

Technical note

Project	Edinburgh Tram	Date	04/04/2006
Note	Utilities Strategy	Ref	TMUSDS-AAR-DS-118
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1 Introduction

1.1 The purpose of this document is to advise on the work undertaken to date together with planned future work with regards to the design of the utilities' apparatus diversion/protection work for the Edinburgh Tram Project. Processes that have been set, decisions that have been taken and assumptions that have been made are detailed in relation to design approach, survey approach, approvals process together with a brief synopsis of the utility related project history.

1.2 It is generally understood by all parties the utility apparatus diversion design is out of sequence with the roads design work and is being advanced ahead of that design to support the procurement of an advance MUDFA (Multi Utility Diversion Framework Agreement) contract. The MUDFA contract has been set up to accelerate the utility apparatus diversions ahead of the construction of the tramway infrastructure work thereby providing an apparatus free site for the infrastructure work. The main objective of the design team is to ensure that the design of apparatus diversions will progress on the basis of utilising the most up to date information relating to tramway and roads alignment at any specific time during its development.

1.3 Whilst the utilities design is an SDS responsibility, the responsibility for the MUDFA procurement lies with tie/TSS with SDS obliged to act in support of that procurement.

2 Project History

2.1 **MUDFA - Initial Objective for MUDFA ITN issue** - A series of meetings with tie/TSS were initiated at which issues relating to the MUDFA tender process were discussed together with the expected levels of SDS design support. Initially it was agreed by SDS to prepare example design sections for tie/TSS review together with as much utility conflict analysis as could be done in the timescale coupled with a schedule of rates prepared by Corduroys to aid MUDFA contractor pricing. Consequently,

design efforts were concentrated on this with Christmas as the deadline for MUDFA ITN.

- 2.2 SDS prepared plans and schedules for Sectors 14 and 19 plus available conflict schedules and made these available to TSS prior to Christmas 2005. This information was subsequently not used in the ITN document.
- 2.3 Furthermore, on the run up to Christmas, SDS were also charged with preparing an Overarching Specification which would act as a reference to all utility specific specifications received from TSS and cover generic civil engineering works. This was issued after Christmas prior to the ITN deadline of 09/01/06.
- 2.4 **Actual Submission early March 2006** - The actual SDS submission was made up of a Bill of Quantities taken off C3 drawings and the Babbie Utility Interface Report and prepared by Corduroys together with the Utility Overarching Specification submission.
- 2.5 **Utilities Interface Meetings** - Buy in from each of the SUCs to a suitable design check and approval process is critical to the success of the utilities design element. Meetings have been held by TSS, and are ongoing, to agree protocols with SUC technical staff relating to the design and construction process, works to be undertaken by MUDFA and work to be retained by the SUCs, in relation to the terms of the protective Agreements entered into by tie during the Parliamentary process. TSS/tie is responsible for the setting up and chairing these meetings with the individual SUCs. There was significant delay in setting up these meetings with SUCs. Some minor SUCs together with BAA and Forth Ports have yet to enter into working agreements with tie for the utility works and so no technical meetings have been held with them.
- 2.6 The second phase of meetings during February/March 2006 were set up by TSS to discuss, at a lower level, the design rules, approval requirements, communication and how design/approval information transfer will be managed given the high volumes of information expected and tight programme. Notable feedback from the meeting with Scottish Water was that the use of side entry manhole would not be permitted (in accordance with company policy) without specific individual applications for specification waiver.
- 2.7 Dates for the third phase of meetings are yet to be confirmed. The purpose of these meetings, part of the design process set out in section 3.1, is to confirm present utility apparatus records against the SUC's latest records and to review SDS' initial diversion and protection design proposals. It is expected that design rules and SUC expectation will become evident at this stage thus feeding into latter designs.

3 Design

- 3.1 This section outlines how we have reached the current design status. It details our initial approach, driven by MUDFA procurement, the base information used and design assumptions made.
- 3.2 **Initial Approach** - In simplistic terms, the overall philosophy for the design is to develop design packages to a level that they could be passed for construction. These packages would consist of plan drawings detailing (referencing each affected utility) existing, diverted and protected apparatus and schedule (cross referenced) containing details of the works such as utility type, material, bedding type and setting out.
- 3.3 The design process is split into 3 main elements which are linked to the design programme for the whole of the works. These elements are:
- (a) STAGE 1 – Support to MUDFA Tender Issue on 9th January 2006 (actually issued early March 2006)
 - (b) STAGE 2 – Preliminary Design for whole of works (coincident with Infracore tender design delivery 30 June 2006)
 - (c) STAGE 3 – Detailed Design for whole of works (July 2006 to Nov 2006)
- 3.4 As referred to in the introduction, it was always recognised that the utility diversion design is out of sequence with the roads design work and will progress on the basis of the most up to date information relating to tram and road alignment, along with structure, OLE, environmental, geotechnical and archaeological information, at any specific time. Consequently the utility diversion design will be subject to potential significant change as the tram and road alignment moves towards a 'design freeze' stage. This interaction has been accounted for within the design process.
- 3.5 The overall design process per section is:
- 1. Identify all potential conflicts within 2m of the tram swept path
 - 2. Reference each conflict (on schedule and drawings)
 - 3. Categorise each conflict as either: under swept path, 0-450mm from swept path, 450-2000mm from swept path, and beyond swept path
 - 4. Assess for potential side entry manhole locations
 - 5. Identify potential environmental/archaeological 'hot spots'
 - 6. Cross reference against original Utilities Interface Report

7. Integrate survey information from Adien and Aperio and update against base information
8. Liaise with SUCs to obtain actual details on size, material and invert level of identified conflicts
9. Assess potential future maintenance work problems
10. Preliminary design PU diversion and protection
11. Carry out IDC check
12. Review against Cost Estimate
13. Issue Preliminary Design
14. Design Development with SUCs and tie
15. Consult with SUCs regarding wider implications of works
16. Consult with tie regarding commercial implications
17. Carry out IDC check
18. Review against Cost Estimate
19. SUCs approval period
20. Receive comments and update drawings
21. Finalise Detailed Design
22. Issue for construction

3.6 **Base Information** - The following drawing were used in the assessment of utility conflicts, together with a review of the Utilities Interface Report, based on the fact that they had chainages marked (required for apparatus scheduling) and that, from review of the files, were more up to date than those issued in tie Disk 2.

- (a) Line 1 from tie Disk 8 "pu master route.dwg" for Line 1, which was created 9th June 1997, modified 22nd September 2005
(Filepath T:\Bridges\Projects\Edinburgh Tram\Incoming Information\04.11.05
Additional CDs\SDS Data Submission 4 Nov 05 Disk 8\route1)
Drawing numbers -B137101/UTIL/1/WAT/001-07 , B137101/UTIL/1/C&W/001-073, B137101/UTIL/1/COM/001-073, B137101/UTIL/1/G&E/001-073
- (b) Line 2 from tie Disk 8 "FM_Z2_final_swept_path_hatch.dwg", last modified 29/09/05
(Filepath T:\Bridges\Projects\Edinburgh Tram\Incoming Information\04.11.05
Additional CDs\SDS Data Submission 4 Nov 05 Disk 8\route2) Drawing numbers -
B137101/UTIL/2/WAT/001-051, B137101/UTIL/2/C&W/001-051,
B137101/UTIL/2/COM/001-051, B137101/UTIL/2/G&E/001-051

3.7 **Design assumptions** - The following initial design assumptions have been made

- Position on above PU drawings is taken as accurate, (will be validated in part by GPR survey results)
- Details in Utilities Interface report for Lines 1 and 2 is accurate
- Depths of services in range detailed within NRSWA guidelines
Invert level
- Condition surveys unknown
- Unknown services not identified
- Utilities Clearance envelope

Vertical (to formation)

- 1200mm deep within 450mm swept path
- Account has not been taken of ground improvement measures
- Account has not been taken of construction methods (over excavation for foundations)

Horizontal

- Swept path plus 450mm
- Longitudinal Utilities within 2000mm of swept path are being identified (for further detailed assessment). 2000mm has been adopted to minimise potential of missing key apparatus given the notoriously poor accuracy of utility apparatus plans.

3.8 Advice has been passed to tie/TSS on drawings used, and initial design assumptions. There is no evidence that SUCs have agreed with tie the design envelope of 450mm beyond swept path (horizontally) and 1200mm (vertically).

3.9 **Design Output** - As agreed with tie during the Utilities **Preliminary Design** Phase the principal deliverables will include:

- General arrangement drawing at 1:200, detailing the following
Details in Utilities Interface report for Lines 1 and 2 is accurate
- Combined existing utilities
- Proposed utility diversions
- Proposed locations of any side entry manholes
- Known underground obstructions (i.e. abandoned chambers)
- Conflict and diversion reference (to schedule)
- Utility specific drawings at 1:200, detailing the following (these will be used for approval purposes with the individual SUCs)
- Existing utility locations
- Proposed utility diversions
- Conflict and diversion reference (to schedule)
- Standard detail drawings showing surface reinstatement details, trench details, typical Cross sections, protection requirements

- Drawings in support of Temporary Traffic Regulation Orders and potential diversion routes as determined through the approval process for the MUDFA Works.
- Design Schedules detailing diversions for all sectors cross referenced to drawings detailing existing apparatus material, replacement material, bedding details, setting out information
Unknown services not identified
- ‘Overarching’ Specification for the utility works including reference to all available utility specifications reinstatement details/specification

3.10 During the Utilities **Detailed Design** Phase the principal deliverables will include:

- General arrangement drawing as per preliminary design but updated in accordance with the design process
- Utility specific drawings at 1:200, as per preliminary design but updated in accordance with the design process
- Standard detail drawings as per preliminary design but updated in accordance with the design process
- Design Schedules as per preliminary design but updated in accordance with the design process
- ‘Overarching’ Specification for the utility works as per preliminary design but updated in accordance with the design process
- Temporary Traffic Regulation Orders including schedules and drawings in support of potential diversion routes as determined through the approval process for the MUDFA Works.

4 *Surveys*

4.1 A GPR survey of critical areas is currently underway. Initially it was envisaged that the entire on street section of the tram network would be surveyed to minimise risk of encountering unidentified apparatus during the MUDFA and INFRACO works. This however has not been possible due to programme and budget constraints.

4.2 **Scope Determination**

Programme constraints – as survey works were to be undertaken during night working it was assessed that a survey of the entire site would take in the region of 9 months. This was not possible given the original aspiration of tie with regard to the MUDFA procurement timescale and delivery of the preliminary design.

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- 4.3 **Budget Constraints** – A full utility mapping and detection survey would have cost in excess of £2,000,000, the reduced scope survey is currently estimated at approximately £220,000 (the apparent limit of budget available for survey works for utilities)
- 4.4 As a consequence of the above the scope of the survey was reduced to cover areas classified under the following 3 criteria:
- (a) **Severe congestion** – predominantly junctions, where longitudinal and transverse services cross and at apparatus hubs
 - (b) **Major services** – those identified as high cost from the Utilities Interface Report such as major sewers, 275KV cables and large gas mains. It was envisaged that information with the highest achievable level of accuracy would not only minimise the financial risk but also be required here to allow effective assessment by the SUCs during design development and diversion requirement negotiation phase
 - (c) **Spatial constraints** – areas where high levels of apparatus are identified with very restricted land space thus requiring accurate information to assess spatial feasibility
- 4.5 Driven by budget and programme constraints, following the initial identification of survey areas in line with the above criteria further assessment was undertaken to reclassify into additional level of risk. This assessment of the initial survey split the areas into a further three categories of risk. These three categories were defined through an understanding of the congested nature of the utilities on Line 1.
- (a) Category 1 was defined as the highest risk areas and included such locations as Picardy Place and St Andrews Square.
 - (b) Category 2 was defined as medium risk and included around the Port areas.
 - (c) Category 3 was lesser risk and included parts of the Roseburn Corridor. The final survey has been procured on the basis of category 1.
- 4.6 **Survey Method** - When Adien carries out their work, they investigate utilities with 3 different methods:
- the first method is to identify the services from the combined utility services drawings
 - the second method is to lift the lids of the various services and induce a current into the cables, this is then traced along the surface

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- and markings placed on the pavement indicating location and depth. This is done for every single duct in each chamber
- the third method that is used is to use a GPR unit that is passed over the ground 7 times, and each successive pass carries out a GPR at a different depth, this is then used to identify services that may not be easily located or connected into the chambers.
- 4.7 All of this information is then collected along with GPS topographical survey of the site and incorporated into CAD.
- 4.8 If Adien locate a service that is not easily identified on the drawings, then this service is traced back to find a possible location where it ties into a known service. If this is not within the limits of the survey area then the service is identified as UNKNOWN.
- 4.9 **Survey Findings** - Broadly, the water and gas main locations are considered to be generally in the locations indicated. There is a lot of additional telecommunications and other services that are being identified, such as traffic loops for light signals. The headlines are as follows:
- Water and gas apparatus is relatively accurate
 - Others utility apparatus showing high levels of positioning inaccuracy between plans and survey
 - All utilities – significant volume of additional apparatus identified
 - High number of chambers, tunnels and other underground structures identified
- 4.10 Additional chambers and tunnels are being discovered by Adien. Adien are not entering these tunnels at present, however confined entry access is being prepared.
- 4.11 **Future Survey Work** - It was envisaged that ad hoc surveys would be required as the design progressed however the issue of accuracy of the existing combined PU information has arisen as a result of the initial findings from the Adien survey.
- 4.12 The possibility of **trial trenching** is being considered to verify the Adien utility mapping and detection work and to allow further assessment of critical locations.
- 4.13 As planned the procurement of a **void survey** by specialist's Aperio is currently underway. The survey areas are yet to be identified but will be made on the basis of the following:
- findings of the Adien survey work

- CEC
- Library records
- Local knowledge

5 Approvals Process

- 5.1 The proposed approvals process by the SUCs has several steps. Broadly, through the Preliminary Design process, the SUCs will be consulted with as the design progresses and is developed, however at this stage they are not required to give formal approval to the design.
- 5.2 During Detailed Design, initially the SUCs and design team carry out a Design Development phase where the details are further worked through before further consultations are carried out with both the SUCs with regards to the wider implications of the design on their works. At the same time, tie is consulted with, in regards to the commercial implications of the proposed design.
- 5.3 As comments are received, the design is further updated and furthered with an IDC check. The SUCs then have an Approval Period where they will be able to sign off on the proposed design so that it can be issued for construction following a final IDC check.

6 Conclusion

- 6.1 It has been referred to previously that utility diversion design has progressed on the basis of the stag layouts and combined PU plans and consequently carries a significant risk relating to abortive design work. This abortive work also includes any specific negotiations with SUCs and any checking work.
- 6.2 The utility mapping and detection surveys are showing high level of inaccuracy in the combined utility drawings. It should be noted that the volume of apparatus not identified on the plans is significant. This raises severe risk on the MUDFA scope of works and programme.
- 6.3 Potentially, severe risks of the discovery by MUDFA and Infracore of unknown utility apparatus are being accepted by SDS by restricting the extent of the utility mapping and detection surveys due to budget and programme. This is supported by the findings of the initial survey areas.

