Appendix A

Construction Statement
A1 General Approach

Construction work on Line One will be carried out in well-defined sections to minimise disruption. In order to optimise construction output as many construction sections of the alignment will be worked on at any given time, as constraints allow. In city centre areas these sections are typically 100m long, however longer sections will be worked on outwith the constraints of the central area. Inevitably, this will involve some areas of work remaining open while the different construction activities catch one another up. Generally work within a section will be progressed as far as possible, including the construction of infrastructure such as tram stop platforms, prior to moving on to the next section. Track construction will be as continuous as is practically possible.

The sequence of the works at any one section will be governed by the detailed layout of the street/area and its buried services and any structural works required. For the majority of the route, services would normally be diverted in advance, and in a co-ordinated process. Services lying within the excavation zone beneath the tram alignment will be diverted or lowered where required in order to reduce future disruption to the operation of the tram resulting from service repairs. Work on the track bed and street/finished surface will then follow. A more detailed description of the sequence of construction activities is provided Section A2.

Detailed construction activities at a given section will depend on site access, ground conditions and whether the section is on street or off street.

A1.1 On Street

In sections where the tram runs on-street, the works required to support the tramway will generally employ the ‘Slipform’ technique. This involves pouring wet concrete into the top of forms to create a reinforced concrete slab at an appropriate depth to support the rails while allowing for surface finishes. For deep road surface construction and construction on bridge decks, the rails may be set on plinths above the slab. The concrete slab could be of in situ or precast construction, and be founded on a base of cement bound or compacted granular material with an overall excavation depth of between 0.56m and 1.2m, the depth of construction being dependent on the capacity of the sub grade.

The length of alignment that can be constructed in a continuous stretch will be defined by the requirement to maintain access and comply with restrictions imposed by the emergency services. As a result of this construction activities on narrow streets, or in wider streets where access has to be maintained, will rarely exceed 100m of continuous track. In these circumstances, the track will be constructed in pre-defined bays with construction joints between adjacent bays. This will be the case for sections of track running through the World Heritage Site (WHS) and the city centre core. Outside the city centre core and WHS the use of ‘Slipform’ techniques may be practicable.

New drainage collection will replace or supplement the existing surface drainage, but with the addition of outlets for track drainage at the low point of vertical curves and occasionally in between. Drainage pipes and connections away from the track bed or at an adequate depth beneath it will continue in use. Construction of infrastructure such as tram stops platforms will then follow and finally OLE support poles and wiring will be put into place.
A1.2 Off Street

For the section of track running off-street on the disused railway, excavation works, particularly in areas of cutting, will be required to widen the alignment of the formation. Excavation works will also be required to lower the level of the formation, to allow the tram to pass under road bridges. The sequence of construction will be determined by the available access to the embankment and the structures to be retained and in certain cases reinforced along this section of the route. Works to the structures including any utilities diversions will be completed before track construction begins.

Once track construction commences the working sections will be longer than on street sections as a result of fewer constraints on access requirements etc. However provisions must be made for pedestrians and cyclists who currently use the railway corridor. The contractor will determine the length of the workable section and construction of the track foundations will involve similar techniques employed in on street construction with track surfaces to be finished using ‘grasscrete’ slabs. This will be used instead of ballast to enable the track to blend in with the surroundings and to prevent the ballast material being used as missiles by vandals.
A2 Stages of Construction

A2.1 Introduction

In areas where significant structural works are required, the stages of construction are likely to be complicated. Access for construction to the structures and to the route generally is likely to be the determining factor. This is particularly significant for the section of track running through the former railway corridor and that along the sea wall at Starbank Road. Along the former railway corridor spoil removal and construction of retaining structures is needed. This area will also involve works to bridges and construction of a structure to ramp down from the railway corridor to street level at Ferry Road. At the seawall along Starbank Road works are required to construct a walkway over the Forth. These stages of construction will have to be executed before work on laying the track bed can commence. Outwith these areas the general stages of construction will be more straightforward and the general sequence of track construction following the diversion of the services within each area is shown below:

- Site clearance (including the removal of hard landscaping).
- Demolitions if required.
- General excavation.
- Installation of drainage, ducts and stray current protection beneath track formation.
- Lay granular capping material if required.
- Lay sub base/blinding.
- Fix reinforcement.
- Lay first stage concrete.
- Install rails and complete stray current protection.
- Complete drainage/ducting above first stage concrete.
- Lay second stage concrete around rails.
- Construct Stops where required.
- Complete accommodation works and final surfacing where possible.
- Install OLE supports, wiring and complete cabling.
- Commissioning.

The construction of substations and connection of the main power supply will be carried out to suit the requirements of the power supply company and the programme.

The following sections briefly describe the general construction activities for each activity.

A2.2 Site Clearance

Site clearance will consist of the removal of trees, bushes, fences, street furniture, signs, lamp columns, bus stops, bus shelters, advertising hoarding etc. Where appropriate, items removed will be stored and replaced at a later date. This will be particularly true for trees and historical features like lamp columns and hard landscape features, especially within the WHS. The site clearance required will vary depending on location. Care will be taken to ensure dust and noise is kept to a minimum, and that the removal of items is carried out at an appropriate time so that heavy goods vehicles (HGVs) do not cause disruption to traffic flows, especially at peak times.

A2.3 Demolition

The partial or complete demolition or modification of some existing structures will be required to accommodate the tram. The contractor will employ a specialist demolition sub-contractor to carry out these works. The general public will be excluded from the vicinity of any demolition works.
A2.4 General Excavation

Excavation will be required to allow the construction of the tram tracks at a suitable depth, so that when they are complete they will be level with the existing road surface. Generally, the sides of excavations will only require support where they extend significantly below the formation level for track construction (for example for the construction of drainage, ducts and OLE support foundations). Where space is limited and buildings and/or other structures may be affected, support measures for the excavation works may be required. The degree of support required will depend on the depth of excavation, the nature of the ground, the proximity of adjacent structures and the nature of their foundations. It is likely that the foundations for the OLE supports will be auger bored.

Excavated material will be removed from site using HGVs. Although the exact haul routes have not been defined at this stage, HGV routes will be agreed by the contractor with CEC to minimise traffic disruption and effects on the amenity of residents and non motorised road users. Excavated materials will be tested for contamination and to establish engineering properties. Suitable excavated material will be reused for engineering fill and contaminated and surplus material will be disposed at suitable sites, to be identified by the contractor.

Excavation works will require diversion of utilities. The full extent of the diversionary work will depend on the final route of the alignment and the exact position and depth of the services. Diversion works are likely however to be the cause of considerable disruption.

A2.5 Drainage and Ducting and the Stray Current Protection Beneath Track Formation

The tram tracks incorporate extensive ducting beneath the first layer of concrete and this will be laid prior to tram track construction, eliminating the need for the utility companies to dig up the tracks at a later date. The ducting will be laid in such a manner to be easily connected to surface water collection systems later in the construction process. Practical measures will be incorporated within the track construction from this stage to protect underground services from stray currents and to protect sensitive telecommunications signal cables from interference arising from the tramway power supply system. A suitable insulating and shielding material will be laid to help achieve this.

A2.6 Granular Capping

The condition of the existing road sub-grade is unknown as is the strength of the sub-grade for the off carriageway sections of the alignment. This will need to be determined for detailed design purposes. In conditions where the ground is weak or variable a layer of suitable loose stone material will be laid, prior to the sub base material provide extra stability by achieving a better fill compaction when additional layers are laid on top and compacted.

A2.7 Sub Base / Blinding

The sub base consists of a suitable depth of stone material laid over the sub grade. The material will then be compacted to create the main load-bearing layer of the surface, evenly spreading the load of the paving, and any traffic thereon, to the sub-grade below. Care will be taken to minimise the impact of the associated noise of the compaction process, by working in agreed hours.

A2.8 Fix Reinforcement

Reinforcement mesh is held in position within a timber frame constructed to define the form of the track bed. The reinforcement mesh will help to facilitate stray current protection.
A2.9 First Stage Concrete

Wet concrete is poured into the top of forms over the reinforcement mesh to create a reinforced concrete slab at an appropriate depth to support the rails. This is referred to as the ‘Slipform’ technique. Once the concrete has solidified it is referred to as the base slab.

A2.10 Rail Installation and Stray Current Protection

The rails are clipped to the base slab, set in position and welded together. The rails are pre-coated with a polymeric insulating material that incorporates a layer of stone chippings on the running surface to improve skid resistance. The rails connect to the reinforcement mesh that has been designed to protrude above the base slab at certain points, to complete the stray current protection system.

A2.11 Drainage Ducting above First Stage Concrete

Ducting laid before the sub base layer is connected to a series of purpose made drainage units or a series of drainage slots through a network of pipes. This will allow surface water draining from the tram tracks to be collected and fed into the existing drainage system via a system of gullies or a collector drain. New gullies and associated pipe work will also be required where existing roads are realigned/re-levelled or the tram alignment runs segregated off-street and drains independently of the adjacent roads.

A2.12 Second Stage Concrete

A second layer of concrete is poured around the rails to a level that allows for the final surfacing to be laid. New kerbs, parking bays and OLE base supports will be constructed following completion of the slab construction.

A2.13 Tram Stop Construction

A total of 22 Stops are proposed for Line One. It is anticipated that each stop will take between 2 and 3 months to construct depending on location and design. Stops requiring special access arrangements such as Haymarket Station will require a longer construction period. The final installation of platform infrastructure and equipment will be carried out at the end of the contract to avoid the risk of damage.

A2.14 Accommodation Works and Final Surfacing

It is not envisaged that significant disruption will be caused by the construction of the tram alignment at minor junctions. It is likely that in the majority of cases construction can be achieved either by using conventional traffic management techniques or, in more difficult areas where space is limited, by the use of temporary road closures, with provision of alternative routes and accesses.

Construction of the tram alignment at major junctions and road crossings, will more difficult. The use of conventional construction techniques is likely to produce significant congestion, and special construction methods will have to be adopted so that disruption can be minimised. For example, out of hours working and weekend closure/possession coupled with the use of prefabricated track elements may provide one solution. Before construction methods are decided the impact on traffic flows will be assessed and compared for each alternative. All practical methods of construction for each of the major junctions will be considered, and congestion assessed both at the junction and within the wider road network. Approval of the local authority will be required for whichever construction method is adopted.

Conflicting road and tram movements will be controlled by signals at junctions and where tram alignments cross major carriageways. Existing traffic signals will be upgraded or new signals
installed to accommodate the tram. It is anticipated that where traffic signal control is proposed at major junctions they will be linked to the existing Urban Traffic Control (UTC).

The final stage in the construction of the tram tracks will be to lay the finished surface on top of the second layer of concrete. This will involve, where applicable, reusing the hard landscaping features which were removed and kept in storage or importing new materials to construct the surface finish of the track alignment.

**A2.15 Installation of Main Cabling**

Power (750 volts dc) will be directed to the Light Rail Vehicles via a ducted supply and OLE. The contact wire will be supported from poles or shared lighting/OLE columns situated along the outside edges, or centrally from poles positioned between the lines of tracks. Where agreed with CEC, the contact wires will be suspended from building fixings particularly in the more built-up areas where space is limited. The supports for the overhead conductors will be poles approximately 30 to 50m apart. The spacing will be determined by the design speed of the tram, tram curvature and the gradient of the track. Additional supports may be required at highway junctions and closer spacing will be required on bends.

The foundations required for the OLE support poles may conflict with underground services, especially where supports lie outside the tram tracks. Generally, support poles will be positioned so to avoid services, but this may not be possible in some areas. Where this cannot be avoided, the services will be diverted.

Measures will be necessary to deter the public from getting within touching distance of the overhead wires. Normally the support poles will be erected following completion of track / highway / accommodation works, but prior to the surface finishes to the footpaths. The contact wire for each section will not be suspended in position until all civil construction activities have been completed on that section.

**A2.16 Commissioning**

Before any vehicle can be entered into public revenue earning service, HM Railway Inspectorate will require full testing, operator training and commissioning. A six-month period has been allowed in the programme for this to be carried out.
A3 Construction Methods and Phasing

A3.1 Construction Period

A three-year period (subject to optimism bias) is projected for the construction, testing and commissioning of Line One. It is anticipated that testing and commissioning will occupy the last six months of this three-year programme.

A3.2 Construction Sections and Phasing

In order to meet the proposed construction programme, the route will be constructed in a number of sections simultaneously. The route divides naturally into six sections for construction purposes. These are detailed in Table A3.1.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Approximate Chainage (m) From</th>
<th>To</th>
<th>Approximate Length</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1</td>
<td>0</td>
<td>700</td>
<td>700</td>
<td>Haymarket Station. Viaduct and tie in with Haymarket Station Development.</td>
</tr>
<tr>
<td>Section 2</td>
<td>700</td>
<td>3000</td>
<td>2300</td>
<td>Section of off-street track running on existing railway embankment between Haymarket Yards and Telford Road. Construction sequence and programming likely to be controlled by restricted access to corridor, restricted working space and structural works.</td>
</tr>
<tr>
<td>Section 3</td>
<td>3000</td>
<td>6500</td>
<td>3500</td>
<td>Section of off-street (some on existing railway corridor) and street running track between Telford Road and Sea Wall. Not restricted by significant structural works and access problems.</td>
</tr>
<tr>
<td>Section 4</td>
<td>6500</td>
<td>8200</td>
<td>1700</td>
<td>Section of track affected by proposed structural works to the sea wall at Starbank Road.</td>
</tr>
<tr>
<td>Section 5</td>
<td>8200</td>
<td>11500</td>
<td>3300</td>
<td>Section of on-street and off-street track between sea wall and city centre.</td>
</tr>
<tr>
<td>Section 6</td>
<td>11500</td>
<td>15600</td>
<td>4100</td>
<td>Section of on-street track within the city centre.</td>
</tr>
</tbody>
</table>

The phasing of construction within each section will depend on a number of factors, including safety, environmental considerations, economics, access and practicality. The location of the construction compound sites along the route will have a major influence on the decisions made as to where
construction will start and finish within each of the sections in this respect. Indicative construction compound sites are discussed in Section A3.3.

The rates achievable for construction of the works within each of the Work Sections described above will depend on the following factors:

- Availability of plant, labour and materials as already discussed above.
- Restrictions on access and space available for construction.
- Restrictions on working times.

On sections such as Work Sections 3 and 5 where access is not a major problem the rate of construction will depend primarily on the availability of resources. On other Work Sections such as 1, 2, 4 and 6 restrictions on access and working space, phasing of structural works, environmental factors and limitations on working times will be factors in determining the speed with which the works can be constructed.

To achieve optimum rates of progress on construction of the track, the contactor will open as many areas for construction at once as the constraints and resources allow.

Progress can also be affected because of difficulties in maintaining access, space for construction, dealing with uncharted services, procurement of materials and availability of resources. A planned rate of construction of 3.23m/day on a typical 110m section of single on-street track within the city centre could be reduced to 1.4m/day because of these difficulties. The rates of construction that are likely to be achieved for track construction at any location are likely to vary as follows (1):

- Single on-street track – 1.4m/day to 3.23m/day
- Double on-street track – 1.1m/day to 1.7m/day

A3.3 Construction Compounds and Work Sites

Site compounds of varying capacities will be required for the construction of each section of the route. Prior to the start of construction the contractor will (subject to local authority planning approval) need to enter into agreements for land and/or facilities to be used for compounds. These compounds will be positioned for easy access to the main areas of work and to minimise the number of traffic movements for delivery of goods and materials, but this will depend on availability.

It is envisaged that one main compound, the proposed depot site at Leith, will accommodate the general site office and amenity areas, storage areas for large items of plant and facilities for testing and commissioning. This compound will also service construction working areas in Leith and Newhaven.

The main compound will be supplemented by six smaller compounds, serving the construction working areas around the route. These have been identified as follows:

- Vacant development site at Morrison Street near Haymarket;
- Land adjacent to Roseburn Terrace Bridge;
- Fire Training Ground at Ferry Road;
- Site at Granton Terrace/Granton View near Granton Square;
- Site at Halmyre Street/Smith’s Place off Leith Walk;
- Waverley Station car park at New Street.

These sites are indicative of those which may be used as construction compounds around the route, and have been identified to inform the assessment of the traffic and environmental effects of

(1) Assumptions are based on the construction progress achieved on the NET Line 1 in Nottingham.
The construction of Line One in this ES. The final choice of compound locations and the responsibility for agreements with landowners for these, or other, construction compounds will be the responsibility of the contractor or concessionaire for the tram.

HGVs will transport materials between the construction working areas and the compounds. The traffic and transport implications of these construction compounds, and their relationship with the six proposed scheme working areas are assessed in *Chapter 5* of the ES.

Works site will be progressed on a linear basis, subject to service diversions, due to the nature of the excavation and track laying works. In normal circumstances on a scheme of this size, local site compounds would be established to aid communication and provide messing facilities and secure storage areas for plant and materials at each work site. The nature of a citywide site, however, is that there is unlikely to be any spare land available in some areas, especially within the city centre core itself. In these circumstances, work sites will consequently have to be located within the areas where work is being carried out, and will have to be adapted on a continuous basis to suit the progress of the works. Local site offices, mess huts *etc* are likely to have to be provided at the contractor’s principal compounds in these areas since there is unlikely to be sufficient space available within the street.

The contractor will have to agree pre-defined routes, which can be used by construction traffic between the site compounds and the work sites, together with routes to be used by construction traffic accessing the work areas directly from outside the City. It may also be necessary to limit the times during the day when these routes can be used. Similarly, access to the site compounds and offices is likely be subject to control by the CEC Roads Authority. For the purposes of the EIA, a number of access routes to compounds and work sites have been assumed, and these are discussed in *Chapter 5* of the ES.