO ALLOW FOR FOOT/CYCLE PATH WIDENING; NEW MIXED HEDGE WILL BE PLANTED ON COMPLETION

THE SHREWSBURY AND TELFORD HOSPITAL SITE

ELECTRICITY POLE FOR OVERHEAD LINES TO BE REPOSITIONED

DIMENSIONS FOR ARM 4 TBC THROUGH FURTHER DESIGN

ELECTRICITY POLE FOR OVERHEAD LINES TO BE REPOSITIONED

SHARED 3m WIDE FOOTWAY / CYCLE WAY

Appendix K



## FEASIBILITY APPRAISAL – SUBWAY – QUICK REFERENCE TABLE –

Option 1 – Permanent Propping		Option 2 – Relocation of services and infill		Option 3 – Structural Road		Option 4 – Diversion of access road	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
1 Works can be implemented with expediency.	1 Permanent propping retaining to subway structure and thus, there will be an ongoing maintenance liability.	1 Considered to be best long term solution as kick starts a decentralisation programme.	1 Depends on long term strategic plans of SaTH which is not currently determined.	1 Provide a long term option of elimination risk.	1 Most disruptive in terms of temporary diversion of traffic due to works being undertaken at road level. Diversion will be 12 - 16 weeks.	1 Seeks to provide a long term solution where the temporary propping could become permanent due to reduced loading.	1 Route 1 will inevitably be opposed by local residents and part is outside of SaTH ownership.
2 Works are self contained within the subway	2 Temporary division of up to 4 weeks during re-surfacing.	2 Relocates all building services to reduce risk	2 Requires work to be undertaken in phases which can be implemented over 2 or 3 financial years.	2 Relies on building services being relocated as option 2 so that the roof of the subway can collapse inwards over time.	2 Diversion route will require temporary improvements and revenue costs due to banksmen.		2 Route 2 will also be opposed by local residents and is outside of SaTH ownership.
3 Works only involve a limited period of disruption for re-surfacing purposes requiring a temporary division.	4 Quick fix option.	3 Seeks to eliminate risk to SaTH on a permanent basis.	3 Overhaul gantry system will be quite ugly, but is located in the BOH area of the site.				3 Route 3 faces technical difficulties to connect to Mytton Oak Road and is outside of SaTH ownership.
4 Permanent propping with suitable maintenance has a life expectancy greater than 40 years.		4 The new boiler package for pathology and maternity can be accommodated within the existing pathology plant room where existing plant will be exchanged.	4 Most expensive current option.				4 Introduces significant health and safety measures which would need to be eliminated.
5 Most cost effective current option							