

Guidance Document

G1413 Planning new lines and extensions to existing lines

Issue No.: A1

Issue date: November 2012
Review date: November 2015

MAYOR OF LONDON

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Contents

1	Purpose	4
2	Scope	4
3	Objectives	4
4	Overview of the LU network	4
4.1	The Nature of the LU Railway	4
4.2	Infrastructure	5
4.3	Rolling Stock and Signalling	5
4.4	Traction Power	6
4.5	LU / Network Rail Interface	6
4.6	Depots	6
4.7	Service Frequency	6
4.8	Standards	7
5	The Planning Process	7
5.1	First Ideas	7
5.2	Transport Planning	7
5.3	Project Management	8
5.4	Operational Involvement	8
5.5	Application for Planning Consent	9
5.6	Environmental Impact	9
5.7	Consultation	10
5.8	Side Agreements	10
5.9	Timing	11
5.10	Powers Granted	11
5.11	Safeguarded Routes	11
6	Design – First Steps	12
6.1	The Nature of the Task	12
6.2	Demand and Service Modelling	12
6.3	Fire Safety Strategy	13
6.4	Design Life and Whole Life Cost	14
6.5	Engineering Design Considerations	14
6.6	Enabling Works	14
6.7	Security	15
7	Choice of Route and Alignment	15
7.1	Line Configuration	15
7.2	General Factors Influencing the Choice of Route	16
7.3	Horizontal and Vertical Alignment & Track Configuration	18
7.4	Stations	20
7.5	Terminus Stations	20
7.6	Land Requirements	21
7.7	Ground Conditions	22
7.8	Depots and Stabling Capacity	22
7.9	Visual Impact	23
7.10	Noise and Vibration	23
7.11	Rolling Stock & Control Systems	23
7.12	Traction Power Supply	24
8	Responsibilities	24
9	References	25
9.1	References	25
9.2	Abbreviations	28
9.3	Definitions	29
9.4	Glossary	29
9.5	Subject Matter Expert	29
9.6	Document history	29
10	Appendix 1 – Engineering design considerations	30



10.1	Civil engineering	30
10.2	Track	31
10.3	Station design	31
10.4	E&M	32
10.5	Communications	33
10.6	Operational Considerations in Engineering Design	33
11	Appendix 2 - Depots	34
11.1	Introduction and Scope	34
11.2	Definitions and Terminology	34
11.3	Depot Operation	34
11.4	Brief	35
11.5	Design	35
11.6	Facilities	39

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In this document:

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Note: Emphasised points are shown in a box highlighted in grey.
 Supporting text is shown indented in smaller grey font.

1 Purpose

The guidance in this document describes the main factors that are relevant to the planning and design of new London Underground lines and extensions to existing London Underground lines at project inception.

2 Scope

- 2.1 This Guidance should be used by developers, local authorities, consultants, other third party promoters and Transport for London (TfL) and London Underground (LU) staff.
- 2.2 It covers the planning processes that promoters should be aware of during the early stages of new project development.
- 2.3 It draws attention to key requirements of LU standards relevant to the early stages of design.
- 2.4 It refers to key design considerations that are not always evident or may be overlooked.
- 2.5 It relates to new lines or extensions to existing lines where the operational concept is similar to that used by LU. It does not refer to new lines whose operational concept is significantly different (e.g. Crossrail).
- 2.6 Its primary focus is with land and space requirements and design options having a significant impact on cost.
- 2.7 The guidance does not offer solutions. However, where design compromises are evident, it may provide a general 'steer'. This is not a substitute for ROGS or other legislation and actual requirements will depend on many factors including sponsor's scope, legal constraints, commercial and environmental matters.

3 Objectives

- 3.1 The aim of this document is to provide users with a comprehensive knowledge of the key elements that should be considered during the early stages of a project proposal for new LU lines or extensions to existing LU lines.
- 3.2 Typically it can be used to inform an 'early options' report to stakeholders from which they can determine a feasibility ranking.
- 3.3 The intention is to avoid the need to rework initial designs because important LU considerations have been overlooked. This will minimise the time and work necessary to establish feasible design options.

4 Overview of the LU network

4.1 The Nature of the LU Railway

- 4.1.1 The LU railway differs from most other UK railway undertakings in a number of important ways. These include:
 - a) A high proportion of the network is sub-surface, with stringent fire safety and evacuation requirements;
 - b) A fully electrified network;
 - c) Very high passenger throughput;
 - d) High frequency train services;
 - e) Restricted access and limited time for maintenance.

4.1.2 These give rise to specific network and station design requirements with bespoke standards across all areas of engineering and operations.

4.1.3 Key aims are reliable and safe operation together with keeping passenger journey time and congestion to a minimum.

4.2 Infrastructure

4.2.1 The lines of the LU network are divided into two groups reflecting their construction:

- a) The 'sub-surface' lines, mainly consisting of sections that are of 'cut and cover' construction running just below the surface, often beneath streets, and able to take trains similar in size to those on main lines;
- b) The 'tube' lines, mainly consisting of sections that are of deep tunnelled construction and taking smaller profile tube trains.

Both sub-surface and most tube lines have 'open' sections which are on the surface.

4.2.2 TfL subsidiary - Tube lines are the custodian and maintainer of the deep tube lines; Jubilee, Northern and Piccadilly, and therefore are a key participant in the consultation process where there is a planned interface with these lines.

4.2.3 Special design requirements, particularly relating to means of escape and materials used, apply to sub-surface and tube stations and tunnels.

4.3 Rolling Stock and Signalling

4.3.1 The sub-surface and tube lines each have their own design of rolling stock.



Tube and sub-surface stock

- 4.3.2 Rolling stock dimensions are affected by existing structure gauge and clearances that include:
- a) Different tunnel diameters ranging from 3.4 m in the oldest tube tunnel sections to 4.35m on the Jubilee Line Extension opened in 1999;
 - b) Tight platform curvature at some stations with limited carriage end and centre 'throw' clearances affecting carriage length.
- 4.3.3 Train formation is affected by factors that include:
- a) Varying platform lengths limiting the number of carriages to a train;
 - b) Gradients which determine the number and power of traction units for a train.
- 4.3.4 Signalling systems vary between lines but are being updated in line with new rolling stock to provide Automatic Train Operation (ATO) across the network.

4.4 Traction Power

- 4.4.1 Power to trains throughout the LU network is supplied via two conductor rails which together with the two running rails form a 4 rail system. The historic supply voltage of 630v DC is being progressively increased across the network to 750v DC to improve train performance.

4.5 LU / Network Rail Interface

- 4.5.1 There are some sections of track on the LU network that are shared with Network Rail (NR), otherwise all LU train services run on LU's own track. Both LU and NR track is standard gauge: 1432mm.
- 4.5.2 LU uses NR track between:
- Bakerloo Line:** Harrow and Wealdstone to north of Queen' Park (except Stonebridge Park depot)
- District Line:** Richmond Branch
- 4.5.3 National Rail trains run on LU track between:
- District Line: Wimbledon to Putney Bridge
- Metropolitan Line: Amersham and Harrow on the Hill
- 4.5.4 On dual used track sections signalling systems must be compatible for all users.
- 4.5.5 LU track, including NR track on which LU trains run, is a four rail system – two running rails and two supplying power.
- 4.5.6 Electrical earthing and bonding issues arise when LU and NR electrified track are in the same proximity.
- 4.5.7 Further details together with LU lines running close to NR lines and stations used by LU but owned by NR are given in [OS No. LF08: LU / Network Rail interface](#).

4.6 Depots

- 4.6.1 Depots are required for train maintenance and stabling. There are between one and three on each line. There are also sidings along each line for stabling and reversing.
- 4.6.2 There are train crew depots and line control centres for each line.
- 4.6.3 For detailed requirements see Appendix 2

4.7 Service Frequency

- 4.7.1 The interval between trains ranges between 15 to 30 minutes in the outer parts of the network to 90 seconds in the central area. Details of maximum service intervals on sections of each line are given in [1-391: Standard for train service planning](#).

4.8 Standards

- 4.8.1 LU has its own comprehensive suite of engineering, operational and other standards relating to the LU network. LU category 1 standards are mandatory and any variation is subject to approval through a concession procedure. Concessions can be obtained by making a case to the appropriate LU competent authority.
- 4.8.2 LU standards together with guidance documents and procedures can be found in the [LU management system library](#).
- 4.8.3 Other standards that may be relevant include; The [Railway Group Standards](#) which are the top level standards for main line railway design and other PFI standards such as Tube Lines.
- 4.8.4 The [Railway Safety Principles and Guidance](#) (RSPG), published by the Office of Rail Regulation (ORR), makes important recommendations for stations, tunnels and open sections. Parts 1 and 2 of RSPG were produced by HSE for use by organisations wishing to obtain approval for new or altered works, plant and equipment under the Railways and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994 (ROTS). The Railway and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) revoked ROTS for mainline operators.
- 4.8.5 For new lines, LU standards apply, however in the case of extensions to existing lines, project options will necessarily be constrained by existing arrangements. Although the requirements of LU standards apply, concessions against these may be required.
- 4.8.6 When there is common interest with other operators (e.g. NR, Crossrail, DLR), it is most important to agree whose standards should be used. The basic principal is that the standards of the operator of the new line/extension shall take precedence and at new interchange stations the standards of the station operator shall take precedence.

5 The Planning Process

5.1 First Ideas

- 5.1.1 Proposals for new or extended lines germinate in many ways. Fundamental questions to be answered are:
 - a) What is generating a demand for transport?
 - b) What transport options are available?
 - c) Why is LU a preferred choice?
- 5.1.2 It is essential for developers, boroughs, local authorities and their consultants to have consulted TfL to determine that a project involving LU has merit.
- 5.1.3 There is a web of interacting elements involved in carrying forward projects within LU. The following sub-sections outline the main constituents.

5.2 Transport Planning

- 5.2.1 The LU Transport Planning department is a member of the TfL project steering group whose aim is to resolve conflicts and promote awareness between different transport modes across London.
- 5.2.2 The department's role is to sponsor change within LU relating to network improvements and developments. It can ensure that all appropriate groups and departments within LU are involved at an early stage. Accordingly LU Transport Planning is a good point of entry for new proposals.
- 5.2.3 There should be a business case for a new line or line extension. This business case will normally be owned by whoever receives benefit from the proposal; most likely a developer, borough, etc. although in the case of a new line, the Government can be expected to be actively

involved. LU's usual role is to carry out or facilitate the works required and then to operate the new or additional railway service.

- 5.2.4 When projects progress beyond initial discussions a Development Agreement will be established between LU and the promoter. A key purpose of the Development Agreement will be to set out requirements and processes to protect LU's existing service. It will address responsibilities for financial and technical design and construction matters (including standards to be used) together with responsibilities for eventual operation and maintenance. Assets integrated with LU's network will normally be operated by LU with arrangements agreed for costs and revenue.
- 5.2.5 A key element of any agreement is to ensure that LU's existing service is not compromised and to stipulate use of LU's standards. Assets integrated with LU's network will normally be operated by LU with arrangements agreed for costs and revenue.

5.3 Project Management

- 5.3.1 All new projects will need appropriate management. The [LU Project Management Framework \(PMF\)](#) sets out typical processes for managing LU projects.

The PMF establishes a project management team and covers programme management; engineering feasibility and design, systems integration, value engineering, implications for train services, reviews, etc. and provides for a hierarchy of plans and specifications.

The PMF document [H-0018: Manage engineering](#) sets out engineering management responsibilities for the project which include design duties under the [Construction \(Design and Management\) Regulations 2007](#) and safety verification under [The Railways and Other Guided Transport Systems \(Safety\) Regulations 2006 \(ROGS\)](#).

- 5.3.2 The early stages of the project include business planning, feasibility studies and concept design.

A key document for the concept design stage (PMF stage 3 and RIBA stage C) is the Systems Requirements Specification (or Technical Requirements Specification for less complex projects). It is important to ensure that this contains sufficient engineering content to support the project's feasibility.

5.4 Operational Involvement

- 5.4.1 LU Operations should be involved at an early stage of a project.
- 5.4.2 Operations will produce a Concept of Operation which takes account of the route, stations, platforms, bridges, shafts, train frequency, fire strategy, etc. and sets out:
- The operational purpose of the system;
 - Staffing concepts for the system;
 - How the system will be operated to deliver the operational purpose;
 - Intended operations under abnormal, degraded and emergency conditions.
- 5.4.3 Human factors considerations need to be fully addressed during system development by ensuring that equipment design integrates with future operational practices and the competence and training of operational staff.

To ensure a successful project outcome, the development of operational arrangements such as staffing, training, trade union involvement, etc. for a new project must run in parallel with technical developments. Thus, if the technical specification changes during design or construction, the operational arrangements must change accordingly. Failure to keep abreast of technical changes will result in operational difficulties or failure during use. This will result in cost and delay.

5.5 Application for Planning Consent

- 5.5.1 A promoter will need to identify the organisation that will be responsible for the project and to establish the mechanism to be used to obtain planning consent and development powers.
- 5.5.2 There is a choice of mechanisms relevant to railway construction and operation and expert advice should be sought as appropriate.
- a) Submission of a Hybrid Bill to parliament - this is a means of authorising, by parliamentary process and Act of Parliament, projects jointly promoted by government and the project organisation and which typically are of general public interest but have local effect (e.g. Crossrail). Note that after the 2nd reading of a Bill there can be no further objections about the need for the project.
 - b) Application to the Secretary of State for a Transport and Works Order (TWO) made under the Transport and Works Act 1992 – available only for transport projects usually of medium size (e.g. Metropolitan Line, Croyley Rail Link). The promoting organisation must notify all parties that may be affected. The Secretary of State appoints a planning inspector who considers the planning inspection report and writes a report with recommendations. If there are a number of objections then a public enquiry is required.
 - c) Application for planning permission from a Local Authority under the Town and Country Planning Act 1990. Permitted Development Rights (PDR) under the Act apply to 'railway undertakers on their own operational land in connection with the movement of traffic by rail'.

Indicatively an Act of Parliament is likely to be required for a new line, whilst a TWO would be required for an extension to an existing line.

5.6 Environmental Impact

- 5.6.1 A cornerstone of an application under any of the above is the preparation of an Environmental Impact Statement (EIS) (although certain PDRs can be exempt). This forms part of the [Environmental Impact Assessment \(EIA\) procedure](#) involving consultation with statutory authorities, third parties and the public. An EIS is required to describe the project and assess its effects on people and the environment during its construction and subsequent use.
- 5.6.2 The promoter must ensure that designers provide, at an early stage, all the information required by those both assessing the environmental impact of 'pre-powers' design and preparing the EIS. Construction Planning information having an environmental impact (e.g. lorry movements) must also be included. Sufficient time should be allowed in the project programme for carrying out assessments and preparing the EIS.
- 5.6.3 Key considerations are:
- a) Noise and vibration during construction and when the railway is in service;
 - b) Disruption during construction;
 - c) Visual intrusion;
 - d) Loss of attractive open space;
 - e) Ecology and nature conservation
 - f) Pollution;
 - g) Inhibiting planning options for future use of land;
 - h) Energy consumption
 - i) Electromagnetic interference
 - j) Opportunities for environmental mitigation, such as green roofs
 - k) Geology, soils and contaminated land.

5.7 Consultation

- 5.7.1 Promoters must determine who are the stakeholders and affected parties and then consult them as part of the process of developing the design and as part of the EIA procedure.

Promoters of projects should not underestimate the time needed for consultation and negotiation with affected parties. Consultation should be formal and should be carefully recorded. Inquiry committees will expect to see evidence that consultation has been carried out.

A detailed audit trail should be kept from an early stage to show that all design options have been considered and that all issues arising (e.g. relating to engineering, station location, route, shafts, etc.) have been addressed fully. Public debate, inquiries, parliamentary committees, etc. will constantly challenge decisions and therefore comprehensive explanations need to be readily available.

Whilst the promoter is obliged to consult statutory bodies (e.g. Highways Agency, Local Authorities, etc.) public consultation should be considered as well.

It may be appropriate to hold two or more rounds of public consultation, which may take the form of letter drops, advertisements in the press and road shows. In all cases, the response to public and statutory consultation must be adequately recorded and any changes to the scheme, construction methodology, logistics, etc. should be related back to the relevant consultation. This may be set out in a 'Commitments Register' that can be presented at any inquiry or parliamentary committee hearing to demonstrate the promoter's response to consultation and to formally record commitments so they can be discharged during detailed design or construction or both.

5.8 Side Agreements

- 5.8.1 Promoters should recognise that part of the approvals process involves making side agreements with affected parties, e.g. with landowners and utility companies, **prior** to making application for powers. Such agreements will demonstrate to an inquiry the absence of an objection.
- 5.8.2 Promoters should agree a Code of Construction Practice (CoCP) with affected local authorities (to cover lorry movements, hoardings, noise, etc.).
- 5.8.3 Where an LU line interfaces with NR, DLR or another infrastructure operator, agreement needs to be reached about how infrastructure and operations are integrated and whose standards apply. It is likely that these rail operators and statutory bodies will require Protective Provisions to be included within the Order or Bill.
- 5.8.4 When negotiating agreements, etc., LU Infrastructure Protection staff can give engineering related advice about:
- a) Development agreements;
 - b) Protection provisions in leases;
 - c) Protection provisions for new lines;
 - d) Protection from outside party works (where the developer is not contracted to LU either directly or indirectly).

It is very beneficial for the promoter to appoint a single point of contact for each aspect of negotiation, for example with local authorities, utility companies, landowners, etc.

5.9 Timing

Planning negotiations can take a long time. This needs to be recognised in the project programme at the outset. The sequencing and monitoring of progress should be managed accordingly.

5.10 Powers Granted

5.10.1 An Act of Parliament and a TWO both grant wide powers, including powers for:

- a) Construction, operation and maintenance as specified;
- b) Compulsory acquisition of land or rights over land, including land required temporarily;
- c) Closure or diversion of roads or paths or creation of new rights of way;
- d) Other matters for the protection of the project such as protection of adjoining buildings, use of watercourses, movement of utilities, transfer of an existing undertaking and the making of by-laws.

5.10.2 It is difficult for powers to be added once an Act has been passed or an Order granted. For additional powers a separate process must be undertaken. An additional provision can be implemented, relating to the parliamentary process but can only be submitted during the bill process and not after the Act receives royal assent. In that case a separate Transport and Works Order, assuming the change is not considerable, would be the way to get additional powers. If the change is in fact substantial then a special order from the Secretary of State may be required.

It is essential that every aspect that is required to start, undertake, complete, maintain, operate and further develop the project in perpetuity is identified and included in the application or Bill. For example, all assets over one metre in diameter need to be identified in the application. Promoters should seek legal and other expert advice about what information must be provided. TfL has considerable expertise in this.

5.10.3 Once powers have been obtained, there may be other approvals required before works can commence, covered for example by Protective Provisions as well as the CoCP and side agreements as appropriate.

5.10.4 The project can be activated on existing LU land and on other land once that land has been acquired by compulsory purchase.

5.11 Safeguarded Routes

5.11.1 Prior to applying for powers to build a new line or extension to an existing line railway, undertakings can apply to the Secretary of State to issue safeguarding direction to local planning authorities for a defined route corridor - clearly showing the properties affected.

5.11.2 Safeguarding directions require the local planning authorities to consult the railway undertaking (e.g. LU) before they grant any planning consent that may affect future construction and operation of a railway within a safeguarded area.

5.11.3 The directions make it clear that consent cannot be given against the advice of the undertaking without referring the matter to the Secretary of State.

5.11.4 Safeguarding directions may be issued by the Secretary of State for other transport modes. Information about safeguarded routes is available from each local authority.

6 Design – First Steps

6.1 The Nature of the Task

- 6.1.1 Planning a new or extended line is not a 'straight line' sequence of activity. The work has the following characteristics:
- a) Many disciplines are involved - engineers, lawyers, financiers, architects, town planners, transport economists, train operators;
 - b) The work is iterative, involving trial and error and exploring many options;
 - c) Land can only be purchased by agreement or through blight provisions during the early stages of a project, until compulsory purchase powers are granted. If powers are not present in the area, land can only be purchased by agreement during the early stages of a project.
- 6.1.2 It is a task which combines experience, knowledge, imagination and analysis.
- 6.1.3 It is vital to employ an experienced and competent railway engineering designer.

6.2 Demand and Service Modelling

Models

- 6.2.1 Passenger flow and train service modelling is essential to determine if new lines and line extension proposals are warranted and economically viable.
- 6.2.2 Models using passenger flow data are used to develop station design and train services in order to understand capacity, avoid congestion and optimise journey times. Dwell times at congestion pinch points, which can distort passenger perception of journey time, can also be identified.
- 6.2.3 An overriding consideration with extensions to existing lines is to ensure that existing service levels are maintained with the new extension. Modelling should include a timetable exercise for the whole line.
- 6.2.4 A number of models are used by LU, for example:
- a) Railplan – for overall service;
 - b) PEDS (Pedroute Strategic) – plots all stations and compares service options;
 - c) Static analysis – fast analysis for specific solutions;
 - d) Dynamic model – Legion or Pedroute – to establish journey time.

Passenger Flows

- 6.2.5 Passenger flows should be estimated for the service opening date and reviewed prior to RIBA Stage C (concept design). This design stage is often not reached until several years after initial proposals by which time passenger data may have changed significantly. Passenger flows determine the capacity requirements of escalators, lifts, passageways and platforms (see [S1371: Station planning](#)).
- 6.2.6 Models are tested with passenger flows normally uplifted by 35% to reflect a 70 year service capability at a growth of 0.5% per year. However with known growth (e.g. building of Canary Wharf on the JLE) testing may be carried out for dates in the future using an appropriate uplift factor. Careful consideration should be given to suitable uplift factors.
- 6.2.7 Models need to forecast the impact of proposals on interfacing lines and networks. Increased congestion may require station capacity improvements or there may be a need to lengthen trains or increase their frequency.
- 6.2.8 The design consequences of using, say, 50% uplift may be challenged through Value Engineering input into the business case to determine the net benefit. For example, passenger