Dated 19th November 2019

LONDON UNDERGROUND LIMITED (1)

and

LIONWELD KENNEDY FLOORING LIMITED (2)

FRAMEWORK AGREEMENT
for the supply of Walkway and Drainage Panels

CONTRACT REFERENCE NUMBER: TfL 01366

Contents

THIS AGREEMENT is made on 19th day of November 2019

BETWEEN:

(1) **London Underground Limited**, a company registered in England and Wales under number 01900907 and having its registered office at 55 Broadway, London SW1H 0BD (the "**Company**" which expression shall include its successors and assigns); and

(2) **Lionweld Kennedy Flooring Limited** a company registered in England and Wales under number 054274797 and having its registered office at Marsh Road, Middlesborough Teesside, TS1 5JS (the "**Supplier**").

BACKGROUND

(A) The Supplier carries on the business of manufacturing and selling the Goods.

(B) The Company wishes to buy and the Supplier wishes to supply the Goods on the terms and conditions set out in the Agreement.

(C) This Agreement may be utilised by the Company or any other member of the TfL Group. The Greater London Authority, any of the London boroughs, the Metropolitan Police Service, or any functional body (as defined in the GLA Act) may, if the Supplier so agrees, contract with the Supplier on the terms set out in this Agreement.

THIS DEED WITNESSES as follows:

1 Definitions and Interpretation

1.1 In this Agreement and each Contract the following definitions shall have the following meanings:

"**Additional Goods**" means any goods which the Company requests the Supplier to provide in accordance with the terms of the Agreement and each Contract in addition to those set out in the Specification.

"**Aggregated Annual Spend**" means the total of all sums paid by the Company to the Supplier (exclusive of VAT) pursuant to the terms of the Contract annually calculated in accordance with Clause 9.

"**Agreement**" means these terms and conditions, including the Schedules, as amended, varied or supplemented from time to time.

"**Applicable Laws**" means, depending on the context, all or any laws, statutes, proclamations, recommendations, codes of practice, by-laws, directives, Regulations, statutory instruments, rules, orders, rules of court, delegated or subordinate legislation, rules of common law or any European Union legislation (including any declarations of conformity), at any time or from time to

time in force in the United Kingdom and which are or may become applicable to the Agreement and each Contract, any agreement or document referred to in the Agreement and each Contract, or the Goods.

"**BAFO**" means 'best and final offer'.

"**CCSL**" the Centre for Civil Society Limited or any relevant replacement organisation as notified by the Company from time to time;

"**Cessation Plan**" means a plan agreed between the parties or determined by the Company in accordance with Clause 49.1 to give effect to a Declaration of Ineffectiveness or a Public Procurement Termination Event.

"**Commencement Date**" means the date specified as such in Schedule 1.

"**Company's Representative**" means the person appointed by the Company and named as such in the relevant Order.

"**CompeteFor**" has the meaning given to that term in Clause 50.

"**Confidential Information**" means any information given orally or in writing which is a trade or business secret or method; technical know how; personal data which relates to a living individual who can be identified from that information; information relating to any crime, breach of statutory duty or criminal investigations; information relating to the protection of prominent persons, national security, counter-terrorism or other information relating to the provision of police services for any national or international purpose; information relating to the Company's obligations in accordance with sections 118 to 121 of the Railways Act 1993; confidential financial information including but not limited to taxation information and returns to shareholders; and any other information that a party would reasonably expect to be able to protect by virtue of business confidentiality provisions.

"Consequential Loss" means in relation to a breach of this Agreement or any Contract or other circumstances in which a party is entitled to recover any costs, expenses or liabilities suffered or incurred, loss of profit, loss of revenue, loss of contract, loss of goodwill and/or other financial loss resulting from such breach and whether or not the party committing the breach knew, or ought to have known, that such loss would be likely to be suffered as a result of such breach.

"**Contract**" means a contract as defined in Clause 3.1.

"**Contractual Documentation**" means all documentation and information agreed to be delivered by the Supplier in accordance with each Contract including without limitation records, reports, documents, papers, unpatented designs, drawings, data specifications, manufacturing or work

processes, testing procedures, relevant computer data and all other technical business and similar information originated by or on behalf of the Supplier in accordance with each Contract.

"**Contract Information**" means (i) each Contract and Agreement in its entirety (including from time to time agreed changes to any Contract and/or Agreement) and (ii) data extracted from the invoices submitted pursuant to Clause 9.2 which shall consist of the Supplier's name, the expenditure account code, the expenditure account code description, the document number, the clearing date and the invoice amount.

"**Contract Reference Number**" means the number shown on the front page of this Agreement.

"**Contract Variation Procedure**" means the procedure set out in Schedule 5.

"**Data Protection Legislation**" means:

(a) the Regulation (EU) 2016/679 on the protection of natural persons with regard to the Processing of personal data and on the free movement of such data;

(b) Directive (EU) 2016/680 (the Law Enforcement Directive);

(c) any legislation in force from time to time in the United Kingdom relating to privacy and/or the Processing of Personal Data, including but not limited to the Data Protection Act 2018;

(d) any statutory codes of practice issued by the Information Commissioner in relation to such legislation; and

(e) the Privacy and Electronic Communications (EC Directive) Regulations 2003.

"**Declaration of Ineffectiveness**" means a declaration of ineffectiveness in relation to any Contract made by a court of competent jurisdiction in accordance with Regulation 98 of the Public Contracts Regulations 2015 (as amended) or Regulation 113(2)(a) or Regulation 118(3) of the Utilities Contracts Regulations 2016 (as amended).

"**Defect**" means that the Goods or any part of them do not comply with the requirements of any Contract, or are not fit for their intended purpose, or are of unsatisfactory quality whether in consequence of faulty design, faulty materials, negligence, bad workmanship or in consequence of any other reason attributable to the Supplier or its suppliers or the employees of any of them. For the avoidance of doubt, this shall include damage which occurs during transit from the Supplier to the Company.

"**Delivery Address**" means the address at which the Supplier shall deliver the Goods to the Company and which is set out in the Order or such other destination as may be notified by the Company to the Supplier.

"**Delivery Note**" has the meaning given to that term in Clause 10.6.

"**Dispute**" has the meaning given to that term in Clause 38.1.

"**Documentation**" means all documents, items of information, data, reports, drawings, specifications, plans, software, designs, inventions and/or other material produced or supplied by or on behalf of the Supplier in the performance of each Contract and whether in paper form or stored electronically.

"Excepted Liabilities" means the liability of the Supplier for:

(a) any Liquidated Damages payable;

(b) any abatements for performance levied in accordance with this Agreement or any Contract;

(c) Losses against which the Supplier is entitled to an indemnity under any policy of insurance (or would have been entitled but for any breach or failure to maintain such insurance);

(d) Losses caused by fraudulent acts or acts of a criminal nature; and

(e) Losses caused by the Supplier committing a Prohibited Act or Safety Breach.

"**Excess Costs**" has the meaning given to that term in Clause 17.6.

"**Existing Contracts**" means any and all contracts, whether current, expired or terminated, pursuant to which goods and/or the services have been supplied and/or provided by the Supplier (in the capacity of contractor or subcontractor) to the Company and/or any other member of the TfL Group.

"**Expected Order Delivery Date**" means the date set out in each Order upon which the Goods or any part of them are to be delivered by the Supplier to the Company.

"**Force Majeure Event**" means any of the following (or any circumstances arising as a consequence of any of the following) if and only to the extent that such event or circumstances is or are not caused by, and their effects are beyond the reasonable control of, a party affected by such an event or circumstances and which have an adverse effect on the party affected by such an event or circumstances and such party's ability to perform its obligations under the Agreement or any Contract and is not an event or circumstances (i) whose effect the party affected by such an event is otherwise required to avoid or provide against (other than by way of insurance) under the Agreement or any Contract or (ii) which the party affected by such an event could reasonably have avoided or provided against:

(a) war, invasions, acts of foreign enemies, hostilities (whether war be declared or undeclared), civil war, rebellion, revolutions, insurrection, military or usurped power, confiscation, or requisition by or under the order of any government or public or local authority;

(b) civil unrest;

(c) any act of terrorism or a specific threat of terrorism which results in the partial or total, temporary or long term closure of the Underground Network;

(d) lightning, earthquake or subject to (f) below, extraordinary storm;

(e) fire;

(f) flooding, other than flooding caused by rising water table or by weather conditions (including extraordinary storm);

(g) tunnel collapse;

(h) compliance with the provision of sections 118 to 121 of the Railways Act 1993;

(i) nuclear, chemical or biological contamination including ionizing radiation or contamination by radioactivity from any nuclear fuel or nuclear waste from the combustion of nuclear fuel or radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof;

(j) the discovery of fossils, antiquities or other material which in each case is required to be exhumed or unexploded bombs; and

(k) strikes, lock outs or other industrial action being in each case industry-wide.

"**Goods**" means the goods stated in the Specification to be supplied by the Supplier and any Additional Goods which the Company has agreed to buy under Clause 7.

"**Greater London**" has the meaning ascribed to it in the GLA Act.

"**Greater London Authority Act**" or "**GLA Act**" means the Greater London Authority Act 1999 relating to the formation of the Greater London Authority.

"**Infrastructure Manager**" has the meaning ascribed to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006.

"**Initial Period**" means the number of years from the Commencement Date stated in Schedule 1.

"**Intellectual Property Rights**" means any intellectual property rights in any part of the world and includes but is not limited to all rights to, and interests in, any patents (including supplementary protection certificates), designs, trade-marks, service marks, trade and business names and get up, moral rights, domain names, copyright and neighbouring rights, databases, semi-conductors, know how, knowledge, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) whether registered or not in respect of any technology, technique, concept, idea, style, scheme, formula, system, logo, mark or other matter or thing, existing or conceived, used, developed or produced by any person, together with all applications and rights to apply for registration or protection of such rights, Confidential Information relating to those rights, material embodying those rights and in each case rights of a similar or corresponding character.

"**Interest Rate**" means the percentage above the base rate from time to time of the Bank of England as specified in Schedule 1.

"**Liquidated Damages"** means the sums identified and calculated in accordance with each Order.

"London Living Wage" the London rate for the basic hourly wage as updated and published annually by the CCSL (or any relevant replacement organisation) on its website (www.livingwage.org.uk);

"**Losses**" means any expense, liability, loss, claims, fines, damages, costs (including reasonable legal and other professional fees and disbursements), penalties, settlements and judgments incurred by the Company, its employees or agents (which, for the avoidance of doubt, shall include a Replacement Employer).

"**Mayor**" means the person from time to time holding the office of Mayor of London as established by the GLA Act.

"**Nominated Representatives**" has the meaning given to that term in Clause 38.2.

"**Notice to Proceed**" has the meaning given to that term in Clause 17.7(b).

"**Notified Sum**" has the meaning given to that term in Clause 9.8.

"**Operator**" means a person with statutory duties to provide or secure the provision for Greater London of public passenger services by railway or a person who secures the provision of such services through appropriate contractual arrangements.

"**Order**" means an order which, unless the parties agree otherwise, shall be substantially in the form set out in Schedule 4, entered into by the Company and the Supplier.

"**Order Delivery Date**" means the date upon which the Goods or any part of them are actually delivered to the Delivery Address by the Supplier to the Company.

"**Order Price**" means the amount stated under the heading "Order Price" in the relevant Order.

"**Payment Application**" has the meaning given to that term in Clause 9.2.

"**Personal Data**" has the meaning given to it in the Data Protection Legislation

"**Policies**" means the policies set out in Clause 28.3.

"**Prescribed Period**" has the meaning given to that term in Clause 9.5.

"**Processing**" or "**processing**" has the meaning given to it in the Data Protection Legislation.

"**Prohibited Act**" means:

(a) offering or agreeing to give to any servant, employee, officer or agent of the Company any gift or consideration of any kind as an inducement or reward:

(i) for doing or not doing (or having done or not having done) any act in relation to the obtaining or performance of the Agreement or any Contract or any other contract with the Company; or

(ii) for showing or not showing favour or disfavour to any person in relation to the Agreement or any Contract or any other contract with the Company; or

(b) entering into the Agreement or any Contract or any other contract with the Company with which commission has been paid or has been agreed to be paid by the Supplier or on its behalf or to its knowledge unless, before such Contracts were entered into, particulars of any such commission and of the terms and conditions of any such contract for the payment thereof have been disclosed in writing to the Company; or

(c) committing an offence:

(i) under the Bribery Act 2010;

(ii) under legislation creating offences in respect of fraudulent acts; or

(iii) at common law in respect of fraudulent acts,

in relation to the Agreement or any Contract or any other contract with the Company; or

(d) defrauding or attempting to defraud the Company.

"**Public Procurement Termination Event**" means:

(a) the Agreement or any Contract has been subject to any substantial modification which would require a new procurement procedure in accordance with Regulation 72(9) of the Public Contracts Regulations 2015 or Regulation 88(8) of the Utilities Contracts Regulations 2016; or

(b) if the Company determines that the Agreement or any Contract should not have been awarded to the Supplier in view of a serious infringement of the obligations contained under the EU Treaties and applicable procurement Regulations.

"**QUENSH**" has the meaning given to it in Schedule 6.

"**Regulation**" includes any regulation, rule, official directive, request or guideline (whether or not having the force of law) of any governmental, intergovernmental or supranational body, agency, department or regulatory, self-regulatory or other authority or organisation.

"**Rejected Goods**" has the meaning given to that term in Clause 14.2.

"**Rejection Notice**" has the meaning given to that term in Clause 14.2.

"**Responsible Procurement Policy**" means the policy document entitled the "GLA Group Responsible Procurement Policy" dated March 2006, updated in January 2008 and as may be amended.

"**Safety Breach**" means a material breach of any obligation under any Contract caused by the gross incompetence of or wilful default by the Supplier (or anyone employed by or acting on behalf of the Supplier) or any of its agents which has materially affected the safe operation of the Underground Network or the safety of the Company's customers, staff or any other person.

"**Specification**" means the description of the Goods set out in Schedule 3 and to be provided by the Supplier in accordance with the Agreement.

"**Standards"** means the Category 1 and 2 Standards and Draft Category 1 and 2 Standards and such European, British and International Standards and associated Codes of Practice required by the Company for the Supplier to supply the Goods in accordance with good industry practice. A full set of current Standards is available for the Supplier's use on-line at the LU Standards e-library or as notified to the Supplier.

"**Supplier Personnel**" means all employees, agents or consultants of the Supplier and the Supplier's subcontractors from time to time.

"**Supplier's Representative**" means the person appointed by the Supplier and named as such in the relevant Order.

"**Term**" means the period specified as such in Schedule 1 to this Agreement.

"**TfL**" or "**Transport for London**" means Transport for London, a statutory body set up by the Greater London Authority Act.

"**TfL Group**" means Transport for London and all of its subsidiaries and their subsidiaries (as defined in Section 1159 of the Companies Act 2006) from time to time, together with Crossrail Limited (company number 04212657) and reference to any "**member of the TfL Group**" refers to TfL or any such subsidiary.

"**Transparency Commitment**" means TfL's commitment (applying to TfL, the Company and the rest of the TfL Group) to publish contracts, tender documents, and data from invoices received in accordance with the Local Government Transparency Code 2015 and TfL's own published transparency commitments.

"**Underground Network**" means the stations and depots (wherever situate), assets, systems, track and other buildings which are used in the maintenance and provision of the underground service known as "London Underground".

"**VAT**" means value added tax as provided for in the Value Added Tax Act 1994 and legislation (whether delegated or otherwise) supplemental thereto, or in any primary or secondary legislation promulgated by the European Union or any official body or agency of the European Union, and any similar sales, consumption or turnover tax replacing or introduced in addition to the foregoing.

"**Variation Order**" means the written authorisation from the Company to a Variation Proposal in accordance with the Contract Variation Procedure.

"**Variation Proposal**" means the written proposal put by the Company or the Supplier to vary any Contract and/or this Agreement in accordance with the Contract Variation Procedure in substantially the form set out in Appendix 1 to Schedule 5.

"**Warranty Period**" the period specified as such in Schedule 1.

"**Working Day**" means any day of the week (other than Saturday or Sunday) which is not an English bank holiday, or public holiday.

1.2 The headings in the Agreement and each Contract are only for convenience and shall not affect its interpretation.

1.3 Where appropriate, the singular includes the plural and vice versa.

1.4 A reference to a Clause or a Schedule shall be to a Clause of or, as the case may be, a Schedule to, the Agreement and each Contract and references to the Agreement and each Contract include its recitals and Schedules.

1.5 References to (or to any specified provision of) the Agreement and each Contract or any other document shall be construed as references to the Agreement and each Contract, that provision or that document as in force for the time being and as from time to time amended in accordance with the terms of the Agreement and each Contract.

1.6 Reference to any Applicable Laws and Standards also includes a reference to the Applicable Laws and Standards as from time to time amended, extended or re-enacted.

1.7 References to the "**Company**" shall include its successors, transferees and assignees.

1.8 References to a person, firm or company includes any individual company, unincorporated association or body (including a partnership or joint venture) or other entity whether or not having a separate legal personality.

1.9 In the event that a conflict, ambiguity or inconsistency exists between the documents comprising the Agreement and each Contract, the order of priority for the purpose of construction in descending order is:

(a) the Clauses of the Agreement and each Contract;

(b) the Schedules to the Agreement and each Contract (equal priority but subject to Clause 1.10); and

(c) any other document referred to in, or incorporated by reference into, the Agreement and each Contract.

1.10 The documents that make up the Schedules shall be taken as being mutually explanatory of one another. In the event of any conflict between any provision of the clauses of the Agreement and each Contract and a provision of any other Schedule then the clauses of the Agreement and each Contract will take precedence except where the conflicting part of the other Schedule is explicitly expressed to take precedence over any specific part of the Clauses of the Agreement and each Contract.

2 Duration and Option to Extend

2.1 The Agreement shall commence on the Commencement Date and continues in force for the Term unless terminated earlier in accordance with this Agreement and subject to Clause 2.3.

2.2 Expiry or termination of the Agreement shall not, in and of itself give rise to an expiry or termination of the Contract and each Contract shall continue for the term set out in the relevant Contract.

2.3 The Company shall at its own discretion be entitled at any time prior to the expiry of the Term to inform the Supplier of its intention to extend the Term of the Agreement by a period of up to two (2) years. The provisions of the Agreement shall continue to apply mutatis mutandis to any such extension of the Term (other than this Clause 2.3 containing the option to extend). On receipt of such notice from the Company by the Supplier, the Agreement shall be deemed extended accordingly.

3 Supplier's Primary Obligations

3.1 The Supplier shall supply the Goods to the Company in accordance with:

(a) the terms set out in the Agreement (including the Schedules); and

(b) the terms of the Orders which may from time to time be entered into by the Company and the Supplier,

each Order together with the terms of the Agreement comprising a separate and distinct contract and herein referred to as a "**Contract**".

3.2 When Goods are required by the Company, the Company shall give the Supplier an Order for the goods to be delivered and each Order so given shall be final, unless varied in accordance with the Contract Variation Procedure.

3.3 The Supplier shall ensure and warrants to the Company that the Goods will:

(a) conform in all respects with the Specification and the provisions of each Contract including, without limitation, specifications as to quantity, quality and description;

(b) be of satisfactory quality and fit for the purpose for which they are intended;

(c) comply with all Applicable Laws (including but not limited to any law and regulations applicable to the Company or the Underground Network);

(d) comply with all Standards and any additional standards listed in Schedule 1 or in the Specification;

(e) comply with the requirements of the Company set out in each Contract and all lawful and reasonable directions of the Company;

(f) have a rate of deterioration no more than is reasonably to be expected of high quality, reliable, well designed and engineered, materials, goods and equipment.

3.4 Not used.

3.5 The Supplier warrants and undertakes that the Supplier has entered into and executed this Agreement and any Contract by the Supplier's duly authorised representative in accordance with all procedures required by its governing laws and contractual documents.

3.6 The Supplier warrants to the Company that, as at the date of this Agreement and each Contract, it has not been in any of the situations referred to in Regulation 57(1) of the Public Contracts Regulations 2015 and should therefore have been excluded from the procurement procedure in accordance with those Regulations or Regulation 80(2) of the Utilities Contracts Regulations 2016.

3.7 The Supplier shall perform its obligations under each Contract in accordance with the requirements of the ISO 9000 and ISO 14000 series as appropriate to the supply of Goods any equivalent international quality assurance standards as may be accepted as an alternative in the absolute discretion of the Company.

3.8 It shall be the responsibility of the Supplier to obtain, at its cost, all necessary approvals, licences, permits and consents in relation to the Goods and their delivery, including, but not limited to, those required by any Applicable Laws and Standards.

3.9 Unless otherwise stated in any Contract, the Supplier shall provide all equipment, support services and other facilities necessary for the performance of its obligations under each Contract.

3.10 For the avoidance of doubt, neither a communication from the Company nor the review or acceptance of the Goods waives limits or amends in any way any warranties, liabilities or responsibilities of the Supplier under this Agreement or any Contract.

3.11 The Supplier shall be responsible for the accuracy of all Contractual Documentation and shall pay the Company any extra costs occasioned by any discrepancies, errors or omissions therein. The Supplier shall at its own expense carry out any alterations or remedial work necessitated by such errors, omissions or discrepancies and modify the relevant documents or information accordingly.

3.12 The Supplier warrants to the Company that it has the right to grant to the Company and any member of the TfL Group all licences (including without limitation all rights to sub-licence) of all and any Intellectual Property Rights as contemplated in this Agreement.

3.13 Not used.

3.14 Not used.

4 Not used

5 Records and Audit

5.1 The Supplier shall, and shall procure that its subcontractors shall, maintain a true and correct set of records including personnel records relating to all aspects of their performance of the Agreement and each Contract and all transactions related to the Agreement and each Contract. For the avoidance of doubt, such records shall include but are not limited to:

(a) all necessary information for the evaluation of claims or variations;

(b) management accounts, information from management information systems and any other management records;

(c) accounting records (in hard copy as well as computer readable data);

(d) subcontract files (including proposals of successful and unsuccessful bidders, bids, rebids etc);

(e) original estimates;

(f) estimating worksheets;

(g) correspondence;

(h) variation and claims files (including documentation covering negotiated settlements);

(i) general ledger entries detailing cash and trade discounts and rebates;

(j) commitments (agreements and leases) greater than £5,000;

(k) detailed inspection records; and

(l) such materials prepared in relation to the invitation to tender and subsequent tendering process relating to cost breakdowns, reconciliations against BAFO pricing and project plans, in each case which have not already been provided to the Company.

5.2 The Supplier agrees, and shall procure that its subcontractors agree, to retain all such records in such a manner as the Company may reasonably instruct for a period of not less than twelve (12) years after completion of performance under each Contract. In the absence of specific instructions as to the method of storage, the Supplier shall retain his records in an orderly and logical fashion.

5.3 The Company and its authorised representatives and any party legally authorised to inspect any part of the Underground Network shall have the right to inspect and audit any of the records referred to in Clause 5.1 at any time during the period referred to in Clause 5.2.

5.4 The Supplier shall promptly provide all reasonable co-operation in relation to any audit or check including, to the extent reasonably possible in each particular circumstance:

(a) granting or procuring the grant of access to any premises used in performance of each Contract, whether the Supplier's own premises or otherwise;

(b) granting or procuring the grant of access to any equipment (including all computer hardware, software and databases) used (whether exclusively or non-exclusively) in the performance of the Supplier's obligations under each Contract, wherever situated and whether the Supplier's own equipment or otherwise;

(c) making any contracts and other documents and records required to be maintained under each Contract available for inspection;

(d) providing a reasonable number of copies of any contracts and other documents or records reasonably required by the Company's auditor and/or granting copying facilities to the Company's auditor for the purposes of making such copies; and

(e) complying with the Company's reasonable requests for access to senior personnel engaged in the Supplier's performance of each Contract.

5.5 The Supplier shall maintain an effective and economical programme for monitoring and maintaining product quality, planned and developed in conjunction with any other functions of the Supplier necessary to satisfy each Contract’s requirements.

5.6 The Supplier shall permit the Company's authorised representatives, access and facilities (as required and when notified) for the purpose of systems and product quality audits including but not limited to access to documentation showing results of testing and inspection, certificates of conformance and safety-related documents. The Supplier shall provide the Company with a copy of any or all of the records listed in Clause 5.1, free of charge within thirty (30) days of the Company’s request for the same.

5.7 The Supplier shall and shall ensure that any sub-contractor or sub-supplier shall ensure that appropriate security systems are in place to prevent unauthorised access to, extraction of and/or alteration to data during the audit undertaken pursuant to the Agreement and any Contract.

6 Company's Obligations

6.1 The Company shall pay the Supplier the Order Price for the Goods in accordance with the terms of the relevant Contract.

6.2 Payment of the Order Price shall not affect any claims or rights which the Company may have against the Supplier and shall not be an admission by the Company that the Supplier has performed its obligations under the relevant Contract properly.

6.3 The Agreement is not an exclusive arrangement and nothing in the Agreement or any Contract operates to prevent the Company from engaging any other organisation or person to supply goods similar to or the same as the Goods.

7 Additional Goods

7.1 The Company may, at any time during the term of any Contract, request the Supplier to provide a quotation for the supply of Additional Goods in accordance with the Contract Variation Procedure. If a Variation Order is made in respect of such Additional Goods, the relevant Contract shall be amended to include such Additional Goods, the Expected Order Delivery Date and the quoted price.

8 Variation

8.1 Unless the parties agree otherwise in writing, any variation to the Agreement or any Contract shall be made under the Contract Variation Procedure.

8.2 The Supplier shall not proceed to implement any variation unless a Variation Order has been entered into in respect of such variation.

9 Price and Payment

9.1 The prices for the Goods shall be the Order Price set out in the Order using the rates and prices set out in Schedule 2 and shall be inclusive of costs of packaging, carriage and insurance. The prices for the Goods in this Agreement or in respect of any Order shall only be changed in accordance with the Contract Variation Procedure.

9.2 An invoice for the Price stating the Purchase Order number, cost centre number(s), supplier code, delivery address, a brief description of the Goods (including part numbers (if any)) and any other information notified in writing to the Supplier by the Company shall be sent by the Supplier to the address for invoices stated in the Purchase Order after the delivery of Goods.

9.3 Subject to Clause 9.5, if the invoice is approved the Company shall pay the Price within 30 days of the date of receipt of the invoice (the "**Final Date for Payment**"). The Company's obligation to

pay the Supplier shall be conditional upon the Supplier notifying the Company in writing of its bank account details. The Company shall make payments by Bank Transfer (Bank Automated Clearance System (BACS)) or such other method as it may notify from time to time.

9.4 If the Company fails to pay any amount properly due and payable by it under the Contract by the Final Date for Payment the Supplier shall be entitled to simple interest on any outstanding amount at the Interest Rate set out in Schedule 1 accruing on a daily basis from the Final Date for Payment until the date of actual payment. This Clause 9.4 shall not apply to payments that the Company disputes in good faith.

9.5 This Clause 9.5 shall apply where Part II of the Act applies:

9.5.1 Not less than 14 days before the final day of each of the Company's accounting periods as notified to the Supplier by the Company from time to time, the Supplier shall submit to the address for invoices stated in the Purchase Order an Application for Payment ("**AFP**") in respect of any delivery of Goods in the preceding accounting period and for which an AFP has not already been submitted. The AFP shall contain the information required in accordance with Clause 9.2 and state the sum that the Supplier considers will become due to him on the payment due date in accordance with Clause 9.5.3 below and the basis on which that sum is calculated.

9.5.2 Not later than five days after each payment due date the Company shall issue a Contract Payment Approval Form ("**CPAF**") to the Supplier. The CPAF shall be the Company's notice of payment and shall specify the amount due at the payment due date ("**Notified Sum**") and the basis on which that sum is calculated. Not later than five days after receipt of the CPAF, the Supplier shall deliver an invoice for the sum certified in the CPAF. The Supplier shall issue a corrected invoice, where required, within five days of receipt of any Pay Less Notice in accordance with Clause 9.5.5 below.

9.5.3 The date on which each payment becomes due shall be the later of:

(i) the final day of the relevant accounting period; and

(ii) 14 days after the date of receipt by the Company of the Supplier's AFP.

The final date for payment is 28 days after the date on which payment becomes due.

9.5.4 If a CPAF is not issued by the Company in accordance with Clause 9.5.2, the sum to be paid by the Company is, subject to Clause 9.5.5, the sum stated as due in the Supplier's AFP in accordance with Clause 9.5.1.

9.5.5 If the Company intends to pay less than the notified sum, it shall issue a notice to the Supplier ("**Pay Less Notice**") not later than one day before the final date for payment, stating the amount considered to be due and the basis on which that sum is calculated.

The Company shall not withhold payment of an amount due under the Contract unless it has notified its intention to pay less than the Notified Sum as required by the Contract.

9.5.6 If the Supplier's employment is terminated under Clause 17.1 (d) because the Supplier has become insolvent the Company need not pay any sum due to the Supplier either: (i) where the Supplier becomes insolvent prior to the prescribed period before the final date for payment, provided that the Company issues a Pay Less Notice notifying the Company's intention not to pay such sum, or (ii) in any event, if the Supplier becomes insolvent after the prescribed period before the final date for payment.

9.6 Save with the prior written consent of the Company, the Price shall be:

9.6.1 exclusive of any applicable VAT which shall be identified as a separate item on all invoices, APFs and CPAFs;

9.6.2 inclusive of all expenses and disbursements including, without limitation, the costs incurred in delivery of the Goods to the delivery address stated on the Purchase Order; and

9.6.3 fixed for the duration of the Contract and no variation in the Price nor extra charges shall be made whether on account of increased material, labour or transport costs, fluctuation in rates of exchange or otherwise.

9.7 Not used.

9.8 Any payment made by the Company hereunder including the final payment under the Contract shall not prevent the Company from recovering any amount overpaid or wrongfully paid however such payments may have arisen including, without limitation, those paid to the Supplier by mistake of law or of fact. The Company shall be entitled to withhold from any sums due or which may become due to the Supplier from the Company (i) any amount in respect of which there exists a bone fide dispute; and (ii) any amount which on the basis of the Company's bona fide estimate the Company considers due to it from the Supplier. Such estimates shall be binding upon the Supplier until agreement between the Company and the Supplier or any award order or judgement whichever shall be earlier.

10 Delivery of Goods

10.1 The Goods shall be delivered by the Supplier to the Company on the Expected Order Delivery Date and on the times stated in the Order and at the Delivery Address. The Supplier shall be responsible for, and shall comply with all reasonable instructions of the Company with regard to, the unloading of the Goods at the Delivery Address. The Company shall be under no obligation to accept partial delivery of an Order.

10.2 Not used.

10.3 If the Goods are not supplied on the Expected Order Delivery Date stated in the relevant Order then, without limiting any other remedy, the Company shall be entitled to deduct from the price payable for such Goods or to claim from the Supplier by way of Liquidated Damages for delay the amount stated in Schedule 1 for the period of delay stated in Schedule 1. The Company shall not be entitled to deduct such amount from the price payable for such Goods or to claim such amount from the Supplier by way of Liquidated Damages for delay to the extent that the delay is due to (i) a default or other act of prevention of the Company, its agents, employees or contractors (other than the Supplier) or (ii) a Force Majeure Event, or a (iii) Permitted Delay Event.

10.4 The Supplier accepts that the amount of Liquidated Damages under any Contract constitutes a genuine pre-estimate of the loss that would be suffered by the Company as a result of the Supplier's failure to achieve the Expected Order Delivery Date.

10.5 The Goods shall be properly packed and secured in such a manner as to reach the Delivery Address in good condition and otherwise in a condition which fully complies with the requirements of each Contract.

10.6 The Supplier shall provide a detailed delivery note stating the relevant Contract Reference Number, Order number (given on the relevant Order) and giving full particulars of the Goods to be supplied (the "**Delivery Note**"). A hard copy of the Delivery Note shall be delivered with the Goods and a soft copy shall be sent by email to the Company to the email address set out in Schedule 1 on the Order Delivery Date.

10.7 If for any reason the Company is unable to accept delivery of the Goods on or after the Expected Order Delivery Date, the Supplier shall store the Goods, safeguard them and take all reasonable steps to prevent their deterioration until the Order Delivery Date, and the Company shall be liable to the Supplier for the reasonable cost (including insurance) of its so doing.

10.8 In the event that all or any of the obligations of the Supplier under any Contract to pay Liquidated Damages are held to be unenforceable, the Supplier agrees to pay the Company damages in respect of all actual Losses suffered by the Company due to the circumstances in respect of which Liquidated Damages would have been payable if the relevant obligation had been enforceable including, without limitation, loss of profit, loss of use, loss of revenues, loss of production and loss of savings. The damages payable by the Supplier in accordance with this Clause 10 shall not exceed the amounts which would have been payable if the relevant obligation(s) to pay Liquidated Damages had been enforceable save where such obligation(s) are held to be unenforceable as a result of any argument or proceedings raised or brought by the Supplier that such obligation(s) are unenforceable, in which case the amount of such damages shall be unlimited.

10.9 The Supplier will not, and will ensure that neither its subcontractors, suppliers nor any other person will have, a lien, charge or encumbrance on or over any of the Goods which are vested in the Company under Clause 13.2 for any sum due to the Supplier or its subcontractors, suppliers or other persons and the Supplier shall take all reasonable steps as may be necessary to ensure that the title of the Company and the exclusion of any such lien charge or encumbrance are brought to the notice of subcontractors and other persons dealing with any such Goods.

10.10 The Company shall be under no obligation to accept or pay for any Goods delivered in excess of the quantity ordered. If the Company elects not to accept such over-delivered Goods it shall be entitled to give notice in writing to the Supplier to remove them. Within 7 days of receipt by the Supplier of such notice the Supplier shall remove the excess and refund to the Company any expenses incurred by the Company as a result of such over-delivery (including but not limited to the costs of moving and storing them) failing which the Company shall be entitled to dispose of such Goods and to charge the Supplier for the costs of such disposal. The risk in any over-delivered Goods shall remain with the Supplier until they are collected by or on behalf of the Supplier or disposed of or purchased by the Company, as appropriate.

10.11 Notwithstanding Clause 10.6 the Company may revise the Delivery Note by providing the Supplier with not less than one (1) days notice of the revised Expected Order Delivery Date (the "Revised Delivery Note").

11 Not used

12 Failure to Supply

12.1 Without prejudice to any other right or remedy of the Company under this Agreement and each Contract, and its rights under Clause 17, if the Supplier fails to supply the Goods or any part to the Company's satisfaction the Company may give the Supplier at least seven (7) days' notice in writing (except in an emergency when no notice need be given) requiring the Supplier to remedy such failure. If the Supplier fails to comply with the requirements of the Company specified in such notice the Company shall be entitled to perform or procure the supply of the Goods or part thereof itself or from a third party. Without prejudice to any other right or remedy of the Company hereunder or under the general law, all expenditure properly incurred by the Company exercising its rights under this Clause 12 is recoverable by the Company from the Supplier and the Company shall be entitled to deduct such amounts from any amount due or to become due to the Supplier under the Contract.

12.2 For the purposes of Clause 12.1 the Supplier hereby grants to the Company and any third party the right to use any Intellectual Property Rights, Documentation, goods, materials and spares belonging to the Supplier or used by the Supplier in connection with the Contract as may be required by the Company to exercise its rights under Clause 12.1 and the Supplier shall provide

all such co-operation and assistance as may be required by the Company to enable the Company to exercise its rights under Clause 12.1.

13 Risk and Ownership

13.1 Risk of damage to, or loss of, the Goods shall pass to the Company upon counter-signature by the Company of the Delivery Note. If the Company serves a Rejection Notice under Clause 14.2, risk of damage to and loss of the Goods shall pass to the Supplier on the earlier of the date that the Supplier removes the Goods from the Delivery Address (or such other address as the Company shall specify under Clause 14.3) or the date falling three (3) days after the receipt by the Supplier of the Rejection Notice.

13.2 The Supplier shall, without further act, pass title to the Goods, with full title guarantee to the Company, upon the Order Delivery Date.

14 Inspection of the Goods

14.1 Following delivery by the Supplier to the Company of the Goods the Company shall inspect the Goods.

14.2 If, following the inspection referred to in Clause 14.1, the Goods do not comply with the terms of the relevant Contract, including but not limited to, conforming to the Specification and being fit for the purpose for which they are intended, without prejudice to any rights or remedies the Company may have against the Supplier, whether under the relevant Contract or otherwise, the Company may by notice in writing (the "**Rejection Notice**") to the Supplier reject all or any part of the Goods (the "**Rejected Goods**").

14.3 The Rejection Notice shall specify the reason for the rejection of the Rejected Goods. Within seven (7) days of receipt of the Rejection Notice, the Supplier shall remove such Rejected Goods at its risk and expense from the Delivery Address or such other address as the Company shall specify in the Rejection Notice and shall at the Company's option:

(a) replace such Rejected Goods with Goods which conform in all respects with the relevant Contract within five (5) Working Days; or

(b) if an application for payment has been submitted or payment made for the Rejected Goods, issue a credit note in respect of that application or refund the payment (as applicable); and

(c) pay the Company's Losses resulting from the Supplier's delivery of Goods that were not in conformity with the terms of the relevant Contract.

14.4 The Company's rights and remedies under this Clause 14 are in addition to the rights and remedies available to it in respect of the statutory conditions relating to description, quality, fitness for purpose and correspondence with sample implied into the relevant Contract by the Sale of Goods Act 1979.

14.5 If the Supplier fails to promptly replace Rejected Goods in accordance with Clause 14.3(a), the Company may, without affecting its rights under Clause 14.3(c), obtain substitute goods from a third party supplier, or have the Rejected Goods repaired by a third party, and the Supplier shall promptly reimburse the Company for the costs it incurs in doing so.

14.6 The Goods shall conform in all respects with any sample approved by the Company and in the absence of a sample; all the Goods provided shall be within the normal limits of industrial quality.

15 Warranty

15.1 Without prejudice to any rights or remedies the Company may have against the Supplier whether under each Contract or otherwise, the Supplier shall without delay, upon a request by the Company to do so, replace or (at the Company's option) repair all Goods in which a Defect has occurred or is likely to occur in the reasonable opinion of the Company, provided that such request is made during the Warranty Period set out in Schedule 1. Any replacement Goods shall comply in all respects with the terms of the relevant Contract and shall conform to the Specification and shall be fit for the purpose for which they are intended.

15.2 For the avoidance of doubt, where Goods are replaced or repaired in accordance with this Clause 15, such repaired Goods or replacement Goods shall be re-delivered to the Company in accordance with the terms of the relevant Contract and the provisions of Clauses 10, 13 and 14 shall apply to such re-delivered Goods. The Warranty Period for these purposes shall commence on the date that the Supplier delivers the Goods in accordance with Clause 10 or, where applicable, re-delivers the Goods in accordance with this Clause 15.

15.3 The Supplier shall use all reasonable endeavours to procure for the Company the benefit of such warranties and other rights as are conferred on the Supplier in relation to Defects in such part or parts of the Goods which are not manufactured by the Supplier.

16 Intellectual Property Rights

16.1 Existing Contracts

The Agreement is entirely without prejudice to, and nothing in it is intended to, nor shall, in any way prejudice the rights of any member of the TfL Group in relation to intellectual property under or pursuant to Existing Contracts.

16.2 Not used

16.3 Ownership of the Supplier's Intellectual Property Rights

All Intellectual Property Rights owned by the Supplier or its subcontractors (of any tier) or other third party shall remain or be vested in the Supplier, its subcontractors (of any tier) or other third party (as the case may be).

16.4 Company's Licence to use the Supplier's Intellectual Property Rights

The Company shall have and the Supplier hereby grants and procures that its subcontractors (of any tier) or other third party grant, to the Company a worldwide, royalty-free, perpetual, irrevocable, non-exclusive licence (with the right to sub-licence such rights to any third party) to use and copy the Intellectual Property Rights referred to in Clause 16.3 that are used by the Supplier in or in connection with its provision of the Goods for the purposes of:

(a) understanding the Goods;

(b) maintaining, repairing, modifying, altering, enhancing, re-figuring, correcting, replacing, re-procuring and re-tendering the Goods;

(c) extending, interfacing with, integrating with, connecting into and adjusting the Goods;

(d) enabling the Company to carry out the operation, maintenance, repair, renewal and enhancement of the Underground Network;

(e) executing and completing the provision of the Goods; and

(f) enabling the Company to perform its function and duties as Infrastructure Manager and Operator of the Underground Network.

16.5 Provision of Supporting Documentation and Other Materials

The Supplier shall:

(a) promptly, and in any event by no later than such date as the Company may notify to the Supplier, provide at no charge to the Company, copies of any materials and items (including, without limitation, Documentation) in the Supplier's or subcontractor's (of any tier) or other third party's possession or control (or which ought reasonably to be in the Supplier's or subcontractor's (of any tier) or other third party's possession or control) which are referred to or relied upon in using and copying, or required in any way for the use and copying of, the Intellectual Property Rights referred to in Clauses 16.4 above; and

(b) keep copies of such materials, items and Documentation in a secure place where they will not deteriorate and undertake regular (and in any event not less than every three months)

integrity testing of the same and provide written evidence of such testing to the Company at regular intervals and in any event upon the Company's request.

16.6 Not used

16.7 Not used

16.8 Company's Rights in relation to Other Procurement Activities

For the avoidance of doubt, the Company shall be entitled to use and copy the materials, items and Documentation referred to in Clause 16.5 above and anything in which the Intellectual Property Rights referred to in Clauses 16.4 subsist for the purposes of inviting tenders or of procuring goods and/or services the same as or similar to the Goods for the carrying out of any activities in connection with the licence under Clause 16.4 subject always to the Company's requirements for tenderers to treat the same in the strictest confidence.

16.9 Supplier's Indemnity against Third Party Intellectual Property Rights Infringement

(a) The Supplier shall indemnify and hold harmless the Company and any member of the TfL Group against any actions, claims, losses, demands, costs, charges or expenses that arise from or are incurred by reason of any infringement or alleged infringement of any Intellectual Property Rights belonging to any subcontractor (of any tier) or other third party and against all costs and damages of any kind which the Company may incur in connection with any actual or threatened proceedings before any court or arbitrator or any other dispute resolution forum. If required by the Company the Supplier shall conduct negotiations with any subcontractor (of any tier) or other third party and/or a defence in relation to any action, claim or demand referred to herein on behalf of the Company.

(b) In the event of a claim of infringement of any Intellectual Property Rights the Supplier shall use all reasonable endeavours to make such alterations or adjustment to the Goods as may be necessary to ensure that the use and provision of the Goods continues in spite of such claim.

16.10 Ownership of the Company's Intellectual Property Rights

Intellectual Property Rights in all Documentation and in all other material and items supplied by the Company to the Supplier in connection with the Agreement and each Contract shall remain vested in the Company or the person owning such rights at the time the Documentation, material or items were supplied. The Supplier shall, if so requested, at any time, execute such documents and perform such acts as may be required fully and effectively to assure to the Company the rights referred to in this Clause.

Company's Intellectual Property Rights

16.11 The Supplier is not entitled to use in any manner whatsoever any Intellectual Property Rights belonging to the Company.

17 Termination and Suspension

17.1 The Company may terminate the Agreement and/or any individual Contract (in which case any remaining outstanding Contracts shall survive) immediately by notice in writing to the Supplier if:

(a) the Supplier commits a breach of the Agreement and/or any Contract which in the case of a breach capable of remedy has not been remedied within five (5) Working Days, or such other period as may be agreed between the Supplier and the Company, of the Company serving notice on the Supplier requiring such remedy;

(b) the Supplier or anyone employed by or acting on behalf of the Supplier (whether or not acting independently of the Supplier when committing any breach) commits a Safety Breach or Prohibited Act;

(c) any limit on the Supplier's liability to pay Liquidated Damages is reached or exceeded;

(d) the Supplier enters into compulsory or voluntary liquidation (other than for the purpose of effecting a solvent reconstruction or amalgamation provided that if the company resulting from such reconstruction or amalgamation is a different legal entity it shall agree to be bound by and assume the obligations of the Supplier under the Agreement and each Contract) or is deemed unable to pay its debts as they fall due in accordance with Section 123(1) of the Insolvency Act 1986, or a meeting of its shareholders or directors is convened to consider any resolution for (or petition or file documents with the courts for) its administration or an administrative receiver, manager, administrator, liquidator, trustee or other similar officer is appointed or notice is given to appoint the same;

(e) a breach of the Supplier's obligations under Clause 27, Clause 44 or Clause 49.8; or

(f) the Supplier has, at the date of this Agreement or of each Contract, been in one of the situations referred to in Regulation 57(1) of the Public Contracts Regulations 2015 and should therefore have been excluded from the procurement procedure in accordance with those Regulations or Regulation 80(2) of the Utilities Contracts Regulations 2016 (without prejudice to the Company's rights of termination implied into this Agreement and each Contract by Regulation 73(3) of the Public Contracts Regulations 2015 or Regulation 89(3) of the Utilities Contracts Regulations 2016);

(g) the Supplier fails to comply in the provision of the Goods with legal obligations in the fields of environmental, social or labour law,

17.2 Without prejudice to Clause 17.1, the Company shall have the right:

(a) to terminate the Agreement and/or any individual Contract (in which case any remaining outstanding Contracts shall survive) at any time by giving notice of not less than thirty (30) days to the Supplier in writing; or

(b) at any time to require the Supplier to suspend the provision of the Goods by giving notice in writing (a "**Suspension Notice**") to the Supplier.

17.3 Without prejudice to the Company's right to terminate this Agreement or each Contract under Clauses 17.1 or 17.2 or at common law, the Company may terminate this Agreement or any Contract at any time following a Declaration of Ineffectiveness or a Public Procurement Termination Event in accordance with the provisions of Clause 49.1.

17.4 In the event that the Company terminates the Agreement and/or any Contract for any reason under this Clause 17, the Supplier shall, without prejudice to any other rights or remedies which the Company may have under the Agreement and such Contract or under general law, at the Company's option:

(a) permit the Company to enter the Supplier's premises and take possession of any equipment, goods or Documentation which are the property of the Company; and

(b) permit the Company to place an order for the remaining Goods (or equivalent goods) with any other person or persons; and

(c) promptly return to the Company any equipment, goods or Documentation which are the property of the Company and of which the Supplier or any of its subcontractors have possession.

In either such case, the Company shall be entitled to retain those Goods already provided by the Supplier in accordance with the Agreement and the relevant Contract, at the material time.

17.5 In the event that the Agreement and/or any Contract is terminated, the liability of the Company shall be limited to payment to the Supplier for those Goods provided in accordance with the Agreement and such Contract up until the date of such termination.

17.6 Following a termination in accordance with Clause 17.1 (but not a termination in accordance with Clause 17.2(a)) the Supplier shall be liable to the Company for

(a) any Losses of whatever nature arising out of or in connection with the relevant breach; and

(b) where the Company exercises its rights under Clause 17.4(b) and in so doing incurs costs which are in excess of those which would have been incurred in relation to the due

provision of the Goods under the Agreement and the relevant Contract by the Supplier ("**Excess Costs**"), such Excess Costs.

17.7 In the event that the Agreement and/or any Contract is suspended in accordance with Clause 17.2(b), the Supplier shall:

(a) issue to the Company an application for payment in respect of those Goods provided to the Company in accordance with the Agreement and the relevant Contract up until the date of such suspension; and

(b) not carry out any further work in connection with the provision of the Goods until such time as the Company issues a notice lifting the suspension (a "**Notice to Proceed**").

17.8 In the event that the Agreement and/or any Contract is suspended in accordance with Clause 17.2(b), and such suspension continues for a period of twenty-eight (28) days, the Supplier shall be entitled to request that the Company serve a Notice to Proceed. In the event that no Notice to Proceed is issued by the Company within a further fourteen (14) days from such request of the Supplier, the Supplier shall be entitled to approach the Company with a request for a variation, in accordance with the Contract Variation Procedure.

17.9 In the event that the parties are unable to agree upon the variation requested under Clause 17.8, then a Dispute shall be deemed to have arisen and the matter shall be referred for resolution in accordance with Clause 38.

17.10 Termination of the Agreement and/or any Contract for whatever reason shall not affect the accrued rights of the parties arising in any way out of the Agreement and the relevant Contract as at the date of termination and in particular but without limitation the right to recover damages against the other party.

17.11 If anyone employed by the Supplier, acting independently of the Supplier, commits a Safety Breach or Prohibited Act, then the Company may require the Supplier to exclude that individual from the provision of the Goods with immediate effect and that individual may only resume the provision of the Goods at the Company's absolute discretion.

18 Cooperation in Handover

18.1 The Supplier shall provide at no cost such reasonable assistance to the Company and to any third party nominated by the Company as the Company may require during the last six (6) months of the Agreement and in the three (3) months after the expiry of the Term (or, in the case of earlier termination for any reason, the period of three (3) months from the effective Agreement termination date) to facilitate the engagement of a successor supplier and/or the resumption by the Company of the supply of the Goods and in such a manner so as not to unduly disrupt or hinder the Company's business.

18.2 Without prejudice to the generality of Clause 18.1 above, the Supplier shall on or prior to the expiry of the Term transfer to the Company such Documentation relating to the Goods or full copies thereof as the Company may request.

19 Indemnity and Insurance

19.1 The Supplier shall be liable for, and shall indemnify the Company, including any of its employees, servants, agents, subcontractors, directors and officers and members of the TfL Group on an after-tax basis against all Losses suffered or incurred by the Company or relevant member of the TfL Group, arising from or in connection with the performance or non-performance of the Supplier under the Agreement and each Contract:

(a) in respect of death or personal injury to any person;

(b) in respect of loss of or damage to any property (including the Underground Network and any other property belonging to the Company or for which it is responsible);

(c) arising out of or in the course of or by reason of any act, omission, negligence or breach of contract or breach of statutory duty, wilful misconduct of the Supplier, its employees, agents or subcontractors; and

(d) arising under the Company's contracts with third parties,

and shall, at its own cost on the Company's request, defend the Company in any proceedings involving the same.

19.2 The Supplier shall not be liable to indemnify the Company or any member of the TfL Group under the indemnity in Clause 19.1 to the extent Losses are solely due to the negligence, breach of duty or breach of contract of the Company.

19.3 The Supplier's indemnity under Clause 19.1 and all other indemnities under the Agreement and each Contract shall remain in force for the duration of the Agreement and each Contract and for the period of twelve (12) years after the Order Delivery Date or earlier termination of the Agreement and each Contract.

19.4 The Company may withhold from any sum due or which may become due to the Supplier any sum due to the Company as a result of the operation of Clause 19.1.

19.5 Other than in respect of the Losses (i) described in Clauses 19.1(a) and 19.1(d) above and (ii) Excepted Liabilities, neither party shall have any liability to the other for any Consequential Loss arising out of the performance of its obligations under or in connection with the Agreement and each Contract. Each party respectively undertakes not to sue the other party, TfL or any member of the TfL Group in respect of Consequential Loss.

19.6 Without prejudice to the obligation to indemnify the Company set out in Clause 19.1, the Supplier undertakes to:

(a) maintain at its own cost insurance which complies with the Employers' Liability (Compulsory Insurance) Act 1969 and any statutory orders made under such Act or any amendment or re-enactment thereof;

(b) maintain at its own cost an adequate level of public liability insurance in respect of the Supplier's liability for death or injury to any person and loss of or damage to property and being not less than £5,000,000 (five million pounds) per occurrence;

(c) maintain at its own cost an adequate level of ”goods in transit” insurance commensurate with the risk and, where appropriate, being not less than £50,000 (fifty thousand pounds) per occurrence, in respect of the Supplier’s liability for theft, loss or damage to property and Goods while in transit from one place to another or being stored during a journey;

(d) maintain at its own cost product liability insurance in respect of the Supplier's liability for death or injury to any person, or loss or damage to any property arising out of its performance of any Contract in an amount not less than £5,000,000 (five million pounds), for any one occurrence;

(e) ensure that the foregoing insurance policy or policies shall be or are effected with a reputable insurer. Such insurance shall be on terms approved by the Company (such approval not to be unreasonably withheld or delayed) and shall be maintained in force for a period not less than twelve (12) years after the delivery of the Goods;

(f) ensure that any subcontractors also maintain adequate insurance having regard to the obligations under the contract which they are contracted to fulfil; and

(g) produce within seven (7) days of any reasonable request by the Company and in any event before the provision of any of the Goods by the Supplier under any Contract satisfactory evidence in the form of a broker’s letter or similar, confirming the existence of insurance in accordance with the terms of this Clause 19.6.

19.7 The Supplier’s liabilities under each Contract shall not be deemed to be released or limited by the Supplier taking out the insurance policies referred to in Clause 19.6.

19.8 If the Supplier fails to maintain the insurance policies as provided in this Clause 19, the Company may effect and keep in force any such insurance and pay such premium or premiums at commercially competitive rates as may be necessary for that purpose and from time to time deduct the amount so paid from any monies due or which become due to the Supplier or recover the same as a debt due from the Supplier.

19.9 The Supplier's total liability to the Company for all matters arising under or in connection with the Agreement, other than the excluded matters, is limited to amount specified in Schedule 1 and applies in contract, tort and otherwise to the extent allowed under the law of the Agreement. The excluded matters are amounts payable by the Supplier as stated in the Agreement for:

(a) Excepted Liabilities

(b) loss of or damage to the Company's property,

(c) any Losses against which the Company is indemnified under Clause 25 (Supplier Personnel); or

(d) any Losses against which the Company is indemnified under Clause 16.9 (Intellectual Property Rights)."

20 Not used

21 Force Majeure and Permitted Delay events

Force Majeure

21.1 Neither party shall be in breach of its obligations under any Contract if there is any total or partial failure of performance by it of its duties and obligations under any Contract occasioned by any Force Majeure Event. If either party is unable to perform its duties and obligations under the Agreement or any Contract as a direct result of a Force Majeure Event, that party shall within one (1) Working Day of such event taking place give written notice to the other party specifying the event and the steps taken by it to minimise or overcome the effects of such event. The operation of the relevant Contract shall be suspended during the period (and only during the period) in which the Force Majeure Event continues. Without delay upon the Force Majeure Event ceasing to exist the party relying upon it shall give written notice to the other of this fact. If the Force Majeure Event continues for a period of more than twenty-eight (28) days and substantially affects the abilities of the Supplier to perform its obligations under the relevant Contract, the Company shall have the right to terminate the relevant Contract immediately upon giving written notice of such termination to the Supplier.

Permitted Delay Events

21.2 If delay is caused or either Party can reasonably foresee delay occurring by reason of a Permitted Delay Event then the Supplier shall give notice to the Company's Representative of the same and any claim for an extension of time to the Expected Order Delivery Date, within seven (7) days after the cause of any delay has arisen.

21.3 For the purposes of this Agreement or any Contract, the occurrence of one or more of the following shall constitute a "Permitted Delay Event":

(a) any act of prevention, omission, default or neglect or breach by the Company of an express obligation under this Agreement or any Contract; or

(b) any variation of the Agreement or any Contract under Clause 8; or

(c) the suspension of this Agreement or any Contract in accordance with Clause 17 (other than where the suspension is necessary by reason of default by the Supplier).

21.4 Where any delay in achieving the Expected Order Delivery Date arises, the Supplier shall be entitled to an extension to such Expected Order Delivery Date (either prospectively or retrospectively) but only to the extent that such delay is directly caused by a Permitted Delay Event that has a direct and material adverse effect on the Supplier's ability to provide the Goods by the Expected Order Delivery Date and provided that the Supplier:

(a) notifies the Company of the Permitted Delay Event in accordance with Clause 21.2 and subsequently provides such further information as the Company may reasonably require regarding the nature and likely duration of such event;

(b) provides the Company with reasonable access to the Supplier's premises or of its subcontractors for investigating the validity of the potential Permitted Delay Event;

(c) uses its reasonable endeavours to mitigate the delay to the relevant Expected Order Delivery Date; and

(d) shall not be entitled to an extension of time to the extent that the Permitted Delay Event was caused by or resulted from any act, omission, neglect, default or breach of this Agreement by the Supplier, its subcontractors and/or employees.

22 Safety

22.1 The Supplier shall not endanger in any manner the health and safety of, or unreasonably interfere with the proper performance of the duties of, the Company's employees or third parties or otherwise expose the Company to liability under any Applicable Laws and Standards, including (without limitation) the Health and Safety at Work etc. Act 1974, the Transport and Works Act 1992, or any statutory modifications or re-enactments thereof.

22.2 The Supplier shall act in accordance with the health and safety regulations and requirements stated in the Specification, including (but not limited to):

(a) the provisions of the Company's Contract QUENSH Conditions that are indicated as being applicable to any Contract in the QUENSH menu set out in the Specification ("**QUENSH**") as amended from time to time; and

(b) the Company's drug and alcohol principles as amended from time to time.

22.3 Section 20.1.1 (Alcohol and drugs) of QUENSH shall apply to the Agreement and each Contract as if the term "LU Premises" means any of the Company's property and as if references to "LU" are references to the Company.

22.4 The Company may at its discretion carry out on the Supplier's behalf any testing of the Supplier's employees, subcontractors or agents for drugs or alcohol which each Contract requires the Supplier to carry out. The reasonable cost to the Company of carrying out the testing shall be paid by the Supplier.

23 Not used

24 Independent Supplier

24.1 The Supplier is an independent supplier and is not and shall not hold itself out as, and shall procure that none of the Supplier's employees or subcontractors or their employees hold themselves out as, an agent of the Company. All personnel used by the Supplier in the performance of its obligations under each Contract shall be employees of the Supplier, or any subcontractor or agent of the Supplier.

25 Supplier Personnel

25.1 For the purposes of this Clause 25:

"**Current Service Provider"** means any person, company or other legal entity which on or before the Commencement Date was the employer of any of the Transferring Employees, and which (for the avoidance of doubt) may include the Company;

"Replacement Employer" means any person to whom a Subsequent Relevant Employee may or does transfer under the Transfer Regulations on expiry or termination of the Agreement (or part of it) or any Contract;

"Relevant Claims and Liabilities" means all liabilities, obligations, proceedings, court or tribunal orders, losses, fines and penalties, damages, expenses, costs (including reasonable legal costs and disbursements) actions, claims and demands;

"Subsequent Transfer Date" means the time and date on which a Subsequent Relevant Employee transfers to a Replacement Employer by virtue of the Transfer Regulations;

"Subsequent Relevant Employee" means a person employed or engaged by the Supplier or relevant subcontractor from time to time in respect of any part of the supply of Goods who would transfer to a Replacement Employer by virtue of the Transfer Regulations on the expiry or termination of the Agreement (or part of it) or any Contract;

"Transfer Regulations" means all or any of the following: the Transfer of Undertakings (Protection of Employment) Regulations 2006; the Transfer of Employment (Pension Protection) Regulations 2005; any other or further regulations, order or statutory instrument which apply or are capable of applying to a person to whom section 257 of the Pensions Act 2004 applies, as amended, replaced or extended from time to time and including any regulations or other legislation which (either with or without modification) re-enacts, adopts, consolidates or enacts in rewritten form any such regulations; and

"Transferring Employees" means those employees of or those engaged by the Current Service Provider who transfer or have the right to transfer to the Supplier under the Transfer Regulations.

25.2 The Supplier will comply and procures that his sub-contractors comply with any obligations which may arise out of a transfer to the Company or another person under the Transfer Regulations upon the expiry of the Term or earlier termination of the Agreement or any Contract.

25.3 At any time during the last twelve (12) months of the Agreement and/or during any period of notice terminating the Agreement and/or any Contract, the Company may require the Supplier to provide, within a specified period of being requested, to the Company (or to any other person or persons nominated by the Company) such information as is reasonably required by the Company or such other persons relevant to the potential liabilities of the Company or any other person arising under the Transfer Regulations including but not limited to information on the following:

(a) the names of employees (of the Supplier or its subcontractors) engaged in supplying the Goods, their salaries and other conditions of employment, ages and length of service;

(b) the method of organisation of the employees (of the Supplier or its subcontractors) engaged in supplying the Goods and documentary evidence relating to such organisation;

(c) the proposals for informing and consulting with affected employees;

(d) details of collective agreements and union recognition agreements; and

(e) any other employee liability information within the meaning of the Transfer Regulations,

(f) and will in addition provide copies to the Company upon request of any communication with any potential or intended new consultant or the Supplier's employees or their representatives relating to the effect on such employees of the expiry or termination of the Agreement.

25.4 The Supplier will provide the Company upon request with the name and address of a person within its organisation to whom all queries and requests for information under this Clause 25 may be addressed. The Supplier will if required by the Company warrant that any information provided under Clause 25 is accurate, complete and not misleading, including any information supplied in relation to its subcontractors.

25.5 The Supplier will not and will procure that its subcontractors will not in the twelve (12) months prior to the expiry or termination of the Agreement (or, where notice of termination is given of less than six (6) months, during any such period of notice) or any Contract without the Company's prior written consent:

(a) re-organise or substantially alter the number or method of organisation or identity of the employees engaged in the provision of the Goods, except to the extent that any such change is the result of a bona fide business reorganisation of the Supplier or the relevant subcontractor which is not related or confined to the employees engaged in supplying the Goods or to the expected expiry of the Term or termination of the Agreement, or

(b) make any increase to the salaries or any significant change to the terms and conditions of employment of the employees engaged in the provision of the Goods, except where such increases or changes would have arisen in the ordinary course of the Supplier's or the relevant sub-contractor's business and are not related to the expiry of the Term or termination of the Agreement (either because they are applied to all of the Supplier's or the relevant sub-contractor's employees, whether or not engaged in providing the Goods or otherwise) or are the result of a bona fide business reorganisation of the Supplier or the relevant sub-contractor which is not related or confined to the employees engaged in supplying the Goods or to the expiry of the Term or termination of the Agreement.

25.6 The Supplier shall indemnify the Company against all Relevant Claims and Liabilities arising from or incurred by reason of any act or omission of the Supplier, its servants or agents in connection with or arising from or incurred by reason of the employment of the Transferring Employees, including but not limited to any claim against the Company or any other person for damages for breach of contract, or for compensation for unfair or wrongful dismissal or redundancy, or failure to provide comparable pension rates, or failure to provide information, or failure to inform or consult Transferring Employees, or in respect of death or personal injury, breach of statutory duty or any other claim in tort by a Transferring Employee, or by a person who would be a Transferring Employee but for any act or omission (including dismissal or constructive dismissal) of the

Supplier, arising from the operation (or alleged operation) of the Transfer Regulations in relation to the Goods.

25.7 The Supplier shall indemnify the Company and all Replacement Employers against all Relevant Claims and Liabilities arising from or related to:

(a) any claim by a Subsequent Relevant Employee in respect of any default, failure or omission (or alleged default, failure or omission) by any person whatsoever concerning or arising from employment before a Subsequent Transfer Date in respect of which the Company or the Replacement Employer incurs liability cost or expense by reason of the operation (or alleged operation) of the Transfer Regulations; and

(b) any claim by any former or existing employee of the Supplier or relevant Subcontractor (other than a Subsequent Relevant Employee) in respect of which the Company or a Replacement Employer incurs liability cost or expense by reason of the operation (or alleged operation) of the Transfer Regulations.

(c) In this Clause 25.7 "Relevant Claims and Liabilities" include those incurred by the Company by reason of any contract term between the Company and a Replacement Employer provided always that in relation to Relevant Claims and Liabilities which the Company may incur to a Replacement Employer, the Supplier shall not be required to indemnify the Company for more than or with a greater scope than it would if such Relevant Claims and Liabilities were made against or incurred by the Company in providing an indemnity to the Replacement Supplier on the same terms set out in sub-clauses (a) and (b) above.

25.8 The provisions of this Clause 25 are without prejudice to the Transfer Regulations. For the avoidance of doubt, any remedies available to the Company for any breach by the Supplier of any provision of this Clause 25 shall be in addition to and not in substitution for any remedies available to the Company under any provision of the Transfer Regulations.

25.9 Not used

25.10 Not used

25.11 Not used

25.12 Not used

25.13 Not used

25.14 Not used

26 Confidentiality

26.1 The Supplier undertakes to keep confidential and not to disclose to any third party (without the prior written consent of the Company) any Confidential Information supplied by the Company to the Supplier and shall use such information only for the purpose of the performance of his obligations under each Contract.

26.2 On the Company's request, the Supplier shall, so far as is reasonably possible:

(a) transfer onto hard copies or other media in industry standard format and programming languages and deliver to the Company any Confidential Information in its possession or control supplied by the Company to the Supplier;

(b) return to the Company all copies (whether hard copy or other media) of such Confidential Information; and

(c) destroy, erase or otherwise expunge from its records, systems, databases or other forms of archive all such Confidential Information save to the extent that information needs to be retained for statutory purposes or tax purposes.

26.3 The Supplier shall ensure that all his subcontractors, suppliers, employees and agents perform his obligations in Clauses 26.1 and 26.2 as if they were the Supplier, and the Supplier shall be responsible to the Company for any act or omission by his subcontractors, suppliers, employees and agents in breach of such obligations.

26.4 The Supplier shall notify the Company promptly if the Supplier becomes aware of any breach of confidence by a subcontractor, supplier, employee or agent and shall give the Company all assistance the Company reasonably requires in connection with any proceedings the Company brings, or other steps the Company takes, against that subcontractor, supplier, employee or agent for such breach of confidence.

26.5 The Supplier shall not, either alone or jointly with others, publish any material relating to the Company, the Company’s Representative, any Contract or the Goods without the prior written consent of the Company.

26.6 The Supplier shall not, either alone or jointly with others, make any press, television, radio or other media announcement in connection with any Contract or the Goods, or any Dispute arising under or in connection with any Contract.

26.7 The provisions of Clauses 26.1 to 26.6 shall not apply:

(a) to any information which is already in the public domain at the time of its disclosure other than by breach of any Contract; or

(b) to any information which is required to be disclosed to the extent required by any applicable law, the regulations of any recognised stock exchange, any taxation authorities or by order of a court or other tribunal of competent jurisdiction or any relevant regulatory body.

26.8 The Supplier acknowledges that damages would not be an adequate remedy for any breach of this Clause 26 by the Supplier and that (without prejudice to all other remedies to which the Company may be entitled as a matter of law) the Company shall be entitled to any form of equitable relief to enforce the provisions of this Clause 26.

27 London Living Wage

27.1 For the purposes of this Clause 27, "Sub-contractor" means a sub-contractor (of any tier) of the Supplier.

27.2 The Supplier acknowledges and agrees that the Mayor pursuant to section 155 of the Greater London Authority Act has directed that members of the TfL Group ensure that the London Living Wage be paid to anyone engaged by any member of the TfL Group who is required to discharge contractual obligations (whether as a direct contractor or a sub-contractor (of any tier) of that direct contractor) on the Company's estate in the circumstances set out in Clause 27.3(a).

27.3 Without prejudice to any other provision of this Agreement and any Contract, the Supplier shall:

(a) ensure that its employees and procure that the employees of its Sub-contractors engaged in the provision of the Goods or performance of this Agreement or any Contract:

(i) for two (2) or more hours of work in any given day in a week, for eight (8) or more consecutive weeks in a year; and

(ii) on the Company's estate including (without limitation) premises and land owned or occupied by the Company,

be paid an hourly wage (or equivalent of an hourly wage) equivalent to or greater than the London Living Wage;

(b) ensure that none of:

(i) its employees; nor

(ii) the employees of its Sub-contractors,

engaged in the provision of the Goods or performance of this Agreement or any Contract be paid less than the amount to which they are entitled in their respective contracts of employment;

(c) provide to the Company such information concerning the London Living Wage as the Company or its nominees may reasonably require from time to time, including (without limitation):

(i) all information necessary for the Company to confirm that the Supplier is complying with its obligations under Clause 27; and

(ii) reasonable evidence that Clause 27 has been implemented;

(d) disseminate on behalf of the Company to:

(i) its employees; and

(ii) the employees of its Sub-contractors,

engaged in the provision of the Goods or performance of this Agreement or any Contract such perception questionnaires as the Company may reasonably require from time to time and promptly collate and return to the Company responses to such questionnaires; and

(e) cooperate and provide all reasonable assistance in monitoring the effect of the London Living Wage including (without limitation):

(i) allowing the CCSL to contact and meet with the Supplier's employees and any trade unions representing the Supplier's employees;

(ii) procuring that the Supplier's Sub-contractors allow the CCSL to contact and meet with the Sub-contractors' employees and any trade unions representing the Sub-contractors' employees,

in order to establish that the obligations in Clause 27.3(a) have been complied with.

27.4 For the avoidance of doubt the Supplier shall:

(a) implement the annual increase in the rate of the London Living Wage; and

(b) procure that its Sub-contractors implement the annual increase in the rate of the London Living Wage,

on or before 1 April in the year following the publication of the increased rate of the London Living Wage.

27.5 The Company reserves the right to audit (acting by itself or its nominee(s)) the provision of the London Living Wage to the Supplier's staff and the staff of its Sub-contractors.

27.6 Without limiting the Company's rights under any other termination provision in this Agreement or any Contract, the Supplier shall remedy any breach of the provisions of this Clause 27 within four (4) weeks' notice of the same from the Company (the "**Notice Period**"). If the Supplier remains in breach of the provisions of this Clause 27 following the Notice Period, the Company may by written notice to the Supplier immediately terminate this Agreement or any Contract.

28 Responsible Procurement

28.1 The Supplier and the Company acknowledge and agree that the Mayor, in accordance with section 155 of the GLA Act has directed TfL and its subsidiaries (including the Company) to do all things reasonably necessary to comply with (inter alia) the Responsible Procurement Policy in its procurement activities.

28.2 The Supplier shall and shall procure that its subcontractors (of any tier) shall comply with, and shall provide such co-operation and assistance as may be reasonably requested by the Company to enable the Company to comply with the Responsible Procurement Policy.

28.3 The Supplier acknowledges and agrees that the Company is required to develop a policy relating to the promotion of the procurement of goods and services in an ethical manner (the "**Ethical Sourcing Policy**") which shall reflect and be consistent with the relevant principles of the Responsible Procurement Policy, and the Supplier shall and shall procure that all of its subcontractors shall comply with such the Ethical Sourcing Policy to the extent it does not conflict with the Responsible Procurement Policy.

28.4 The Supplier acknowledges and agrees that it (and its subcontractors) shall be required to comply with any changes to the Responsible Procurement Policy (and any adjustment or amendment to the Ethical Sourcing Policy as a result of such amendment or adjustment to the Responsible Procurement Policy).

28.5 The Supplier shall not be entitled to any addition to the Order Price in the event of any change to the Responsible Procurement Policy (and any change to the Ethical Sourcing Policy as a result of such change to the Responsible Procurement Policy).

28.6 The Supplier shall procure that any subcontractor (of any tier) is required to comply with the provisions of this Clause 28 and the provisions of this Clause 28 are included in any subcontract (of any tier).

28.7 The Supplier shall not, and shall procure that any subcontractor shall not, without the prior written consent of the Company, vary or purport to vary the provisions contained in any contract or subcontract in accordance with the operation of this Clause 28.

29 Assignment and Subcontracting

29.1 The Supplier shall not assign, novate or subcontract any of its rights or obligations under the Agreement or any Contract or any part thereof without the prior written consent of the Company.

29.2 The subcontracting of all or any part of the Goods to a subcontractor shall not relieve the Supplier of its obligations to supply the Goods under the Agreement and each Contract. The Supplier shall be responsible for the acts and omissions of its subcontractors.

29.3 The Company may novate, assign, transfer or subcontract the Agreement and/or any Contract or any part thereof to any person at any time without the consent of the Supplier, provided the Company has given prior written notice to the Supplier.

29.4 Within seven (7) days of any written request by the Company to the Supplier, the Supplier shall execute a deed of novation in the form set out in Schedule 7 in favour of any person to whom the Agreement and/or any Contract is being novated.

29.5 For the purposes of Clauses 29.6 to 29.10:

"**Subcontract**" means a contract between the Supplier and a Subcontractor; and

"**Subcontractor**" means a subcontractor to the Supplier, being the counterparty of a contract with the Supplier involved in the supply of goods, facilities or services necessary for or related to the provision of the Services (or any part of them).

29.6 Subject to the Company's prior written consent pursuant to Clause 29.1, where the Supplier subcontracts any or all of the provision of the Goods, the Supplier shall include in each Subcontract (and procure that its Subcontractors (and any of their subcontractors of any tier) include in each of their subcontracts of any tier):

29.6.1 payment terms substantially similar to those set out in Clause 9, and

29.6.2 terms allowing the Supplier or (in respect of a subcontract below the first tier) the payer under the relevant subcontract to terminate that subcontract if the relevant subcontractor fails to comply in the performance of its contract with legal obligations in the fields of environmental, social or labour law.

29.7 On or before the Commencement Date or Order Commencement Date (as applicable), the Supplier shall notify the Company in writing of the name, contact details and details of the legal representatives of any Subcontractor, to the extent that such information has not already been provided by the Supplier to the Company. The Supplier shall also immediately provide to the Company in writing the name, contact details and details of the legal representatives of each new

Subcontractor which the Supplier subsequently involves in the provision of the Goods after the Commencement Date or Order Commencement Date (as applicable).

29.8 The Company reserves the right to verify whether there are any grounds for excluding any Subcontractor under Regulation 57 of the Public Contracts Regulations 2015. Where necessary for the purpose of the Company's exercise of its right under this Clause 29.8, the Company may request that the information provided by the Supplier under Clause 29.8 shall be accompanied by one or more European Single Procurement Document(s) (within the meaning of Regulation 59 of the Public Contracts Regulations 2015) in respect of the relevant Subcontractor(s). Further, the Company:

(a) shall require that the Supplier replace any Subcontractor in respect of which the verification has shown that there are compulsory grounds for exclusion under Regulation 57 of the Public Contracts Regulations 2015; and

(b) may require that the Supplier replace any Subcontractor in respect of which the verification has shown that there are non-compulsory grounds for exclusion under Regulation 57 of the Public Contracts Regulations 2015.

29.9 The Supplier shall promptly notify the Company of any circumstances from time to time that might give rise to a right of the Company to require replacement of a subcontractor pursuant to Clauses 29.8(a) or 29.8(b).

29.10 The Company shall have no obligation to make any termination or compensation payment in respect of any termination pursuant to Clauses 29.8(a) or 29.8(b).

30 Company's and Supplier's Representative

Each party shall in respect of each Contract appoint one or more representatives to act on its behalf under the relevant Contract. Each party shall advise the other party, in writing, of the names and contact details of its representatives and these shall be recorded in the Order. The Supplier shall not appoint such a representative without the prior written consent of the Company (which consent shall not be unreasonably withheld). Any party may, on giving reasonable notice to the other party, appoint an additional representative or replace an existing representative but the Supplier may only do so with the prior written consent of the Company. Each party shall be responsible for the acts, omissions, neglects and defaults of its representatives as if such acts, omissions, neglects and defaults were its own. Each party will be bound by any decision made or action taken by its representatives.

31 Costs

Except as otherwise agreed, each party shall bear its own costs incurred in connection with the negotiation, preparation and execution of the Agreement and each Contract.

32 Severance

If a provision of the Agreement or any Contract is, or becomes, invalid, unenforceable or illegal, that will not affect the legality, validity or enforceability of any other provision of the Agreement or any Contract, provided that the operation of this Clause 32 would not negate the commercial interest and purpose of the parties under the Agreement or any Contract.

33 Publicity

The text of any press release or other communication to be published by or in the media concerning the subject matter of the Agreement and any Contract shall require the prior written approval of the Company. No interviews concerning the same shall be given by the Supplier with the media without prior written approval from the Company of the content of such an interview.

34 Corrupt Gifts and Payments of Commission

34.1 The Supplier undertakes that it shall not and procures that its subcontractors and suppliers shall not enter into or offer to enter into any business arrangement with any servant, employee, officer or agent of the Company other than as a representative of the Company without the Company's prior written approval.

34.2 The Supplier undertakes that it shall not, and uses reasonable endeavours to procure that its subcontractors and suppliers shall not commit any Prohibited Acts or cause the Company to commit any equivalent act.

34.3 The Company shall have the right to audit any and all records necessary to confirm compliance with this Clause 34 at any time during performance of the Agreement and each Contract and during the twelve (12) year period following completion of performance.

35 No Waiver

35.1 No failure or delay on the part of either party to exercise any right or remedy under the Agreement or any Contract shall be construed or operate as a waiver thereof nor shall any single or partial exercise of any right or remedy as the case may be. The rights and remedies provided in the Agreement or any Contract are cumulative and are not exclusive of any rights or remedies provided by law.

35.2 No payment made by the Company shall indicate or be taken to indicate the Company’s acceptance or approval of any part of the Goods or any act or omission of the Supplier from any obligation or liability imposed upon the Supplier by any provision of the Agreement or otherwise.

36 Entire Contract

The Contract embodies and sets forth the entire contract and understanding of the parties and shall supersede all prior oral or written contracts understandings or arrangements relating to the subject matter of the Agreement or any Contract. Except in the case of fraud neither party shall be entitled to rely on any contract, understanding or arrangement which is not expressly set forth in the Agreement or any Contract.

37 Notices and Service of Process

Any notice or other document given under, or in connection with, the Agreement or any Contract must be in English and in writing and sent by letter or delivered by hand to the other party's representatives in each case to the address below. The notice or other document will be effective as follows:

(a) if the notice or other document is sent by letter, it will be effective when it is delivered; and

(b) if the notice or other document is delivered by hand to the other party's representative, it will be effective immediately it is delivered.

The addresses of the Company and the Supplier are set out in Schedule 1.

If a party's details change, it must notify the other party promptly in writing of any such changes. The parties agree that proceedings arising out of or in connection with the Agreement or any Contract may be served in accordance with this Clause 37.

38 Dispute Resolution

38.1 Any question, dispute, difference or claim (a "**Dispute**") shall be resolved in accordance with this Clause 38.

38.2 The parties shall use their reasonable endeavours to resolve any Dispute by a meeting between the Company's Representative and a suitably qualified and duly authorised representative of the Supplier (together the "**Nominated Representatives**") which shall be convened to discuss such Dispute within fourteen (14) days of notification in writing by one party to the other of a matter in dispute.

38.3 If the Dispute has not been resolved within twenty-eight (28) days after the date of a meeting between the Nominated Representatives in accordance with Clause 38.2 (or if no such meeting was convened within twenty-eight (28) days after the date on which notification was served by one party on the other), the Dispute shall be referred as soon as practicable to the Company's Senior Commercial Manager and the Supplier's Managing Director or in the absence or

unavailability of these personnel, persons of similar status deputised to resolve disputes on behalf of their respective companies.

38.4 If the Dispute has not been resolved within twenty-one (21) days of it being referred to the Company's Senior Commercial Manager and the Supplier's Managing Director or their deputies in accordance with Clause 38.3 either party may refer the matter for resolution in accordance with the provisions of Clause 41.

38.5 Clauses 38.1 to 38.4 are subject to the Supplier's rights (if any) under the HGCRA to refer a Dispute to adjudication at any time. Any such adjudication shall be in accordance with the Company's Adjudication Rules. For the purposes of this Clause 38.5, "**Adjudication Rules**" means the most recent edition of the Company's adjudication rules on the date of the notice referring adjudication.

39 Counterparts

Agreement may be executed in several counterparts each of which shall be deemed an original and all of which shall constitute one and the same document.

40 Partnerships and Joint Ventures

40.1 If the Supplier is a partnership, the rights, obligations and liabilities of the partners in the partnership under the Agreement are joint and several. The Agreement and the liabilities of the partners under the Agreement shall not automatically terminate upon the death, retirement or resignation of any one or more members of such partnership or upon the admission of additional partner or partners. The partner or partners in the partnership shall use their reasonable endeavours to procure that any additional partner or partners enter into an agreement with the Company confirming his/her acceptance of the rights, obligations and liabilities of the Supplier under the Agreement.

40.2 If the Supplier comprises two (2) or more parties in joint venture, the rights, obligations and liabilities of each such party under the Agreement are joint and several.

40.3 Nothing in the Agreement shall constitute, or shall be deemed to constitute, a partnership between the parties. Except as expressly provided in the Agreement, neither party is deemed to be the agent of the other and neither party holds itself out as the agent of the other.

41 Governing Law and Jurisdiction

41.1 This Agreement and each Contract and any dispute or claim arising out of or in connection with it or its subject matter shall be governed by and construed in accordance with the law of England and Wales.

41.2 The Company and the Supplier submit, subject to the provisions of this Agreement and any Contract, to the exclusive jurisdiction of the courts of England and Wales provided that the Company has the right in its absolute discretion to enforce a judgement and/or to take proceedings in any other jurisdiction in which the Supplier is incorporated or in which any asset of the Supplier may be situated.

42 Contracts (Rights of Third Parties) Act 1999

42.1 Subject to the Replacement Employer's rights in accordance with Clause 25, no person except any member of the TfL Group may enforce the Agreement and any Contract by virtue of the Contracts (Rights of Third Parties) Act 1999, but this does not affect any other right or remedy of a third party arising at law.

42.2 Notwithstanding those rights referred to in Clause 42.1, the Company and the Supplier may agree to vary or rescind the Agreement and any Contract without the consent of any third party.

43 Bonds, Warranties and Guarantees

43.1 Where stated in Schedule 1, the Supplier shall at its own expense provide within seven (7) days of the Company's request the following:

(a) an executed bond issued by a financial institution whose long term debt obligations are rated not less than A- by Standard & Poor's and/or A3 by Moody's in the form set out in Schedule 8 in favour of the Company;

(b) an executed parent company guarantee from the ultimate holding company or other parent company of the Supplier (provided that such company's long-term debt obligations are rated not less than A- by Standard & Poor's and/or A3 by Moody's) in the form set out in Schedule 8 in favour of the Company.

43.2 The Supplier shall ensure that any bond required under Clause 43.1:

(a) provides, in aggregate, credit protection for the Company in an amount of not less than the amount specified in Schedule 1; and

(b) is renewed every twelve (12) months until the earlier of (i) expiry of the Warranty Period applicable to the final Delivery Date or (ii) twelve (12) months after termination.

43.3 If at any time the existing bond and/or parent company guarantee cease(s) to meet the requirements of Clauses 43.1 and 43.2 then the Supplier shall replace such bond and/or parent company guarantee with a bond and/or parent company guarantee (as the case may be) that meets the requirements within seven (7) days.

43.4 If requested by the Company, the Supplier shall provide an accompanying legal opinion to the bond and/or parent company guarantee supplied under Clause 43.1 completed and signed by a qualified lawyer from the country in which the guarantor and/or parent company is resident in the form specified by the Company.

43.5 If any performance bond and/or parent company guarantee required by any Contract is not procured by the Supplier and delivered to the Company in accordance with Clause 43.1, one quarter of the aggregate of the Order Price for the relevant Contract shall be retained in assessments of the amount due and shall not be payable to the Supplier until such documents have been delivered.

43.6 If required by the Company, the Supplier shall procure that the terms of any subcontract require the subcontractor, within seven (7) days of a written request by the Company to the subcontractor, to enter into:

(a) a collateral warranty in the form set out in Schedule 9 in favour of the Company and if requested by the Company, the Supplier shall require the subcontractor to provide an accompanying legal opinion completed and signed by a qualified lawyer from the country in which the subcontractor is resident in the form specified by the Company; and

(b) a parent company guarantee in the form provided by the Company from the ultimate holding company of the subcontractor in respect of any of the subcontractor's obligations under any collateral warranty required under this Clause 43.6.

43.7 If any warranty (including any accompanying parent company guarantee) required under Clause 43.6 is not delivered to the Company in accordance with Clause 43.6 one quarter of the aggregate of the Order Price relative to the Goods provided by the relevant subcontractor shall be retained in assessments of the amount due and is not payable until such warranty has been delivered.

44 Change of Control

The Supplier shall not without the prior written consent of the Company implement any change of ownership of the Supplier where such change relates to fifty per cent (50%) or more of the issued share capital of the Supplier.

45 Interest

45.1 If either party fails to pay to the other any amount payable in connection with the Agreement or any Contract on or before the due date for payment, interest shall accrue on the overdue amount from the due date for payment until the date of actual payment (whether before or after judgment) at the Interest Rate set out in Schedule 2. Any interest accruing under this Clause 45.1 shall be immediately payable by the paying party on demand.

45.2 Interest (if unpaid) arising on an overdue amount will be compounded monthly with the overdue amount but will remain immediately due and payable.

46 Freedom of Information

46.1 For the purposes of this Clause 46:

"**FOI Legislation**" means the Freedom of Information Act 2000, all regulations made under it and the Environmental Information Regulations 2004 and any amendment or re-enactment of any of them; and any guidance issued by the Information Commissioner, the Department for Constitutional Affairs, or the Department for Environment Food and Rural Affairs (including in each case its successors or assigns) in relation to such legislation;

"**Information**" means information recorded in any form held by the Company or by the Supplier on behalf of the Company; and

"**Information Request**" means a request for any Information under the FOI Legislation.

46.2 The Supplier acknowledges that the Company:

(a) is subject to the FOI Legislation and agrees to assist and co-operate with the Company to enable the Company to comply with its obligations under the FOI Legislation; and

(b) may be obliged under the FOI Legislation to disclose Information without consulting or obtaining consent from the Supplier.

46.3 Without prejudice to the generality of Clause 46.2 the Supplier shall and shall procure that its subcontractors (if any) shall:

(a) transfer to the Company's Representative (or such other person as may be notified by the Company to the Supplier) each Information Request relevant to the Agreement or any Contract, the supply of Goods or any member of the TfL Group that it or they (as the case may be) receive as soon as practicable and in any event within two (2) Working Days of receiving such Information Request; and

(b) in relation to Information held by the Supplier on behalf of the Company, provide the Company with details about and/or copies of all such Information that the Company requests and such details and/or copies shall be provided within five (5) Working Days of a request from the Company (or such other period as the Company may reasonably specify), and in such forms as the Company may reasonably specify.

46.4 The Company shall be responsible for determining whether Information is exempt information under the FOI Legislation and for determining what Information will be disclosed in response to

an Information Request in accordance with the FOI Legislation. The Supplier shall not itself respond to any person making an Information Request, save to acknowledge receipt, unless expressly authorised to do so by the Company.

47 Data Transparency

47.1 The Supplier acknowledges that the Company is subject to the Transparency Commitment. Accordingly, notwithstanding Clause 26 and Clause 46, the Supplier hereby gives its consent for the Company to publish the Contract Information to the general public.

47.2 The Company may in its absolute discretion redact all or part of the Contract Information prior to its publication. In so doing and in its absolute discretion the Company may take account of the exemptions/exceptions that would be available in relation to information requested under the FOI Legislation. The Company may in its absolute discretion consult with the Supplier regarding any redactions to the Contract Information to be published pursuant to Clause 47.1. The Company shall make the final decision regarding publication and/or redaction of the Contract Information.

48 Survival

48.1 The provisions of Clauses 5 (Records and Audit), 15 (Warranty), 16 (Intellectual Property Rights), 17 (Termination), 19 (Indemnity and Insurance), 25 (Supplier Personnel), 26 (Confidentiality), 28 (Responsible Procurement), 32 (Severance), 33 (Publicity), 34 (Corrupt Gifts and Payments of Commission, 35 (No Waiver), 36 (Entire Contract), 37 (Notices and Service of Process), 38 (Dispute Resolution), 41 (Governing Law and Jurisdiction), 42 (Contracts (Rights of Third Parties) Act 1999), 46 (Freedom of Information), 47 (Data Transparency), 48 (Survival), 49.1 and 49.5 (Transport for London Group) will survive the termination or expiry of this Agreement and any Contract and continue in full force and effect, along with any other Clauses or Schedules of this Agreement and any Contract necessary to give effect to them. In addition, any other provision of this Agreement and any Contract which by its nature or implication (including in respect of any accrued rights and liabilities) is required to survive the termination will survive such termination as aforesaid.

49 Transport for London Group

49.1 **Declaration of Ineffectiveness and Public Procurement Termination Event**

(a) Without prejudice to the Company's right to terminate the Agreement and any Contract under Clause 17.1, Clause 17.2(a) or at common law, the Company may terminate the Agreement and any Contract at any time in accordance with the provisions of this Clause 49.1 in the event that:

(i) there is a Declaration of Ineffectiveness; or

(ii) there is a Public Procurement Termination Event (without prejudice to the Company's rights of termination implied into the Agreement and each Contract by Regulation 73(3) of the Public Contracts Regulations 2015 or Regulation 89(3) of the Utilities Contracts Regulations 2016).

(b) In the event that any court makes a Declaration of Ineffectiveness or there is a Public Procurement Termination Event, the Company shall notify the Supplier. The parties agree that the provisions of this Clause 49.1 shall apply as from the date of receipt by the Supplier of the notification of a Declaration of Ineffectiveness or a Public Procurement Termination Event. Where there is any conflict or discrepancy between the provisions of Clause 17.1 and this Clause 49.1 or the Cessation Plan, the provisions of this Clause 49.1 and the Cessation Plan prevail.

(c) The Declaration of Ineffectiveness or the Public Procurement Termination Event shall not prejudice or affect any right, liability or remedy which has accrued or which shall accrue to either party prior to or after such Declaration of Ineffectiveness or Public Procurement Termination Event.

(d) As from the date of receipt by the Supplier of the notification of the Declaration of Ineffectiveness or the Public Procurement Termination Event, the parties (acting reasonably and in good faith) shall agree or, in the absence of such agreement, the Company shall reasonably determine an appropriate Cessation Plan with the object of achieving:

(i) an orderly and efficient cessation of the supply of Goods or (at the Company's request) a transition of the supply of Goods to the Company or such other entity as the Company may specify; and

(ii) minimal disruption or inconvenience to the Company or to public passenger transport services or facilities, in accordance with the provisions of this Clause 49.1 and to give effect to the terms of the Declaration of Ineffectiveness or the Public Procurement Termination Event.

(e) Upon agreement, or determination by the Company of the Cessation Plan the parties shall comply with their respective obligations under the Cessation Plan.

(f) The Company shall pay the Supplier's reasonable costs in assisting the Company in preparing, agreeing and complying with the Cessation Plan. Such costs shall be based on any comparable costs or charges agreed as part of the Agreement and any Contract or as otherwise reasonably determined by the Company. Provided that the Company shall not be liable to the Supplier for any loss of profit, revenue goodwill or loss of

opportunity as a result of the early termination of the Agreement and any Contract in accordance with this Clause 49.1.

49.2 **Crime and Disorder Act 1998**

The Supplier acknowledges that Transport for London is under a duty under Section 17 of the Crime and Disorder Act 1998 (as amended by the Police and Justice Act 2006 and the Policing and Crime Act 2009) to:

(a) have due regard to the impact of crime, disorder and community safety in the exercise of TfL's duties;

(b) where appropriate, identify actions to reduce levels of crime and disorder; and

(c) without prejudice to any other obligation imposed on the Company, exercise its functions with due regard to the likely effect of the exercise of those functions on, and the need to do all that it reasonably can to prevent in its area;

(i) crime and disorder (including anti-social and other behaviour adversely affecting the local environment);

(ii) the misuse of drugs, alcohol and other substances; and

(iii) re-offending

and in the performance of the Agreement and each Contract, the Supplier shall assist and co-operate with the Company and relevant members of the TfL Group and shall use reasonable endeavours to procure that its subcontractors assist and co-operate, with the Company and relevant members of the TfL Group to enable TfL to satisfy its duty.

49.3 **The Company's business**

The Supplier acknowledges that it:

(a) has sufficient information about the Company and the supply of Goods;

(b) is aware of the Company's processes and business;

(c) has made all appropriate and necessary enquiries to enable it to carry out the supply of Goods in accordance with the Agreement and each Contract;

(d) is aware of the purposes for which the supply of Goods are required; and

(e) shall neither be entitled to any additional payment nor excused from any obligation or liability under the Agreement and each Contract due to any misinterpretation or misunderstanding by it of any fact relating to the supply of Goods*.*

49.4 **Best value**

The Supplier acknowledges that TfL is a best value authority for the purposes of the Local Government Act 1999 and as such the Company is required to make arrangements to secure continuous improvement in the way it exercises its functions, having regard to a combination of economy, efficiency and effectiveness. The Supplier shall assist the Company to discharge TfL's duty where possible, and in doing so, shall carry out any review of the supply of Goods reasonably requested by the Company from time to time. The Supplier shall negotiate in good faith (acting reasonably) with the Company any changes to the Agreement and any Contract in order for the Company to achieve best value.

49.5 **Data Protection and Cyber Security**

(a) The Supplier shall comply with all of its obligations under the Data Protection Legislation.

(b) The Supplier shall follow the 10 Steps to Cyber Security issued by the National Cyber Security Centre (or equivalent or replacement guidance or requirements in place from time to time).

49.6 **Conflict of Interest**

(a) The Supplier acknowledges and agrees that it does not have any interest in any matter where there is or is reasonably likely to be a conflict of interest with the carrying out of the supply of Goods or with any member of the TfL Group, save to the extent fully disclosed to and approved in writing by the Company.

(b) The Supplier shall undertake ongoing and regular checks for any conflict of interest throughout the duration of the Agreement and any Contract and in any event not less than once in every six (6) months and shall notify the Company in writing immediately on becoming aware of any actual or potential conflict of interest with the carrying out of the supply of Goods under the Agreement and any Contract or with any member of the TfL Group and shall work with the Company to do whatever is necessary (including the separation of staff working on, and data relating to, the supply of Goods from the matter in question) to manage such conflict to the Company's satisfaction, provided that, where the Company is not so satisfied (in its absolute discretion) it shall be entitled to terminate the Agreement and any Contract.

49.7 **Equality, Diversity and Modern Slavery**

49.7.1 Without limiting the generality of any other provision of the Agreement and any Contract, the Supplier:

(a) shall not unlawfully discriminate;

(b) shall procure that its employees and agents do not unlawfully discriminate; and

(c) shall use reasonable endeavours to procure that its subcontractors do not unlawfully discriminate when providing the Supply,

within the meaning and scope of the Equality Act 2006, the Equality Act 2010 and any other relevant enactments in force from time to time in relation to discrimination in employment.

49.7.2 The Supplier acknowledges that the Company is under a duty under section 149 of the Equality Act 2010 to have due regard to the need to:

(a) eliminate unlawful discrimination on the grounds of age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation (all "**Protected Characteristics**") and marriage and civil partnership;

(b) advance equality of opportunity between persons who share a Protected Characteristic and persons who do not share it; and

(c) foster good relations between persons who share a Protected Characteristic and persons who do not.

In performing the Agreement and each Contract the Supplier shall assist and cooperate with the Company where possible in satisfying this duty.

49.7.3 The Supplier shall ensure that its staff, and those of its subcontractors who are engaged in the performance of the Agreement and each Contract comply with the Company's policies in relation to equal opportunities and diversity, workplace harassment and drugs and alcohol as may be updated from time to time. Copies of these policies are available from the Company at any time on request.

49.7.4 To the extent that the Company is required to assist or co-operate with TfL in compliance with its duties under the Equality Act 2010 (Specific Duties) Regulations 2011, the Supplier shall assist and co-operate with the Company where possible.

49.7.5 Where applicable to the Supplier, the Supplier shall comply with the Modern Slavery Act 2015 and any guidance issued by the Secretary of State under it.

49.8 **Work Related Road Risk**

49.8.1 For the purposes of Clauses 49.8.2 to 49.8.9 (inclusive) of this Agreement, the following expressions shall have the following meanings:

"**Alternative Scheme**"	has the meaning given to it in Clause 49.8.2(a);
"**Approved Progressive Driver Training**"	an ongoing programme of Drivers' training to ensure they have the appropriate knowledge, skills and attitude to operate safely on urban roads. This includes the training specific for the urban environment (including on-road experience from a cyclist's perspective), which is required to be completed at least once every 5 years;
"Car-derived Van"	a vehicle based on a car, but with an interior that has been altered for the purpose of carrying larger amounts of goods and/or equipment;
"Category N2 HGV"	a vehicle designed and constructed for the carriage of goods having a MAM exceeding 3,500 kilograms but not exceeding 12,000 kilograms;
"Category N3 HGV"	a vehicle designed and constructed for the carriage of goods and having a MAM exceeding 12,000 kilograms;
"Collision Report"	a report detailing all collisions during the previous twelve (12) months involving injuries to persons or fatalities;
"Delivery and Servicing Vehicle"	a HGV, a Van or a Car-derived Van;
"Direct Vision Standard" or "DVS"	Direct Vision Standard, a performance based assessment and rating tool, as updated from time to time that measures how much direct vision a Driver

	has from a Category N3 HGV cab in relation to other road users. Further information can be found at: www.tfl.gov.uk;
"Driver"	any employee of the Supplier (including an agency or contracted driver), who operates Delivery and Servicing Vehicles on behalf of the Supplier while delivering the Goods;
"DVLA"	Driver and Vehicle Licensing Agency;
"FORS"	the Fleet Operator Recognition Scheme, which is an accreditation scheme for businesses operating commercial vehicles including vans, HGV, coaches and powered two wheelers.. It offers impartial, independent advice and guidance to motivate companies to improve their compliance with relevant laws and their environmental, social and economic performance;
"FORS Standard"	the standard setting out the accreditation requirements for the Fleet Operator Recognition Scheme, a copy of which can be found at: www.fors-online.org.uk
"Gold Accreditation"	the highest level of accreditation within the FORS Standard, the requirements of which are more particularly described at: www.fors-online.org.uk
"HGV"	a vehicle with a MAM exceeding 3,500 kilograms;
"MAM"	the maximum authorised mass of a vehicle or trailer including the maximum load that can be carried safely while used on the road;
"Silver Accreditation"	the minimum level of accreditation within the FORS Standard acceptable for the contract schedule, the requirements of which are more particularly

	described at: www.fors-online.org.uk
"Van"	a vehicle with a MAM not exceeding 3,500 kilograms; and
"WRRR Self-Certification Report"	has the meaning given to it in Clause 49.8.7.

Fleet Operator Recognition Scheme Accreditation

49.8.2 Where the Supplier operates Delivery and Servicing Vehicles to provide the Goods, it shall within 90 days of the Commencement Date:

(a) (unless already registered) register for FORS or a scheme, which in the reasonable opinion of the Company, is an acceptable substitute to FORS (the "Alternative Scheme"); and

(b) (unless already accredited) have attained the standard of Silver Accreditation (or higher) or the equivalent within the Alternative Scheme and shall maintain the standard of Silver Accreditation (or equivalent standard within the Alternative Scheme) by way of an annual independent audit in accordance with the FORS Standard or take such steps as may be required to maintain the equivalent standard within the Alternative Scheme. Alternatively, where the Supplier has attained Gold Accreditation, the maintenance requirements shall be undertaken in accordance with the periods set out in the FORS Standard.

Safety Features on HGVs

49.8.3 The Supplier shall ensure that every HGV, which it uses to provide the Goods, shall be fitted with safety features consistent with the FORS Silver Accreditation.

Direct Vision Standard (DVS)

49.8.4 Not used

Driver Training

49.8.5 Where the Supplier operates Delivery and Servicing Vehicles to provide the Goods the Supplier shall ensure that each of its Drivers attends Approved Progressive Driver Training throughout the duration of the Agreement and each relevant Contract.

Collision Reporting

49.8.6 Where the Supplier operates Delivery and Servicing Vehicles to deliver the Agreement, the Supplier shall:

(a) within 15 days of the Commencement Date, provide to the Company a Collision Report. The Supplier shall provide to the Company an updated Collision Report within five Working Days of a written request from the Company at any time.

Self Certification of Compliance

49.8.7 Where the Supplier operates Delivery and Servicing Vehicles to provide the Goods, within 90 days of the Commencement Date, the Supplier shall provide a written report to the Company detailing its compliance with Clauses 49.8.2, 49.8.3, 49.8.4, 49.8.5, and 49.8.5 (as applicable) of this Agreement (the "WRRR Self-Certification Report"). The Supplier shall provide updates of the WRRR Self-Certification Report to the Company on each six month anniversary of its submission of the initial WRRR Self-Certification Report.

Obligations of the Supplier regarding subcontractors

49.8.8 The Supplier shall ensure that those of its sub-contractors who operate Category N2 HGVs, Category N3 HGVs, Vans and/or Car-derived Vans to provide the Goods shall comply with the corresponding provisions of this Agreement:

(a) Clause 49.8.2, 49.8.4, 49.8.5, 49.8.7; and

(b) for Category N2 HGVs – Clauses 49.8.3; and

(c) for Category N3 HGVs – Clauses 49.8.3, and, where applicable;

as if those sub-contractors were a party to this Agreement.

Failure to Comply

49.8.9 Without limiting the effect of any other clause of this Agreement or any Contract relating to termination, if the Supplier fails to comply with any of Clauses 49.8.2, 49.8.3, (where applicable), 49.8.3 (where applicable), 49.8.5, 49.8.6, 49.8.7 and 49.8.7;

(a) the Supplier has committed a material breach of this Agreement and any Contract; and

(b) the Company may refuse the Supplier, its employees, agents and Delivery and Servicing Vehicles entry onto any property that is owned, occupied or managed by the Company for any purpose (including but not limited to deliveries).

50 CompeteFor

50.1 Without prejudice to Clause 29 the Supplier will, on a non-exclusive basis, use the CompeteFor electronic brokerage service (or such alternative web-based tool as the Company may direct from time to time) ("**CompeteFor**") to make available to other suppliers all appropriate opportunities,

arising in connection with the Agreement and each Contract, to supply goods, works and services to the Supplier.

50.2 The Supplier will use all reasonable endeavours to ensure that its sub-contractors (for the purposes of this clause, the "**Supplier's Sub-contractors**") use CompeteFor, on a non-exclusive basis, to make available to other sub-contractors all appropriate opportunities, arising in connection with the Agreement and each Contract, to supply goods, works and services to the Supplier's Sub-contractors.

50.3 The Supplier will monitor (and maintain a record of) the number, type and value of opportunities, arising in connection with the Agreement and each Contract, made available to other suppliers via CompeteFor, whether by the Supplier or the Supplier's Sub-contractors, as required by this Clause 50, and will report this information on a quarterly basis by way of email to the Company Representative.

51 Criminal Record Declarations

51.1 For the purposes of this Clause 51:

"**Relevant Individual**" means any servant, employee, officer, consultant or agent of either the Supplier or any subcontractor or supplier involved in the provision of , or intended to provision of, any aspect of the Goods; and

"**Relevant Conviction**" means any unspent criminal conviction relating to actual or potential acts of terrorism or acts which threaten national security.

51.2 The Supplier shall procure from each Relevant Individual (as the case may be) a declaration that he has no Relevant Convictions ("**Declaration**") or disclosure of any Relevant Convictions. A Declaration shall be procured prior to a Relevant Individual providing any of the Goods. The Supplier shall confirm to the Company in writing on request or in any event not less than once in every year that each Relevant Individual has provided a Declaration. The Supplier shall procure that a Relevant Individual notifies the Supplier immediately if he commits a Relevant Conviction and the Supplier shall notify the Company in writing immediately on becoming aware that a Relevant Individual has committed a Relevant Conviction.

51.3 The Supplier shall not engage or allow to act on behalf of the Supplier or any subcontractor in the performance of any aspect of the Goods any Relevant Individual who has disclosed a Relevant Conviction.

51.4 The Company shall have the right in accordance with the audit rights set out in Clause 5 to audit and inspect the records of the Supplier and its subcontractors and its and their respective

employees and agents in order to confirm and monitor compliance with this Clause 51 at any time during performance of this Agreement and each Contract.

51.5 If the Supplier fails to comply with the requirements under Clauses 51.2 and/or 51.3 the Company may, without prejudice to its rights under Clause 17.1, serve notice on the Supplier requiring the Supplier to remove or procure the removal of (as the case may be) any Relevant Individual who has not provided a Declaration from the Contract and/or Company's site with immediate effect and take such steps as are necessary to ensure that such Relevant Individual has no further involvement with the provision of the Goods unless (in the case of non-compliance with Clause 51.2) within seven (7) days of receipt of the notice the Supplier confirms to the Company that he has procured all of the relevant Declarations required under Clause 51.2.

51.6 A persistent breach of Clause 51.2 and/or Clause 51.3 by the Supplier shall entitle the Company to terminate the Agreement and each Contract in whole or in part with immediate effect in accordance with Clause 17.1(a).

51.7 In the event the Company becomes aware that a Relevant Individual has committed a Relevant Conviction, the Supplier shall remove or procure the removal (as the case may be) of such Relevant Individual from the Agreement and each Contract and/or the Company's site with immediate effect and take such steps as are necessary to ensure that such Relevant Individual has no further involvement with the provision of the Goods.

51.8 Nothing in this Clause 51 shall in any way waive, limit or amend any obligation of the Supplier to the Company arising under the Agreement and each Contract and the Supplier's responsibilities in respect of the provision of the Goods remain in full force and effect and the Supplier cannot claim any extra costs or time as a result of any actions under this Clause 51.

Schedule 1
Detailed Terms

a)	Commencement Date	19th November 2019
b)	Term	3 Years (as may be extended in accordance Clause 2.3)
c)	Initial Period	3 Years
d)	Warranty Period	12 months from the Order Delivery Date
e)	Company's Representative: Address for service of notices (Clause 37): Telephone: Email:	Paul Mallows, Senior Commercial Manager
f)	Supplier's Representative: Address for service of notices (Clause 37): Telephone: Email:	Ian Teeley, GRP Business Manager
g)	Framework Specification	**See Schedule 3**
h)	The Liquidated Damages for delay for the purpose of Clause 10.3 payable for such Goods are: The period of delay over which the Liquidated Damages shall be calculated for the purpose of Clause 10.3 is every:	£2,060 Day
i)	The maximum amount of Liquidated Damages payable under Clause 10.3 expressed as a percentage of the price payable for such Goods is:	100% of Contract Price
j)	Security required pursuant to Clause 43.1: Bond Parent Company Guarantee	 No No
k)	Interest Rate pursuant to Clause 45.1	2% above the base rate of the Bank of England
l)	The Suppliers total liability for the purpose of Clause 19.9 is	The aggregate of the Order Price.

Schedule 2

Prices and Schedule of Rates

PART 1 – PRICING PREAMBLES

1. PRICING INTRODUCTION

1.1 This Part 1 provides further details with respect to the Order Price.

2. PRICING CONCEPT

2.1 Prices and schedules of rates under this Framework Agreement are fixed until the expiry of the initial period. After that date schedules of rates included in the Framework Agreement shall be indexed in accordance with Part 3 of this Schedule 2 below.

2.2 The Order Price for each Order shall be formed from a quantified Schedule of Rates. The Schedule of Rates is set out in Part 2 below. Any unique item that cannot be valued by pro-rata from the Schedule of Rates shall be valued using the same principles as for Variations, as set out in Clause 8.1 of this Framework Agreement.

2.3 The Schedule of Rates shall be in Sterling and shall include all applicable taxes and all other statutory costs and the like but excluding VAT.

2.4 The items in the Schedule of Rates shall be inclusive of all costs and charges whatsoever and shall be deemed to include all costs, overheads, profit, risk allowances and the like required for the Supplier's performance of an order.

TFL-01366 Walkway and Drainage Panels **Schedule of Rates**

		Year 1			Year 2			Year 3		
		Product	Delivery	Total	Product	Delivery	Total	Product	Delivery	Total
	Deep Tube track - 4ft walkway									
	All panels are phenolic resin, 19mm square mesh									
A	Size 690x1000mmx50mm thick			0.00			0.00			0.00
B	Size 860x1000mmx50mm thick			0.00			0.00			0.00
C	Size 1000x1000mmx50mm thick			0.00			0.00			0.00
	Drainage Catch-pits Covers									
	All panels are phenolic resin, 38mm square mesh									
D	Size 3000x1000mmx25mm thick			0.00			0.00			0.00
E	Size 3660x1220mmx25mm thick			0.00			0.00			0.00
F	Size 3000x1000mmx38mm thick			0.00			0.00			0.00
G	Size 3660x1220mmx38mm thick			0.00			0.00			0.00
	Open Section and Depot track access walkways									
	All panels are polyester resin, 38mm square mesh									
H	Size 3000x1000mmx25mm thick			0.00			0.00			0.00
I	Size 3660x1220mmx25mm thick			0.00			0.00			0.00
J	Size 3000x1000mmx38mm thick			0.00			0.00			0.00
K	Size 3660x1220mmx38mm thick			0.00			0.00			0.00

PART 3 – INDEXATION

1. OVERVIEW

1.1 The Schedule of Rates shall be subject to indexation after the initial period in accordance with paragraph 2 below.

1.2 The rates and Order Price for any Orders already in existence shall not be altered or amended by virtue of any adjustment under this Part 3 of Schedule 2 Indexation. Indexed rates will only be used for the purposes of any future Orders.

1.3 If the Framework Agreement is extended under Clause 2 then the existing rates apply until the next indexation period.

2. INDEXATION

2.1 The Schedule of Rates shall be adjusted on expiry of the initial period of this agreement in accordance with the following formula:

$$I = \left(\frac{RPIX_y}{RPIX_x}\right)$$

2.2 For the purposes of the formula in Paragraph 2.1 above:

I means the indexation factor applied in any calculation performed pursuant to paragraph 2.1 of this Schedule 2;

$RPIX_y$ means the value of the Retail Price Index excluding Mortgage Interest Payments (RPIX) published in December immediately prior to the current Indexation Date;

$RPIX_x$ means the value of the Retail Price Index excluding Mortgage Interest Payments (RPIX) for the Indexation Base Date of December 2019;

2.3 If the index ceases to be published, then such other appropriate index that may be published in place thereof shall apply or, in the absence of an appropriate replacement index, such index shall apply as the Parties may agree.

2.4 If the index is superseded by an index with a base date which is later than the Indexation Base Date, the superseding index shall be used with an appropriate adjustment to the Indexation Base Date, and base price to neutralise the effect of the change at the date the substitution is made.

2.5 Provisional Indices

Where an index is published as “provisional” and is subsequently amended:

2.5.1 the calculation of any applicable adjustment may be undertaken using the published provisional index and invoices may be rendered accordingly;

2.5.2 any published amendment to the provisional index shall result in recalculation of any applicable adjustment; and

2.5.3 such recalculation shall be retrospective for the relevant period, and the Party disadvantaged by the amendment to the provisional index shall be entitled to recover the difference in the value of any invoice calculated on the basis of an amended provisional index.

Schedule 3
Framework Specification

Walkway and Drainage Panels

Framework Specification

Prepared by:

Name	Signature	Date	Title

Reviewed by:

Name	Signature	Date	Title

Approved by:

Name	Signature	Date	Title

Revision History

Issue	Date	Reason for Change

Contents

1 ORGANISATIONAL OVERVIEW

1.1 Transport for London (TfL)

TfL is an executive body of the Greater London Authority, created in 2000 as the integrated body responsible for the Capital's transport system. Its primary role is to implement the Mayor of London's Transport Strategy and manage transport services across the Capital. TfL is made up of many predecessor organisations covering almost all transport modes in London, and therefore has the ingredients and accumulated experience to provide one of the largest integrated transport systems in the world.

TfL is comprised of different modes. The modes are Surface Transport, Corporate, London Underground and Rail and water. TfL is a partner in Crossrail.

TfL manages London's transport network and is responsible for London's buses, the Underground, the Docklands Light Railway (DLR), London Overground, London River Services, Barclays Cycle Hire, electronic vehicles and policing. TfL also runs Victoria Coach Station and the London Transport Museum.

TfL is responsible for 360 miles (580km) of main roads, and all of London's 4,600 traffic lights. In addition, it manages the London Congestion Charging scheme and regulates the city's taxi and private hire trade. TfL also promotes a range of walking and cycling initiatives across the Capital.

1.2 Business Unit

London Underground (LU) is in the process of modernising the tube trackform to provide a resilient track that meets the growing demand for increased tube travel in the Capital. LU also operates more regularly on updating, maintaining and repairing existing track and stock at station and depots.

2 INTRODUCTION

2.1 Background

LU is looking for a material for a variety of flexible uses including:-

- For Deep Tube track - 4ft walkway (space between the running rails) traditionally has been a drainage trench filled with shingle (stone aggregate). This is an inadequate walking surface and provides a number of maintenance and renewal issues. However the final product must provide a Subsurface Railway Environment approved material (with special fire approval requirements), durable, adjustable, even, slip free, low maintenance surface once installed.

- For Drainage Catchpits Covers – In Subsurface Railway Environment (with special fire approval requirements) and open section of LU network a durable, adjustable (to existing asset sizes), lightweight and see through lid once installed.

- For Open Section and Depot track access walkways – walkways are for maintenance, operational staff and general public visitors. Material needs to be

yellow and provide a durable (both colour and structurally), adjustable, even, slip free, low maintenance surface once installed.

LU has been using glass fibre reinforced grating (PE and PH grades for Subsurface and non-sub-surface areas of network) for a number of years and has approved number of manufacturers for the above requirements. LU is open to new material and will assist any supplier with required materials approvals process that would be a requirement for successful tender.

3 SCOPE

3.1 General Requirements

The Supplier shall provide a product (including material data), engineering design and load test data, detailed installation methodology to meet the following specifications:-

For Deep Tube track - 4ft walkway

Material to meet requirements of LU Tube 4-foot walkway panels specification T0440. For detailed dimensional constraints of deep tube track standard formation refer Drawings PCDT1116-DWG-CVL-S001-0000001 for sleeper track formation and PCDT1116-DWG-CVL-S001-0000002 for direct fix track formation. Variations on this system for power cabling, signals and drainage pits will be reviewed during tender assessment. This system will be installed within a Subsurface Railway Environment and the material will need to meet the LU fire material requirements of S1085.

The specification is for a non conductive, lightweight and rigid material to take the loading of the track environment (refer T0440 and S1052). The material shall be corrosion and chemical resistant, with a grated, anti-slip surface with at least 45% of the total surface as voids. The panels shall not include metallic or electrically-conductive materials.

In addition to the requirements, drainage walkway panels for the deep tube section must have:

- A grating void size of 17mm x 17mm to providing a safe walking surface for staff and detraining passengers,
- A Panel size of:
  - 1000mm x 1000mm,
  - 860mm x 1000mm,
  - 690mm x 1000mm.
- A panel weight of no more than 25kg to allow a one-man lift,
- A product depth of 50mm +/-1mm.
- A design span of 850mm +/-50mm,
- Structural integrity for panels spanning in maximum design but minimum allowable width or other restrictions of service performance to be highlighted within design.

Drainage Catch-pits Covers

Material will meet the requirements of Civil Engineering – Track and off-track gravity drainage systems specification T0001. For loading requirements refer Civil Engineering – Gravity Drainage Systems standard S1052. This system will be installed within a Subsurface Railway Environment and the material will need to meet the LU fire material requirements of S1085. Where separate materials are supplied for subsurface environment and non-subsurface environments a clear system of identification shall be incorporated into design.

The specification is for a non conductive, lightweight and rigid. The material shall be corrosion and chemical resistant, with a grated, anti-slip surface with at least 45% of the total surface as voids. The panels shall not include metallic or electrically-conductive materials.

Panel supply dimensions required are 3660mm x 1220mm and/or 3000mm x 1000mm but design shall incorporate a safe methodology for cutting/modifying/reducing panel size to suit various catch-pit sizes.

The aperture size required 32mm x 32mm based on 38 x 38mm centre to centre. Depths are 25mm and 38mm deep.

Open Section and Depot track access walkways

Material shall comply with S1168 Track Asset Walkways. Design shall recommend fixing, holding down, supporting and installation methodology to suit panel design.

Panel supply dimensions required are 3660mm x 1220mm and/or 3000mm x 1000mm but design shall incorporate a safe methodology for cutting/modifying/reducing panel size to suit various walkway dimensions. Panel to be supplied in yellow for visibility and safety reasons (RAL 1003).

The aperture size required 32mm x 32mm based on 38 x3 8mm centre to centre. Depths are 25mm and 38mm deep.

4 REQUIREMENTS / DELIVERABLES

4.1 Supply & delivery

The Supplier will deliver ordered material as the purchase order instructions to one of a number of Storage Depots for further distribution by LU to individual sites (e.g. Ruislip or Lillie Bridge Depot, etc.).

4.2 Installation & upgrades

The Supplier will recommend the installation methodology of the product and will provide a quote for any materials required within this methodology but LU will take responsibility for installation and may source all items other than the panels from separate source.

4.3 Maintenance, spares and consumables

LU will retain responsibility for maintenance, spares and consumables but the Supplier will guarantee the durability of the product and will work with LU to resolve any issues relating to this during the life of the product.

4.4 Inspection & certification

The Supplier will certify that its product meets all Specification requirements and performs to approve design for product use in track. The Supplier may be asked to inspect the product in track for verification of the above certification but insitu track installation and maintenance inspections of the panels will be the responsibility of LU.

4.5 Documentation, drawings, manuals and cost data

The Supplier will supply adequate information to identify product, correct installation, correct use of product and conditions of use in track (see appendices 4 and 5).

4.6 Handling, packaging, storage

The Supplier will supply methodology and all details required for handling, cutting or modifying product, delivery methodology and packaging plus storage requirements for durability of product and H&S requirements.

4.7 Delivery, delivery phasing or sequencing of operations

LU will agree, in advance the delivery schedule for the product. The Supplier shall provide all lead times and limitation to delivery of the tender and inform LU of any changes during the period of contract as soon as practicable.

4.8 Training & support requirements

LU has an expectation that the supplier will be available to discuss any or all of the above information by various means including visiting LU Depots, and work sites, where required or agreed during office hours and nights (during engineering hours). Access to these locations and any requirements for this access will be arranged by LU including all relevant training and PPE.

4.9 Site and Contract Management

LU will assume responsibility for storage, individual site delivery, installation and maintenance of product. The Supplier will supply and update LU of deliver schedule and any delivery phasing based on programme agreed with LU.

4.10 Review meetings

The Suppliers will be required to attend 2 review meetings, a preliminary meeting to go through the scope and a final meeting to present and review design and commercial. Suppliers are expected to read Category 1 Standard S1538 Assurance and complete Design Compliance Declaration (see appendices 2 and 3)

4.11 Contingencies

Supplier shall hold agreed amount of product available at 1 month and 6 month notice. This will be negotiated and managed over contract period.

5 Demand Forecast

The following numbers of panels will be required as part of this contract annually. These are indicative volumes. The exact requirements will be established as works are planned.

Panel size	Annual Number of Panels
Deep Tube track - 4ft walkway	
690mm x 1000mm x 50mm thick	1,000
860mm x 1000mm x 50mm thick	3,000
1000mm x 1000mm x 50mm thick	1,000
Drainage Catch-pits Covers	
3000 x 1000mm x 25mm thick	300
3660 x 1220mm x 25mm thick	300
3000 x 1000mm x 38mm thick	200
3660 x 1220mm x 38mm thick	200
Open Section and Depot track access walkways	
3000 x 1000mm x 25mm thick	300
3660 x 1220mm x 25mm thick	300
3000 x 1000mm x 38mm thick	200
3660 x 1220mm x 38mm thick	200
Total	**7,000**

6 Supporting Documentation

Document No.	Document Title
T0440	Tube 4-foot walkway (Tech Spec)
T0001	Civil Engineering – Track and off-track Gravity Drainage Systems (Tech Spec)
PCDT116-DWG-CVL-S001-0000001	Typical Tube Track Drainage, GRP Cover and Details, Sleepers (Drawing)
PCDT1116-DWG-CVL-S001-0000002	Typical Tube Track Drainage, GRP Cover and Details, Direct Fix (Drawing)

7 Appendices

Appendix 1. Design Compliance Declaration

Appendix 2. S1011 Product Acceptance and Registration (Cat 1 Std)

Appendix 3. S1052 Civil Engineering – Gravity Drainage Systems (Cat 1 Std)

Appendix 4. S1085 Fire Safety Performance of materials – Station and Tunnel Infrastructure (Cat 1 Std)

Appendix 5. S1168 Track Asset walkways (Cat 1 Std)

Appendix 6. S1538 Assurance (Cat 1 Std)

6.1 T0440 - Tube 4-foot walkway (Tech Spec)

Technical Specification

T0440 Tube 4-foot walkway panels

Issue: A1

Issue date: May 2014
Review date: May 2017

MAYOR OF LONDON

Contents

1 Purpose

The purpose of this technical specification is to define the performance requirements and acceptance criteria for four-foot walkway panels within the tube environment.

2 Scope

This technical specification relates to four-foot walkway panels which may be installed to span the drainage channel in tube running tunnels as an alternative to filling the channel with shingle. The tube track concerned may be either sleepered or not.

3 Requirements

3.1 Performance in track

3.1.1 Walkway panels are to be able to span a maximum of 850mm wide channel and sit within a 75mm wide by 50mm high rebate (total cover width of 1000mm including rebate either side) as shown in Figure 1, and sustain the following loads:

1) a uniformly distributed load of 5kN/m² with deflection not exceeding 0.5% of span.

2) Point loads from “Iron Men” rail handlers without permanent deflection. (Iron Men are lifting frames mounted on wheels; they have a self weight of 135kg and a safe working load of 1500kg. For further details and load cases to be considered refer to Attachment 2.)

3.1.2 Walkway panels shall lend themselves to straightforward site fabrication and assembly using standard hand tools without the use of hot works or heavy equipment.

3.1.3 Walkway panels shall have a grated structure with at least 45% of the total surface as voids. A grating size of 17x17mm has been assessed by LU as providing a safe walking surface for staff and detraining passengers; if the supplier proposes an alternative configuration he shall provide LU with evidence that such configuration is no less safe.

3.1.4 The walkway panels shall have an anti-slip surfacing: see clause 3.4.3.

3.1.5 In order to allow a one-man lift the maximum panel size of 1000x1000mm shall weigh no more than 25kg.

3.1.6 In order to resist aerodynamic uplift the maximum panel size of 1000x1000mm shall not weigh less than 23kg.

3.1.7 The material shall be corrosion and chemical resistant for the tube environment. Refer to Attachment 1 for environmental performance criteria.

3.1.8 The intended service life of the walkway material shall be nominally 50 years. The supplier shall provide assurance to this effect.

3.2 Material composition and finish

3.2.1 The composition of the panel material shall be declared to LU by the supplier.

3.2.2 The panels shall not include metallic or electrically-conductive materials.

3.2.3 Changes to the design, materials or the production process from those used for type approval testing shall not be introduced without prior approval from LU. LU may require the repetition of the type approval tests described in this specification before approving changes.

Note:	LU is committed to improving the sustainability of the materials it uses and therefore has a preference for recycled materials where these are capable of achieving the required performance.

3.2.4 The upper surface of the panels shall be free of tripping and slipping hazards.

3.3 Dimensions

3.3.1 Dimensions and their tolerances shall be as shown below:

Table 1 – Tolerances	
Cover Depth – 50mm	+/- 2mm
Cover Width or Length – Varies	Must be able to be cut to +/-10mm
Cover grating voids – see clause 3.1.3	+/-1mm and represent between 40% and 50% of surface
Cover weight – based on maximum panel size of 1000 x 1000 x 50mm	23kg Min / 25kg Max.

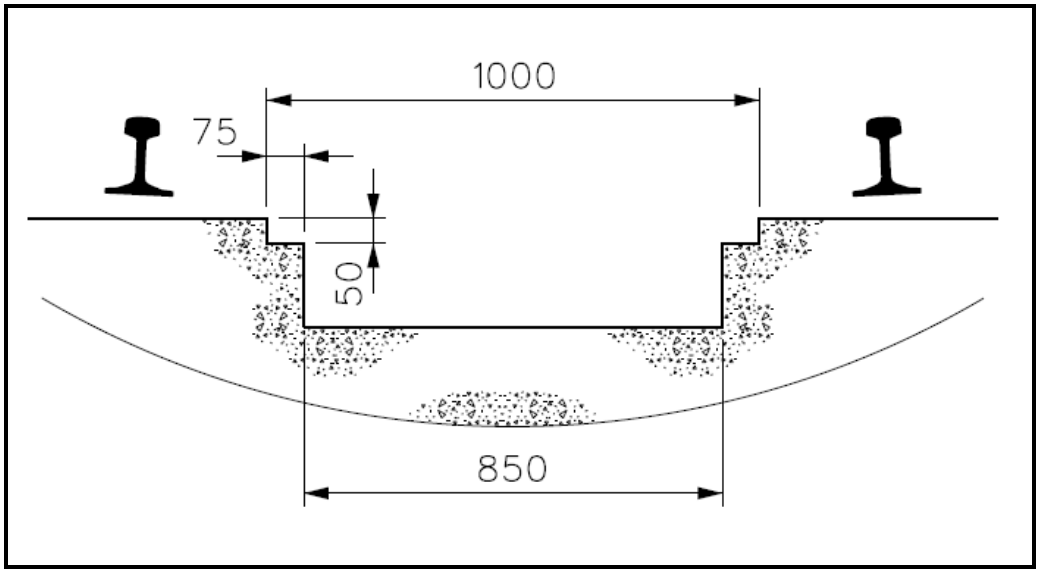


Fig. 1 – Typical concrete formation details

3.3.2 General arrangements of track fitted with walkway covers are shown on LU drawings PCDT1116-DWG-CVL-S001-0000001 and PCDT1116-DWG-CVL-S001-0000002.

3.4 Acceptance testing

3.4.1 General

All supporting data shall be based on tests undertaken by an independent laboratory (UKAS-certified or approved equivalent).

3.4.2 Fire performance

The material shall comply with the requirements of 1-085.

3.4.3 Slip resistance

Slip resistance, when assessed using the method in EN 13036-4, shall be not less than 36 under dry and wet conditions.

3.4.4 Resistance to chemicals

The supplier shall demonstrate that the material's properties will not be adversely affected by chemicals likely to be encountered during its service life, e.g. oils, fuels and solvents used on the railway network.

3.4.5 Material density

The material density shall be stated by the supplier when acceptance is sought. This will enable LU to plan appropriate manual and mechanical handling procedures.

3.4.6 Debris from cutting and drilling

The supplier shall assure LU that debris such as dust and shavings arising from the cutting and drilling of the material will not pose any risk to personnel or the environment.

3.5 Labelling and storage

3.5.1 Each item shall be labelled to show the following information, on a part of the surface which will be visible after installation:

- Manufacturer's name
- Product series and resin type
- Lot number traceable to the date of manufacture
- Reference number as required to assist assembly on site.

3.5.2 Markings shall be applied by paint or ink stencil, sticker, or both. Markings shall be permanent, shall not overlap, and shall be applied in such a manner as not to damage the product.

3.5.2 Legibility must be maintained for at least 15 years from manufacture.

3.6 Information to be supplied by the manufacturer for the purpose of type approval

The following information shall be provided to LU:

a) Dimensions and tolerances of the proposed product;

b) The test results required to demonstrate compliance with this specification;

c) A statement of how the manufacturer will manage quality control to ensure that all items supplied will continue to meet the requirements of this specification;

d) Recommendations regarding drilling and cutting of the material, in particular:
   i. the optimum type of drill and saw;
   ii. safety data related to task of drilling, cutting or grinding of the material;

e) The method of packaging and handling which will be used, including stack size.

3.7 Certification

The manufacturer shall provide, with each batch supplied, a certificate of conformity and any other relevant documentation testifying that they have been manufactured in accordance with relevant standards and these requirements.

3.8 Quality Assurance

Suppliers seeking product acceptance or tendering for supply shall submit a Quality Assurance Plan stating how consistent compliance with the requirements of this specification will be ensured. In addition, the method of manufacture shall be described in sufficient detail to enable independent verification of compliance.

4 Responsibilities

Any person to whom a responsibility related to this specification is assigned shall be qualified and appropriately certificated to undertake that responsibility. In particular they shall be fully conversant with this specification.

5 Supporting information

This specification has been created in response to expressions of interest in the use of walkway panels formed of non-slip materials as an alternative means of providing four-foot walkways in tube running tunnels, where the traditional shingle needs periodic replacement, tends to impede free drainage and does not provide an even walking surface.

6 References

6.1 References

6.1.1 British Standards

Document no.	Title
EN 13036-4	Road and airfield surface characteristics – test methods. Part 4: method of measurement of slip/skid resistance of a surface: the pendulum test

Note: European Standards (EN) are prefixed "BS" when used in the United Kingdom

6.1.2 LU company documents

Document no.	Title
S1157	Track – Performance, design and configuration
1-085	Fire Safety Performance of Materials

6.1.3 LU drawings

Document no.	Title
PCDT1116-DWG-CVL-S001-0000001	Typical Tube Track Drainage GRP Cover and Details - Sleeper Formation
PCDT1116-DWG-CVL-S001-0000002	Typical Tube Track Drainage GRP Cover and Details – Direct Fix Formation

6.2 Person accountable for the document

Person accountable for the document
Stephen Barber, Head of Track Engineering, LU

6.3 Document history

Issue no	Date	Changes	Author
A1	April 2014	New specification. Issued for review and comment. DRACCT ref 02516.	Shawn Doring

7 Attachments

7.1 Attachment 1: Environmental performance criteria

The criteria set out below are extracted from LU standard S1157.

Parameter	Description
Ambient temperature range	Typically 20C to 30C in tube tunnels
Relative humidity	Typically 35% to 65% in tube tunnels

7.2 Attachment 2: Iron Man Details

Iron men rail handlers are lifting frames mounted on wheels that have a self weight of 135kg and a safe working load of 1500kg. These lifting devices will be deliberately 'de-railed' on to the covers and used to lift rails (see photos 1 and 2 below for examples of use on ballasted track). They have four wheels of 205mm diameter, only two of which (with a wheel base of 870mm) could apply a point load on a single cover at any time.

The loadings applied by the use of iron men for various formation configurations to be considered are listed below and shown in Figure 2:

- The 202mm x 1000mm cover will only support one wheel of the Iron Man per cover, therefore a point load of 409kg mid span,
- The 387mm x 1000mm cover will again, only support one wheel of the Iron Man per cover, therefore a point load of 409kg mid span,
- The 894mm x 1000mm cover could in theory support both wheels mid span. The point loads applied by the wheels will be 870mm apart, therefore are applied 12mm inside each edge,
- The 1000mm x 1000mm cover could in theory support both wheels mid span. The point loads applied by the wheels will be 870mm apart, therefore are applied 65mm inside each edge.

Photo 1 – Iron Man de-railed to move rail

Photo 2 – Iron Man on rails

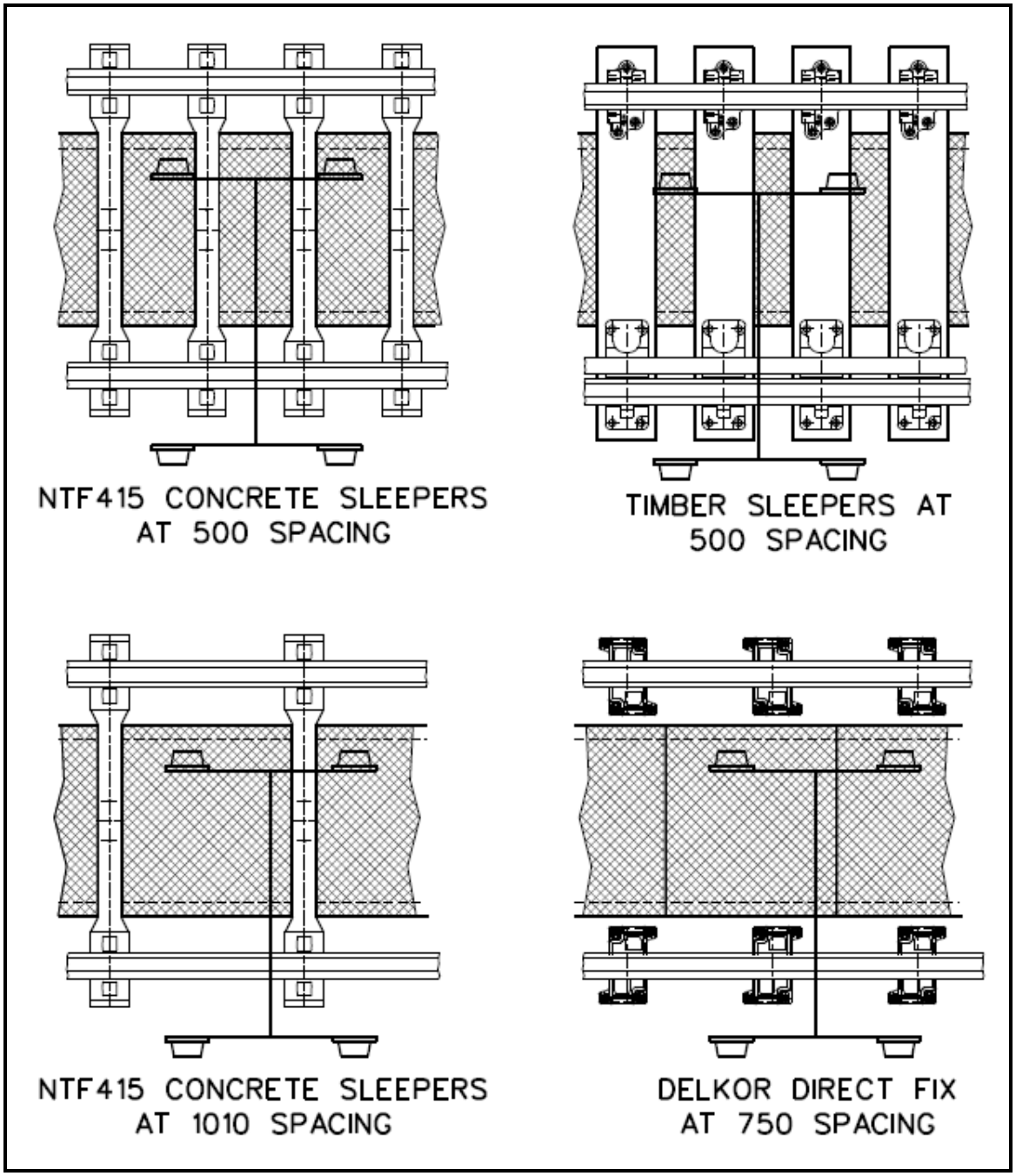


Fig. 2 – Iron Man load positions

6.2 T0001 - Track and off-track Gravity Drainage Systems (Tech Spec)

Technical Specification

T0001 Civil Engineering - Track and Off-track Gravity Drainage Systems

Please read the Written Notices attached to this standard

Issue: A1 **Issue date:** February 2011

Contents

1 Purpose

1.1 The purpose of this Specification is to provide designers and tenderers / contractors with the minimum technical standards and physical requirements that Track and Off-track Drainage gravity systems shall be designed and constructed to meet.

2 Scope

2.1 This Specification applies to all Track and Off-track gravity drainage systems designed and constructed by or for London Underground Ltd (LUL).

3 Specification

3.1 Preamble

3.1.1 This specification is substantially based on the Department for Transport's Specification for Highway Works (SHW), Series 500 Drainage and Service Ducts (incorporating November 2009 amendments) and (but to a far lesser extent) on the UK Water Industry Research publication, the Civil Engineering Specification for the Water Industry (6th Edition) (CESWI). Significant editing has taken place to improve the relevance of source Clauses in the context of railway drainage installations generally and London Underground (LU) infrastructure specifically. Many Clauses within this specification retain references to other SHW series Clauses (eg. Earthworks Series 600 Clauses), in such cases the specific requirements of the referenced SHW Clause are deemed to apply.

3.1.2 This specification is as far as possible, a performance based standard. However, given that the LU environment is rather unique in certain respects, some prescription remains in the document.

3.1.3 This document is generic in form and not tied to either the Institution of Civil Engineers Conditions of Contract (Measurement Version)(7th Edition) or the Civil Engineering Standard Method of Measurement (3rd Edition) or the Manual of Contract Documents for Highway Works Volume 4 Bills of Quantities for Highway Works.

3.1.4 The document contains references to the 'Client', 'Engineer' and 'Contractor'. It should be noted that in the context of this specification those terms shall be taken to have logical meaning in the broad senses of the words and shall be viewed as independent of the specific Conditions of Contract. Thus the term 'Client' shall be taken to mean Employer, Authority, Purchaser, etc; similarly 'Contractor' shall mean 'Contractor' in the traditional contractual sense if appropriate, or shall mean the relevant entity within other forms of contract such as alliancing and joint ventures, etc; and the term 'Engineer' shall also be construed in a generic sense to mean Contract Administrator, Project Manager, etc. as appropriate to the contract.

3.1.5 There is no reference in the specification to satisfy legislation. This follows the general principle that the works are to be constructed to comply with all relevant statutes.

3.1.6 This specification provides broad guidance on acceptable materials and levels of workmanship. However, in common with both CESWI and SHW, the standard requirements of this specification must be augmented for each discrete package of work with a *contract specific appendix* (sometimes referred to as a '*Particular Specification*'). In conjunction with this specification, the contract specific appendix is referred to as *Appendix D1;* it shall contain contract specific information and requirements. Further guidance on the preparation of the contract specific Appendix D1 is given at the end of this specification in Section 7.1 - Attachment 1.

3.2 General

3.2.1 Terms and Abbreviations

3.2.1.1 Unless specifically defined otherwise in Clauses 6.2 and 6.3, the definitions of terms used in the Specification and associated documents are those in BS 6100, Glossary of Building and Civil Engineering Terms.

3.2.2 British, European and International Standards

3.2.2.1 British, European and international standards shall be deemed to be those current 28 days prior to the date for return of tenders, or those current at the date of receipt of this specification document, whichever may be applicable.

3.2.3 Health, Safety, Environment and Quality

3.2.3.1 The current version of LU Category 1 Standard 1-551 Procuring and Managing Suppliers and Contractors – HS & E Requirements, shall be complied with during all construction, installation, testing and commissioning work.

3.2.3.2 New works and maintenance work shall comply with BS EN 752 Clause 7 Health and Safety Principles.

3.2.4 Existing and As-built Survey Drawings

3.2.4.1 Where required by the contract, as-built drawings shall be provided in electronic format and comply with the current version of LU Category 1 Standard 1-037 Computer Aided Design Data and the particular requirements of Appendix D1.

3.2.5 Impact on Outside Party Assets

3.2.5.1 Where required by the contract, the impact on Outside Party assets shall be determined in accordance with the current version of LU Category 1 Standard 1-023 Infrastructure Protection.

3.2.6 Contractor Designs

3.2.6.1 All items to be designed by the Contractor shall be scheduled in Appendix D1 together with all applicable design standards and scopes of work.

3.2.6.2 The Contractor shall provide a fully signed-off Design Check Certificate for the category of check undertaken and appropriate for the asset designed in accordance with the current version of LU Category 1 Standard 1-538 Assurance.

3.3 Technical

3.3.1 General

3.3.1.1 Where the term ‘drain’ is used in this section of the specification, it shall be deemed to include the terms ‘sewer’ and ‘piped culvert’.

3.3.1.2 Where the term ‘drain’ is used in this section of the specification, it refers to manufactured pipes with diameters of 900mm or less. Pipes with diameters greater than 900mm are classified as structures and are not subject to this specification.

3.3.1.3 Unless otherwise described in Appendix D1 only one type of pipe shall be used within any individual drain between consecutive chambers. The Contractor shall ensure that plastics pipes are not subject to deterioration due to sunlight during the period between manufacture and installation in the ground.

3.3.1.4 The Design Life of drainage assets shall be in accordance with Table 3.3.1.1 unless identified otherwise in Appendix D1. Evidence of compliance shall be in the form of Agrément Certificates or other verified testing and copies of such certificates and test data shall be supplied to the Engineer.

Drainage asset	Design life
Drainage assets (unless stated otherwise)	60 years
Catchpit covers	20 years
Brick drain	125 years
Non brick drain (other than hydrocarbon-based materials) i.e. clay, concrete pipe	100 years
Pipes made from hydrocarbon-based materials e.g. High Performance Polyethylene (HPPE); and CIPP lining systems.	40 years

Table 3.3.1.1 – Design Life of Drainage Assets

3.3.1.5 All materials supplied under the contract shall comply with the requirements of the current version of LU Category 1 Standard 1-050 Civil Engineering – Common Requirements.

3.3.1.6 LU maintains a Products Register (http://www.lu-apr.co.uk); only products appearing on that register may be incorporated into the works. Should a supplier or contractor wish to use a product not on the register then special approval (from the LU *Principle Engineer for Pumps and Drainage*) will need to be sought and granted before it can be incorporated in the works.

3.3.2 Pipes for Track and Off-track Gravity Drainage

3.3.2.1 Pipes for Track and Off-track gravity drainage shall be selected from the alternatives listed in Table 3.3.2.1 unless clause 3.3.2.2 applies and shall comply with the standards and particular requirements therein. The contractor shall show that the pipes he selects have hydraulic flow capacity equal to that assumed in the hydraulic design of the system as described in Appendix D1.

On completion of the whole of the works, the Contractor shall provide the Engineer with a schedule showing details of all pipe types used, including quality, joints and name of manufacturer.

3.3.2.2 If pipes manufactured from materials other than those shown in Table 3.3.2.1 are required to be used, they shall be specified in Appendix D1.

Material	Usage	Standard	Particular Requirements
Vitrified clay (VC).	Surface and ground water carrier drains.	BS 65 or BS EN 295	"Normal" or "surface water" pipes as defined in BS 65.
	Surface and ground water filter drains.	BS EN 295	Perforated with flexible mechanical joints.
Concrete (with Portland Cement or Sulphate-Resisting Portland Cement when required in Appendix D1. Super-sulphated cement shall not be used).	Surface and ground water carrier drains.	BS 5911-1 and BS EN 1916 (Ordinary reinforced or unreinforced)	
		BS 5911-5	
Iron	Surface and ground water carrier drains.	BS EN 598 (Ductile iron)	
Thermoplastics solid wall pipes and fittings. Unplasticised	Surface and ground water carrier drains.	BS EN 1401 (PVC-U) BS EN 1852-1 (PP)	

polyvinyl-chloride (PVC-U). Polypropylene (PP). Polyethylene (PE).		BS EN 12666-1 (PE)	High Performance Polyethylene (HPPE) grades PE80 and PE100 only.
		DIN 8074 & 8075 (PE)	High Performance Polyethylene (HPPE) grades PE80 and PE100 only.
	Surface and ground water filter drains.	BS EN 1401 (PVC-U) BS EN 1852-1 (PP)	
		BS EN 12666-1 (PE)	High Performance Polyethylene (HPPE) grades PE80 and PE100 only.
		DIN 8074 & 8075 (PE)	High Performance Polyethylene (HPPE) grades PE80 and PE100 only.

Table 3.3.2.1 Pipes for Track and Off-track Gravity Drainage

3.3.2.3 The following are **not** permitted:

a) Use of rigid or semi-rigid pipes with rigid joints for any buried pipeline.
b) The use of *twin-walled* or *structured wall* plastic pipes.
c) The use of open jointed pipes.

3.3.2.4 All filter drainage shall employ perforated pipes with the following characteristics:

a) Perforations should be not less than 1000mm² per metre length of pipe or 1% of the pipe external surface area per metre length of pipe – whichever is the greater; and should not reduce the pipe stiffness by more than 5%.
b) Circular perforations should be between 10mm and 6mm in diameter.
c) Rectangular slots should be between 7mm and 3mm in width (unless stipulated otherwise in Appendix D1).
d) Perforations shall be distributed in a minimum of three rows, each row shall be no more than 90° from the adjacent row.
e) Perforated pipes shall only contain perforations within the top half of the pipe unless stipulated otherwise in Appendix D1.

3.3.2.5 Use of hydrocarbon based pipes

3.3.2.5.1 The use of hydrocarbon based pipe materials in particular (and any other materials in general) which fail to meet the requirements of the current version of LU Category 1 Standard 1-085 Fire Safety Performance of Materials, in respect of flammability, smoke emission and toxic fume emission in Sub-surface Railway areas, shafts and tunnels (both bored tunnel and cut & cover tunnel forms), is not permitted unless a concession / fire waiver is obtained against the standard.

3.3.2.5.2 A concession / fire waiver for use of High Performance Polyethylene (HPPE) exists (LU ref. CR03003). This material is permitted for use as track drainage in sub-surface railway when buried under a minimum depth of 500 mm of track ballast and/or inert gravel, and when exposed pipe ends have been treated in one of the following two ways:

a) The ends of the pipe to be cut off and trimmed back 30-50mm to the chamber wall and the annulus sealed off at the end with epoxy mortar. In accordance with standard detail drawing *Proposed Option 1* (Ref. NNNN0000-DWG-DRN-SA00-5390001).

b) The ends of the pipe to be entirely encased by an aluminium fire protection pipe cap. The protection pipe cap is screwed into the chamber wall. In accordance

with standard detail drawing *Proposed Option 3* (Ref. NNNN0000-DWG-DRN-SA00-5390003).

3.3.2.5.3 A second concession for the use of HPPE pipe exists (LU ref. CR05565) that permits its use as track drainage in Sub-surface Railway, shafts and tunnels (both bored tunnel and cut & cover tunnel forms) when covered by a minimum depth of inert gravel of 130mm and enclosed in a fire barrier sock in accordance with Clause 3.3.4.8. Where the depth of cover is 500mm or greater, the fire barrier sock is *not* required and the requirements of concession CR03003 shall apply. Under this concession (LU ref. CR05565) exposed pipe ends must be cut back flush with the internal walls of chambers they are built into. No further special treatment of the pipe ends is required *if* the chambers involved are covered by solid covers or planks (made from suitable fire-resistant materials). However, if open covers or gratings are used, then the exposed pipe ends must be treated in accordance with concession CR03003 (i.e. as described above in Clause 3.3.2.5.2).

3.3.2.6 When pipes are required beneath and across the track, flexible joints shall be located within the Six Foot, Ten Foot and the Cess, such that pipeline articulation is possible and a degree of differential settlement can be accommodated.

3.3.3 Excavation for Pipes and Chambers

3.3.3.1 The Contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. He shall be responsible for maintaining the nature of the acceptable material so that when it is placed and compacted it remains acceptable in accordance with the contract. Acceptability shall be determined in accordance with Table 6/1 of the SHW and any contract specific requirements in Appendix D1.

3.3.3.2 The Contractor shall ensure that he does not adversely affect the stability of excavations or fills by his methods of stockpiling materials, use of plant or siting of temporary buildings or structures.

3.3.3.3 Excavations for foundations and trenches shall be adequately supported at all times, and, except where otherwise described in Appendix D1, shall not be battered. Where excavations are permitted to be battered they shall be benched as described in Appendix D1 and/or on the Contract drawings prior to backfilling and compaction. The additional work and materials shall be provided by the Contractor. Sheeting and other excavation supports shall be removed as filling proceeds except where they are required by the Contract to be left in position, in which case the requirement shall be stated in Appendix D1.

3.3.3.4 Excavations requiring backfilling shall remain open only for the minimum period necessary. Where such excavations are within 2 metres of the nearest running rail, the maximum length of excavation which can be opened at any one time is 15 metres (except when clause 3.3.3.5 applies) but this may be reduced by the Engineer on site following his assessment of the ground conditions and adjacent engineering train loading.

3.3.3.5 In exceptional circumstances the maximum length of excavation may be increased beyond 15m subject to a formal load bearing capacity assessment of the ground and adjacent engineering train loading conditions by a suitably experienced and qualified Geotechnical Engineer.

3.3.3.6 The Contractor shall keep earthworks free of water including:

a) arranging for the rapid removal of water
   i. shed on to the earthworks;
   ii. entering the earthworks from any source;

b) lowering and maintaining by appropriate measures, the water level in excavations, sufficiently to enable the Permanent Works to be constructed.

3.3.3.7 In carrying out the requirements of sub-Clause 3.3.3.6 of this specification the Contractor shall:

a) form and maintain cuttings, embankments and other areas of fill with appropriate falls and gradient and sealed surfaces;

b) provide where necessary temporary watercourses, drains, pumping and the like;

c) discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable;

d) provide adequate means for trapping silt on temporary systems discharging into permanent drainage systems.

3.3.3.8 The Contractor shall carry out and maintain any groundwater lowering or other treatment required in Appendix D1.

3.3.3.9 Soft spots existing below the bottom of an excavation shall be removed and the resulting voids backfilled with either of the following:

a) Type 1 unbound mixture for sub-base complying with SHW Clause 803, well compacted.

b) Pipe bedding material complying with SHW Clause 503, well compacted.

3.3.3.10 Any additional excavation below the bottom of an excavation that is required because the Contractor has allowed the bottom to become soft or otherwise unacceptable for the construction of the pipeline or chambers shall be made good as described in sub-Clause 3.3.3.9 of this Clause.

3.3.3.11 Any excavation greater than the net volume required for the Permanent Works below the level of the pipe surround shall be made good as described in sub-Clause 3.3.3.9 above.

3.3.4 Bedding, Laying and Surrounding of Pipes

3.3.4.1 Immediately following the excavation of the trench, the pipes shall be laid so that each one is in contact with the bed throughout the length of its barrel. The pipes shall be laid at the levels and gradients shown on the drawings and schedules. The deviation in level from that specified at any point shall not exceed 20mm and in addition the algebraic difference of the deviation in level at any two points on each pipe shall not exceed 30mm. In the case of socketed or sleeve jointed pipes the bed shall be cut away and removed at each socket or sleeve to give a clearance of at least 50mm, or 100mm for trenches in material designated as Hard Material, so that the socket or sleeve does not bear on the bed. Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.

3.3.4.2 Pipes and fittings shall be examined for damage and the joint surfaces and components shall be cleaned immediately before laying. Measures shall be taken to prevent soil or other material from entering pipes, and to anchor each pipe to prevent movement before work is complete.

3.3.4.3 Track and Off-track surface and ground water filter drainage pipe and bedding combinations shall be a product of a perforated pipe type selected from Table 3.3.2.1 and a Bedding Class S (for rigid pipe materials) or S1 (for semi-rigid and flexible pipe materials) in accordance with BS EN 1295-1 Tables NA.7 & NA.8 respectively *and* the installation dimensions shown on the Type S detail on standard detail drawing SHW HCD F1. The granular material shall consist of natural and/or recycled coarse aggregate or recycled concrete aggregate complying with BS EN 13242. Where recycled coarse aggregate or recycled concrete aggregate is used in this Clause, it shall have been tested in accordance with SHW Clause 710 and shall not contain more than 1% other materials (Class X). Pipe bedding, haunching and surround material shall be in accordance with the following:

a) For pipes on Classes S and S1 beds in accordance with BS EN 1295-1 Tables NA.7 & NA.8 respectively, the aggregate shall have:
   i. geometrical requirements in accordance with Table 3.3.4.1;
   ii. a resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, Clause 5.2 and Table 9;
   iii. a water-soluble sulphate content of less than 0.38% of sulphate (as SO_3) when tested in accordance with BS EN 1744-1, Clause 10;
   iv. all other requirements in Category $_{NR}$.

b) Unless otherwise described in Appendix D1 the material used for the bedding, haunching and surrounding of filter drains shall comply with the appropriate bedding, haunching and surrounding materials specified in this Clause and with the requirements for backfilling specified in sub-Clause 3.3.6.4.

BS EN 13242, Coarse aggregate (Clause 4.3.2)		
Category for general grading requirements	G_C80-20	
Category for tolerances at mid-size sieves	GT_{NR} (no requirements)	
Category for maximum values of fines content	Gravel – $f_{1.5}$ Crushed rock, recycled aggregate – f_4	
Nominal pipe diameter, mm	Aggregate size, mm	
	Graded	Single-sized
Exceeding 140 but not exceeding 215	No option	10/20 or 14/20
Exceeding 215	No option	10/20, 14/20 or 20/40

Table 3.3.4.1 – BS EN 13242, Coarse Aggregate for Pipe Bedding, Haunching and Surrounding Material to Track and Off-track Surface and Ground Water Filter Drainage

3.3.4.4 Track and Off-track surface and ground water carrier drainage pipe and bedding combinations shall be a product of an unperforated pipe type selected from Table 3.3.2.1 and a Bedding Class S, S2 or A (or Type Z if required). Bedding Classes S and A (which are for rigid pipe materials) shall be in accordance with BS EN 1295-1 Table NA.7; bedding class S2 (which is for semi-rigid and flexible pipe materials) shall be in accordance with BS EN 1295-1 Table NA.8. The installation dimensions for Bedding Classes S and S2 shall both be in accordance with the Type S detail shown on standard detail drawing SHW HCD F1. The installation dimensions for Bedding Class A shall be in accordance with the Type A detail shown on standard detail drawing SHW HCD F1. Bedding Type Z for rigid (or in special cases semi-rigid and flexible) pipe materials shall be in accordance with the installation dimensions for Bedding Type Z detail shown on standard detail drawing SHW HCD F1 and the requirements of this sub-Clause. Granular material shall consist of natural and/or recycled coarse aggregate or recycled concrete aggregate complying with BS EN 13242. Where recycled coarse aggregate or recycled concrete aggregate is used in this Clause, it shall have been tested in accordance with SHW Clause 710 and shall not contain more than 1% other materials (Class X). Pipe bedding, haunching and surround material shall be in accordance with the following:

a) For pipes on Bedding Classes S or S2 in accordance with BS EN 1295-1 Tables NA.7 & NA.8 respectively, the aggregate shall have:
   i. geometrical requirements in accordance with Table 3.3.4.2 or Table 3.3.4.3, note that for Track Drainage single-sized aggregate options from Table 3.3.4.2 may only be used where explicitly required in Appendix D1 as Bedding Class S1 in accordance with BS EN 1295-1 Table NA.7, otherwise all bedding aggregates in this sub-Clause used for Track Drainage shall be graded, fine or all-in aggregates;
   ii. a resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, Clause 5.2 and Table 9;

iii. a water-soluble sulphate content of less than 0.38% of sulphate (as SO_3) when tested in accordance with BS EN 1744-1, Clause 10;

iv. all other requirements in Category $_{NR}$.

b) For pipes on Types A and Z beds as shown on standard detail drawing SHW HCD F1, the concrete shall be standardised prescribed concrete mixes ST4 and ST2 respectively, complying with BS EN 206-1 and BS 8500 and in compliance with i. to iii. below. Backfilling shall not be carried out until after the concrete has cured.

i. Cement type CEM 1 (Portland Cement) to Table 1 of BS 8500-2, or where required in Appendix D1, SRPC (Sulphate Resisting Portland Cement).

ii. Aggregates shall comply with BS EN 12620 and have a minimum aggregate size of 20mm unless described otherwise in the Contract. The total acid-soluble sulphate content of the concrete mix, as SO_4, shall not exceed 5% of the mass of cement in the mix. The acid-soluble sulphate (AS) shall be determined in accordance with Test No. 2 in TRL Report 447.

iii. The consistence of the concrete shall be defined by its consistence class (slump) and be within either consistence class S2 or S3 of BS EN 206-1 and BS 8500 as appropriate for the purpose.

c) Except for filter drains, a further surround above the bed, haunch and surround (except Type Z beds) described above shall be provided to a height of 300mm above the top of the pipe consisting of Class 8 lower trench fill material as described in SHW Table 6/1 and in compliance with SHW Series 600 generally.

BS EN 13242, Coarse aggregate (Clause 4.3.2)		
Category for general grading requirements	G_C80-20	
Category for tolerances at mid-size sieves	GT_{NR} (no requirements)	
Category for maximum values of fines content	Gravel – $f_{1.5}$ Crushed rock, recycled aggregate – f_4	
Nominal pipe diameter, mm	Aggregate size, mm	
	Graded	Single-sized
Exceeding 140 but not exceeding 215	2/14 or 4/20	4/10 or 6/10 or 10/20
Exceeding 215	2/14 or 4/20 or 4/40	4/10 or 6/14 or 10/20 or 14/20 or 20/40

Table 3.3.4.2 – BS EN 13242, Coarse Aggregate for Pipe Bedding, Haunching and Surrounding Material to Track and Off-track Surface and Ground Water Carrier Drainage

BS EN 13242, Fine and all-in aggregate (Clause 4.3.3)		
	Fine	All-in
Category for general grading requirements	G_C80	G_A80
Category for tolerances on manufacturer's declared typical grading	GT_FNR (no requirement)	GT_ANR (no requirement)
Category for maximum values of fines content	Gravel – f_3 Crushed rock, recycled aggregate – f_{11}	
Nominal pipe diameter, mm	Aggregate size, mm	
	Fine	All-in
Exceeding 140 but not exceeding 215	0/1 or 0/2 or 0/4 or 0/6	0/10 or 0/20
Exceeding 215		0/10 or 0/20 or 0/40

Table 3.3.4.3 – BS EN 13242, Fine and All-in Aggregate for Pipe Bedding, Haunching and Surrounding Material to Track and Off-track Surface and Ground Water Carrier Drainage

3.3.4.5 Material for bedding, haunching and surrounding pipes shall not be deposited within 500mm of concrete, cement bound materials or other cementitious materials forming part of the permanent works.

3.3.4.6 Except where the pipeline is to be tested in compliance with Clause 3.3.10 before backfilling, the completion of the bedding, haunching and surrounding of the pipes is to be carried out immediately after jointing. The bed, haunch and surround shall be brought up equally on both sides of the pipe ensuring that it is in contact with the underside of the pipe barrel and be carefully compacted in layers not exceeding 150mm thickness ensuring full compaction next to the trench walls. Pipes shall be maintained to line and level during the bedding, haunching and surrounding operations. Where pipelines are to be tested before being covered, the bedding, haunching and surrounding material shall only be brought up sufficiently to support the pipeline and the joints shall be left exposed until the test is completed satisfactorily.

3.3.4.7 Geotextile Lining

3.3.4.7.1 The trench excavations for Track and Off-track surface and ground water filter drainage shall be constructed in accordance with the geometry indicated on LU standard detail drawing ST 71670 (refer to LU Manual of Good Practice G-052), and lined with geotextile in accordance with the same detail (but using a geotextile fabric compliant with sub-Clause 3.3.4.7.4 or 3.3.4.7.5). The detail ST 71670 shows the geotextile is not to be closed and lapped at the top of the trench; this is to permit the products of ballast attrition to enter the drainage system, whilst simultaneously preventing the migration of fines from the subgrade. Pipe bed, haunch, surround and trench backfill material shall be in accordance with the provisions of this Clause and not those shown on the detail ST 71670.

3.3.4.7.2 Closing and lapping the geotextile at the tops of Track and Off-track surface and ground water filter drainage trenches is only required when described in Appendix D1.

3.3.4.7.3 Where geotextile laps occur longitudinally within a filter drainage trench, the geotextile lap length shall be a minimum 300mm and the upstream sheet shall be lapped under the downstream sheet to minimise the migration of subgrade fines.

3.3.4.7.4 Geotextile used for the purposes defined in this sub-Clause shall meet the following requirements:

a) either thermally bonded non-woven or needle-punched non-woven;

b) mean apparent opening size (AOS O_{90}) (in accordance with EN ISO 12956) of 100µm;

c) minimum permeability (H_{50})(in accordance with EN ISO 11058) of 90 litres/m²/sec;

d) minimum tensile strength (sometimes known as *breaking load*) (in accordance with EN ISO 10319) of 8kN/m;

e) minimum CBR puncture resistance (in accordance with EN ISO 12236) - mean peak strength of 1500N.

3.3.4.7.5 Where tree root penetration is considered to be a potential problem then geotextile used for the purposes defined in this sub-Clause shall meet the following requirements:

a) thermally bonded non-woven;

b) mean apparent opening size (AOS O_{90}) (in accordance with EN ISO 12956) of 100µm;

c) minimum permeability (H_{50}) (in accordance with EN ISO 11058) of 50 litres/m²/sec;

d) minimum tensile strength (breaking load) (in accordance with EN ISO 10319) of 18kN/m;

e) minimum CBR puncture resistance (in accordance with EN ISO 12236) - mean peak strength of 3250N

NOTE: The basis for the above specification (sub-Clause 3.3.4.7.5) is the proprietary product *Terram Root Guard,* which is Terram's thermally bonded non-woven fabric '*Terram 3000*' but with enhanced UV protection and pigment added. For use as a filter drain trench liner in the LU environment, the geotextile does not require UV protection or pigmentation, thus the above physical properties reflect those of *Terram 3000*. Terram Ltd have undertaken controlled testing to support their declared use of *Terram Root Guard* as suitable for preventing tree root penetration. Hence it provides the best available basis for the LU specification.

3.3.4.7.6 Locations where geotextile compliant with sub-Clause 3.3.4.7.5 is to be used shall be scheduled in Appendix D1. Should the Contractor identify additional locations where tree root penetration is considered to be a problem, he shall notify the Engineer immediately so that a change to the specified geotextile at those locations can be made.

3.3.4.7.7 In all cases, the required design life for geotextile and the above physical characteristics shall be confirmed by Agrément Certificates or other verified testing and copies of such certificates and test data shall be supplied to the Engineer.

3.3.4.8 Fire barrier socks shall meet the following requirements:

a) fabricated from suitable woven glass fibre fabric;

b) having a minimum '*weight*' of 400g/m²;

c) having a minimum permeability (H_{50}) (in accordance with EN ISO 11058) of 5 litres/m²/sec;

d) having external seams to facilitate sleeving over pipes;

e) having double stitched seams for durability;

f) utilising stainless steel thread;

g) all edges adequately hemmed to prevent fraying;

h) fabricated with a split seam at one end having a minimum length of 100mm to permit lapping over adjacent sleeves;

i) fabricated with an internal diameter 10mm to 20mm larger than the external diameter of the pipe to be sleeved.

3.3.5 Jointing of Pipes

3.3.5.1 Rigid joints shall mean joints made solid by caulking the sockets, bolting together flanges integral with the pipes, screwing together of threaded pipes, or fusion (or solvent) welding of flexible pipe materials. Flexible joints shall mean joints made with deformable rings or gaskets held between pipe spigots and sockets, sleeves or collars.

3.3.5.2 Threaded joints are permitted for use where pipelines may be subject to high tensile forces; for example, during vertical installation as deep bored soakaways or when being winched through a host pipeline subject to pipe-bursting techniques. They may be employed with or without a deformable ring (according to the particular circumstances of use). In such cases, the joint shall offer a minimum tensile strength that is at least twice the maximum tensile stress that the joint will be subjected to during installation and in normal operation.

3.3.5.3 Manufacturers test data shall be provided to the Engineer to prove the tensile strength of the selected threaded joint. Threaded joints may permit a small amount of angular

rotation but are typically not classified as flexible joints; for the purposes of this specification they shall be regarded as rigid joints.

3.3.5.4 Watertight joints shall comply with the appropriate British or European Standards, the manufacturer's instructions and the following:

a) Joints in PVC-U pipes shall not be made with plastic solvent.
b) Flexible mechanical joints may be used with surface water pipes complying with BS 65.

3.3.5.5 Where a concrete bed, cradle or surround is used with rigid (or in special cases semi-rigid or flexible) pipes having flexible joints, joint filler board complying with SHW Clause 1015 shall be placed in contact with the end of the socket at the pipe joint and shall extend through the full thickness of the concrete in contact with the pipe. Such joints in the concrete bed, cradle or surround shall be at intervals not exceeding 5 metres except where the spacing of the joints in the pipe exceeds 5 metres when they shall be at each pipe joint.

3.3.5.6 Joints in pipes for filter drains shall comply with an applicable British or European Standard and with the following:

a) The ends of perforated concrete pipes with rebated joints and perforated clayware pipes with rebated or sleeve joints shall be pushed tightly together.
b) Perforated or slotted thermoplastic pipes with spigots and sockets or sleeves may be dry-jointed or jointed as unperforated pipes of the same material.

3.3.5.7 If an applicable British or European Standard does not exist, then the joint type shall only be used if it appears on the LU Products Register.

3.3.5.8 Pipe joints should be the proprietary type for the particular pipe used.

3.3.6 Backfilling of Trenches and Filter Drains

3.3.6.1 Backfilling shall be undertaken immediately after the required operations preceding it have been completed.

3.3.6.2 For the purposes of backfilling of track drainage , the top of the trench or filter drain shall be deemed to be track formation level, i.e. the level of the underside of the track support ballast.

3.3.6.3 Except where otherwise described in Appendix D1, trenches other than filter drain trenches shall be backfilled above the pipe surround material described in Clause 3.3.4, with a Class 1, 2 or 3 general fill material complying with SHW Series 600.

3.3.6.4 Backfilling of filter drains

3.3.6.4.1 Filter drains shall be backfilled as described in Appendix D1 with Type A, Type B, Type C or Type D filter material which shall consist of natural or recycled coarse aggregate or recycled concrete aggregate complying with BS EN 13242 and the following:

a) for Types A and C, grading requirements for unbound mixtures in accordance with Table 3.3.6.1 and BS EN 13285;
b) for Types B and D, geometrical requirements in accordance with Table 3.3.6.1 and BS EN 13242;
c) a resistance to fragmentation in Category LA_{50} in accordance with BS EN 13242, Clause 5.2 and Table 9;
d) a water-soluble sulphate content of less than 0.38% of sulphate (as SO_3) when tested in accordance with BS EN 1744-1, Clause 10;
e) all other requirements in Category $_{NR}$;
f) be non-plastic when tested in accordance with BS 1377:Part 2.

3.3.6.4.2 If no requirement for a specific filter material has been identified in Appendix D1 then it shall be assumed that the requirement is for either Type B of Type D filter material, with the choice being made by the contractor on the basis of lowest cost.

3.3.6.4.3 Where recycled coarse aggregate or recycled concrete aggregate is used in accordance with this Clause, it shall have been tested in accordance with Clause 710 and shall not contain more than 1% other materials (Class X).

3.3.6.4.4 When Type A material is used to bed, haunch, surround or backfill filter drains, pipework must either be porous or geotextile wrapped perforated. If geotextile wrapped perforated pipe is used, the geotextile fabric shall comply with Clause 3.3.4.7.

	Type A	**Type B**	**Type C**	**Type D**
Standard	BS EN 13285	BS EN 13242	BS EN 13285	BS EN 13242
Size, mm	0/20	20/40	As described in Appendix D1	10/20
Grading and oversize categories	G_F (with an additional sieve)	G_C80-20		G_C80-20
Oversize category	OC_{80}	-		-
Category for tolerances at mid-size sieves	-	GT_{NR} (no requirement)		GT_{NR} (no requirement)
Category for maximum fines	UF_3	f_{NR} (no requirement)		f_{NR} (no requirement)
Summary grading requirements				
Sieve size, mm	Percentage by mass passing			
80	-	100	As described in Appendix D1	-
63	-	98 – 100		-
40	100	80 – 99		100
32	-	-		98 – 100
20	80 – 99	0 – 20		80 – 99
10	50 – 90	0 – 5		0 – 20
4	30 – 75	-		0 – 5
2	15 – 60	-		-
0.500	0 – 35	-		-
0.125	0 – 4	-		-
0.063	0 – 3	-		-
% in size fraction				
4/10	5 – 35	-		-
2/4	5 – 35	-		-

Table 3.3.6.1 – Grading and Geometrical Requirements for Filter Drain Material

3.3.6.5 Material for backfilling trenches and filter drains shall not be deposited within 500mm of concrete, bound materials or other cementitious materials forming part of the Permanent Works.

3.3.6.6 Carrier drain backfill and filter drain backfill Types A and C shall be deposited and compacted in compliance with SHW Clause 612.

3.3.6.7 Filter drain backfill Types B and D shall be deposited in layers not exceeding 225mm loose depth, but is not required to be subject to mechanical compaction.

3.3.6.8 Material shall be deposited in even layers and shall not be heaped in the trench before being spread. Spreading and compaction shall be carried out evenly without dislodging, distorting or damaging the pipe. Power rammers (or other mechanical compaction plant) shall not be used within 300 mm of any part of the pipe or joint.

3.3.6.9 Except in carriageways, other paved areas and locations described in Appendix D1, backfill of Off-track drainage trenches shall be brought up to ground level. Unless expressly required otherwise within Appendix D1, where topsoil is at the surface on the line of the trench, the upper section of the backfill shall be topsoil of the same thickness and quality as the surrounding ground. For trenches in carriageways or other paved areas the backfill shall be brought up to highway formation level, or highway sub-formation level where capping is required, unless a lower level is described in Appendix D1. Sheeting and other excavation supports shall be removed as the filling proceeds unless described otherwise in the Appendix D1.

3.3.6.10 The position of service ducts and cables crossing trenches shall be permanently marked at surface level as described in Appendix D1.

3.3.6.11 If trench or filter drain excavation takes place within the ballasted zone of the permanent way, new or clean recycled ballast shall be placed on top of the drainage trench after backfilling to match the existing ballast profile, and shall be compacted in accordance with the instructions of the LU Technical Officer on site.

3.3.7 Connecting to Existing Drains, Chambers and Channels

3.3.7.1 Where described in Appendix D1, existing drains shall be extended, connected and jointed to new drains, chambers or channels. Unless described otherwise in Appendix D1, all such connections shall be made during the construction of the new drain or other work and their positions recorded by the Contractor who shall hand to the Engineer a copy of the record of connections made the previous day. Where pipe connections are made to existing brick concrete or stone drains, chambers or channels, the pipes shall be well and tightly built into the concrete, brick or masonry work and be so placed as to discharge at an angle not greater than 60° to the direction of flow of the drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe drains, special connecting pipes shall be laid and jointed as described in Appendix D1. Where site conditions preclude the possibility of executing the work in accordance with this Clause or any particular requirements identified in Appendix D1, the Contractor shall immediately bring it to the attention of the Engineer and await further instruction.

3.3.7.2 Before entering or breaking into an existing sewer or drain, the Contractor shall give appropriate notice of his intention to do so to the authority responsible for the pipeline to which the connection is to be made.

3.3.7.3 Existing drains no longer required shall, as described in Appendix D1, be subject to one of the following:

a) Sealed with standardised prescribed concrete mix ST2 complying with BS EN 206-1 and BS 8500 and in compliance with i. to iii. below.

i. Cement type CEM 1 (Portland Cement) to Table 1 of BS 8500-2, or where required by the Contract SRPC (Sulphate Resisting Portland Cement).

ii. Aggregates shall comply with BS EN 12620 and have a minimum aggregate size of 20mm unless described otherwise in the Contract. The total acid-soluble sulphate content of the concrete mix, as SO_4, shall not exceed 5% of the mass of cement in the mix. The acid-soluble sulphate

(AS) shall be determined in accordance with Test No. 2 in TRL Report 447.

iii. The consistence of the concrete shall be selected by the Contractor and be suitable for the stated purpose.

b) Removed and replaced with general fill material complying with SHW Clause 601 and Table 6/1 and compacted in compliance with SHW Clause 612.

c) Grouted with a 1:10, cement: pfa mix. The grout shall use the minimum quantity of water to ensure the fluidity necessary to render it capable of being pumped to the ends of the pipe. It shall be used within one hour of mixing but when the mix contains a retarding admixture this time may be extended in accordance with the manufacturer's instructions. The cement shall comply with BS 197-1 and the pulverised-fuel ash (pfa) with BS 3892: Part 2, fineness to Zone B and sulphate content not exceeding 1.5%.

3.3.8 Chambers

3.3.8.1 Chambers shall include manholes, catchpits, inspection chambers, draw pits and walled soakaways. Chambers shall be the types specified in Appendix D1, constructed in accordance with applicable London Underground standard details, WRc Sewers for Adoption standard details or the Highway Construction Details F series, as appropriate to that type. All ST concrete mixes (standardised prescribed mixes) referred to in this Clause shall comply with BS EN 206-1 and BS 8500 and be in compliance with the following:

a) Cement type CEM 1 (Portland Cement) to Table 1 of BS 8500-2, or where required by the Contract SRPC (Sulphate Resisting Portland Cement).

b) Aggregates shall comply with BS EN 12620 and have a minimum aggregate size of 20mm unless described otherwise in the Contract. The total acid-soluble sulphate content of the concrete mix, as SO_4, shall not exceed 5% of the mass of cement in the mix. The acid-soluble sulphate (AS) shall be determined in accordance with Test No. 2 in TRL Report 447.

c) The consistence of the concrete shall be defined by its consistence class (slump) and be within either consistence class S2 or S3 of BS EN 206-1 and BS 8500 as appropriate for the purpose.

3.3.8.2 Foundations to precast concrete and brick chambers shall be of ST4 concrete. Foundations to other chambers shall be as specified in Appendix D1. Channels for chambers shall be formed and finished smooth in the foundation concrete or constructed of preformed half circle channels, with sides benched in ST4 concrete, or mortar designation (i) complying with SHW Clause 2404 excluding lime.

3.3.8.3 Brickwork shall comply with SHW Series 2400 and be built with mortar designation (i) in English bond. The joints of brickwork, where exposed, shall be finished as specified for unpointed joints in SHW Clause 2412. The ends of all pipes shall be neatly built into the brickwork and finished flush with mortar designation (i) (complying with SHW Clause 2404 excluding lime) unless specified otherwise in Appendix D1.

3.3.8.4 Precast concrete chambers for use in locations subject to highway loading shall comply with BS 5911-3 and BS EN 1917 and the particular requirements described in Appendix D1.

3.3.8.5 Cast in-situ concrete chambers for use in locations subject to highway loading shall be constructed in accordance with the approved scheme drawings and the particular requirements described in Appendix D1.

3.3.8.6 Precast concrete chambers for use in locations subject to railway loading shall be selected from the LU Approved Product Register; which means that the product has been shown to be structurally adequate and to meet all other relevant LU design criteria.

3.3.8.7 Cast in-situ concrete chambers for use in locations subject to railway loading shall be constructed in accordance with the approved scheme drawings and the particular requirements described in Appendix D1.

3.3.8.8 Chambers shall not be fitted with step irons or ladders unless specified otherwise in Appendix D1. Where chamber access steps irons *are* explicitly required within the contract they shall comply with BS EN 13101 and shall be built in accordance with the relevant chamber drawing. Where chamber access ladders are explicitly required within the contract, the steelwork used for ladders, handholds and other fittings shall comply with BS 970: Part 1 and be galvanized in compliance with SHW Clause 1909 after fabrication. Threaded components shall be galvanized in compliance with SHW Clause 1909.

3.3.8.9 Excavation around chambers shall be backfilled with general fill material as described in SHW Table 6/1 and compacted in compliance with SHW Clause 612. Where mechanical compaction is impracticable, the excavation shall be backfilled with ST2 concrete. Where there are precast concrete access shafts to precast concrete chambers, the shafts shall be surrounded by a minimum thickness of 150mm of ST4 concrete, and the remaining excavation backfilled with general fill material as described in SHW Table 6/1 compacted in compliance with SHW Clause 612.

3.3.8.10 Chamber covers (including cover planks), gratings and frames shall be as described in Appendix D1 and shall comply with the following:

a) Sub-surface Railway inspection chamber covers (including cover planks), gratings and frames shall be produced from materials complying with the current version of London Underground Category 1 Standard: 1-085 Fire Safety Performance of Materials unless a valid fire waiver/concession has been obtained.

b) Covers and gratings in pedestrian and vehicular traffic areas shall comply with BS EN 124 and sub-Clauses 3.3.8.11 to 3.3.8.16 of this Clause.

c) Covers (including cover planks) and gratings shall be of suitable material, design and construction to achieve an in-service skid/slip resistance potential suitable for the conditions of use. This shall be determined by the accelerated polish test method described in BS 9124. The Polished slip resistance value (PSRV) shall be as stated in Appendix D1.

d) Where not covered by a current British and European Standard, covers (including cover planks), gratings and frames shall be selected from the LU Products Register.

NOTE: 1) For track drainage catchpits, the preferred gratings for open areas (i.e. not Sub-surface Railway, shafts and tunnels (*both bored tunnel and cut & cover tunnel forms*)) is 'Multi-Grate' GRP grating 'PE' grade manufactured by Redman Fisher and listed in the LU Products Register.

This grating does not meet the LU Cat 1 Standard 1-052 A3 Clause 3.1.2.7.5. d) & e) (requirements for loading and deflection). This non-conformance does not require a concession in certain conditions which have been defined by the Principle Engineer – Pumps and Drainage.

Locations where the LU Plant Loading criteria are required to be met should not employ these gratings.

2) For track drainage catchpits, the preferred gratings for Sub-surface Railway, shafts and tunnels (*both bored tunnel and cut & cover tunnel forms*) is 'Multi-Grate' GRP grating 'PH' grade manufactured by Redman Fisher and listed in the LU Products Register.

This grating does not meet the LU Cat 1 Standard 1-052 A3 Clause 3.1.2.7.5. d) & e). This non-conformance does not require a concession in certain conditions which have been defined by the Principle Engineer – Pumps and Drainage

Locations where the LU Plant Loading criteria are required to be met should not employ these gratings.

3.3.8.11 Units compliant with BS EN 124, Class D400 (and above) shall incorporate a permanent non-rock feature, either triangular point suspension, or machined faces.

3.3.8.12 Bolts supplied for loosely coupling separate sections of covers and gratings shall be steel hexagon headed, complying with the requirements of BS EN ISO 4016, BS EN ISO 4018 and BS EN ISO 4034 and be galvanized in compliance with SHW Clause 1909. They shall not be less than size M16 complete with hexagon nut and shall be provided with means to prevent undue tightening of unit sections.

3.3.8.13 Unless otherwise specified in Appendix D1, all cast metallic covers, gratings and frames shall be supplied in a fine cast (uncoated) condition. Where a coating is specified in Appendix D1, the coating shall only be applied when the surfaces of the casting are clean, free from rust and dry.

3.3.8.14 Requirements for special duty covers for use in carriageways shall be as described in Appendix D1.

3.3.8.15 Two sets of lifting keys shall be delivered to the Engineer for each type of cover supplied. At least two keyways shall be provided in each complete cover, one in each segment for segmental covers. A recess for a prising bar shall be incorporated in covers unless other means of loosening the cover from the frame are provided.

3.3.8.16 Where covers and gratings require frames, they shall be set in cement mortar designation (i) complying with SHW Clause 2404 or a proprietary quick setting mortar of equivalent strength.

3.3.8.17 For all pipelines constructed using rigid and semi-rigid pipe materials, the nearest joint to any chamber shall be not more than 500 mm from the inner face of the wall and shall not be restricted by any concrete. Between this and the next joint, the length of the articulated pipe shall be in accordance with Table 3.3.8.1.

Nominal pipe diameter (mm)	Length of pipe (mm)
450 and less	500 to 750
Greater than 450	750 to 1000

Table 3.3.8.1 – Length of Articulated Pipe

3.3.8.18 For all pipelines constructed using flexible pipe materials, the nearest joint to any chamber shall be not more than 1000 mm from the inner face of the wall and shall not be restricted by any concrete. Between this and the next joint, the length of the articulated pipe shall be not more than 1000mm.

3.3.8.19 Where the adjustment or replacement of existing frames and covers or gratings is required, the units shall be taken up and re-fixed or removed and replaced with new units complying with sub-Clauses 3.3.8.10 to 3.3.8.16 of this specification, or as described in Appendix D1. On taking up or removal of the unit, any concrete or mortar bedding shall be broken out and the surface prepared. Where existing frames and covers or gratings are to be adjusted, the Contractor shall take up the unit and clean it for re-use. If a frame is present, the adjusted or replaced units shall be laid on a mortar bed complying with sub-Clause 3.3.8.16 of this Clause. The finished thickness of the mortar bed shall be between 10 mm and 25 mm. Where required in Appendix D1, covers and gratings shall be bedded using a proprietary quick setting high strength mortar. Details of such mortar shall be to the approval of the Engineer. Unless otherwise described in Appendix D1, adjusted or replaced frames and covers or

gratings shall be set flush with the new surface. Any additional adjustments shall be by modifying the brickwork in compliance with sub-Clause 3.3.8.3 or by using a frame of a suitable depth or by adding precast concrete chamber sections (as appropriate for each case). On completion of the works, each cover shall be lifted and the frame and seating cleaned.

3.3.9 Gullies and Pipe Junctions

3.3.9.1 Gullies shall be trapped, untrapped or sumpless as described in Appendix D1 and be in accordance with HCD Drawing Numbers F13 and F14. All ST concrete (standardised prescribed mixes) mixes referred to in this Clause shall comply with BS EN 206-1 and BS 8500 and be in compliance with the following:

a) Cement type CEM 1 (Portland Cement) to Table 1 of BS 8500-2, or where required by the Contract SRPC (Sulphate Resisting Portland Cement).

b) Aggregates shall comply with BS EN 12620 and have a minimum aggregate size of 20mm unless described otherwise in the Contract. The total acid-soluble sulphate content of the concrete mix, as SO_4, shall not exceed 5% of the mass of cement in the mix. The acid-soluble sulphate (AS) shall be determined in accordance with Test No. 2 in TRL Report 447.

c) The consistence of the concrete shall be defined by its consistence class (slump) and be within either consistence class S2 or S3 of BS EN 206-1 and BS 8500 as appropriate for the purpose.

3.3.9.2 Gullies shall be constructed so that no part of the spout or trap has a cross-sectional area less than 2/3rd that of the outlet. The depth of water seal in trapped gullies shall be not less than 50 mm.

3.3.9.3 Precast concrete gullies shall comply with BS 5911-6 and clay gullies with BS EN 295. In situ concrete gullies shall be as described in Appendix D1 and constructed of ST4 concrete of 150 mm minimum thickness, using permanent or removable shuttering.

3.3.9.4 Gully gratings, kerb type gully covers and frames shall comply with BS EN 124 and the following and shall be of the classes and sizes described in Appendix D1.

3.3.9.5 The upper surface of gully gratings shall be flat except where otherwise described in Appendix D1. Slots in gratings or between gratings and frames shall not be orientated parallel to the direction of traffic except where the slots are less than 150 mm long or less than 20 mm wide. Minimum waterway areas shall be as specified in Appendix D1. Unless otherwise specified in Appendix D1, all gratings and frames shall be supplied in a fine cast (uncoated) condition. Where a coating is specified in Appendix D1, the coating shall only be applied when the surfaces of the casting are clean, free from rust and dry. Frames shall be bedded on mortar complying with sub-Clause 3.3.8.16. Brickwork shall comply with sub-Clause 3.3.8.3.

3.3.9.6 Backfilling to precast gullies shall be carried out up to sub-formation level with general fill material Class 1, as described in SHW Table 6/1 compacted in compliance with SHW Clause 612. Where mechanical compaction is impracticable, the backfilling shall be in ST2 concrete. The remainder of the backfilling shall be in appropriate capping and road pavement materials except that where mechanical compaction of capping or unbound mixture for sub-base is impracticable ST2 concrete shall be used.

3.3.9.7 Gully connection pipes shall be either flexible or rigid not exceeding 0.7m in length with flexible joints for a distance of 2m from the gully and shall be in accordance with sub-Clause 3.3.8.17 or 3.3.8.18 when entering chambers. Junction pipes shall be manufactured of the same type and class of material as the remainder of the pipes in the run. Junction pipes which are laid but not immediately connected, shall be fitted with temporary stoppers or seals and the position of all such junctions shall be clearly defined by means of stakes or tracing wires properly marked or labelled. Saddles may be used to form junctions only where permitted in Appendix D1. No internal projections

greater than 5 mm will be permitted. Saddles for plastics pipes shall be installed in accordance with the manufacturer's recommendations. Saddles with clay pipes shall be jointed with mortar designation (i) complying with SHW Clause 2404, excluding lime. Saddles and pipes shall be surrounded with ST2 concrete, minimum 150mm thick.

3.3.9.8 Where the adjustment or replacement of existing frames and gratings is required, the units shall be taken up and re-fixed, or removed and replaced with new units complying with sub-Clauses 3.3.9.4 and 3.3.9.5 of this Clause, or as described in Appendix D1. On taking up or removal of the unit, any concrete or mortar bedding shall be broken out and the surface prepared. Where existing frames and covers or gratings are to be adjusted, the Contractor shall take up the unit and clean it for re-use. The adjusted or replaced units shall be laid at a level, unless otherwise described in Appendix D1, 6 mm below the adjoining road surface on a mortar bed complying with sub-Clause 3.3.8.16. The finished thickness of the mortar bed shall be between 10 mm and 25 mm. Where required in Appendix D1, covers and gratings shall be bedded using a proprietary quick setting high strength mortar. Details of such mortar shall be to the approval of the Engineer. Any additional adjustment shall be made by modifying the brickwork in compliance with sub-Clause 3.3.8.3 or by using a frame of suitable depth. On completion of the works, each grating shall be lifted and the frame and seating cleaned.

3.3.10 Testing and Cleaning of New Drainage Systems

3.3.10.1 During the progress of the Works, all existing chambers, gullies and rodding eyes shall be kept clean and free from obstruction. On completion of the whole of the Works, all chambers, gullies and drains including verge/surface water drains and filter drains but excluding all fin and narrow filter drains (*these are drains commonly employed in highway engineering but less so in railway engineering*) shall be left free from obstructions and loose material. Catchpit chambers shall be left clean and free from silt.

3.3.10.2 Unless otherwise required in Appendix D1 all carrier (surface and foul) and filter drains but excluding all fin and narrow filter drains shall be surveyed by Closed Circuit Television (CCTV) in accordance with the relevant requirements of the current edition of the WRc Model Contract Document for Sewer Condition Inspection.

3.3.10.3 The pipes and filter material of filter drains shall at all times be left clean and free from silt and obstruction.

3.3.10.4 Permeability tests shall be as described in Appendix D1.

3.3.10.5 Drainage works shall be inspected and tested as the work proceeds and immediately before the works, plant and systems are commissioned.

3.3.10.6 Testing of drains and sewers shall be carried out in accordance with BS EN 1610 Construction and Testing of Drains and Sewers and BS EN 12889 Trenchless Construction and Testing of Drains and Sewers, as applicable. Where any requirement of these European Standards conflicts with a requirement of this Specification, the European Standard shall take precedence.

3.3.10.7 Air testing and/or water testing of unperforated pipelines with watertight joints (excluding chambers) where required shall be specified in Appendix D1, together with the appropriate BS EN test method.

3.3.10.8 New, upgraded, or renewed pipework assets shall meet the WRc Structural and Serviceability Grade 1 criteria prior to bringing into use. This shall be determined via CCTV survey in accordance with Clause 3.3.10.2, analysed in accordance with the current edition of the WRc Manual of Sewer Condition Classification.

3.3.11 Land Drains

3.3.11.1 Existing land drains which are permanently severed by the Works shall be located and connected into a new drain, pipe or ditch all as described in Appendix D1. The lengths remaining within the Works shall be cleaned out from the new drain trench face as necessary. Any pipe disturbed by the Works shall be re-laid to ensure a free discharge into the new drain. Disused ends of intercepted land drains shall be adequately sealed with ST2 concrete in compliance with BS EN 206-1 and BS 8500 and be in compliance with the following:

a) Cement type CEM 1 (Portland Cement) to Table 1 of BS 8500-2, or where required by the Contract SRPC (Sulphate Resisting Portland Cement).

b) Aggregates shall comply with BS EN 12620 and have a minimum aggregate size of 20mm unless described otherwise in the Contract. The total acid-soluble sulphate content of the concrete mix, as SO_4, shall not exceed 5% of the mass of cement in the mix. The acid-soluble sulphate (AS) shall be determined in accordance with Test No. 2 in TRL Report 447.

c) The consistence of the concrete shall be defined by its consistence class (slump) and be within either consistence class S2 or S3 of BS EN 206-1 and BS 8500 as appropriate for the purpose.

3.3.11.2 Where an existing land drain is exposed and severed by temporary trench excavation, the Contractor shall mark the position of the drain and record it. The drain shall be diverted into an existing drain or watercourse as directed by the Engineer. Alternatively, the normal functioning of the drain shall be continued by the construction of a pipeline or channel adequately supported across the excavation, until permanent restoration is made on the original line.

3.3.11.3 The Contractor shall notify the Engineer of any land drain which is blocked or is otherwise defective when the drain is first exposed.

3.3.12 Linear Drainage Channel Systems

3.3.12.1 Required linear drainage channel systems shall be listed in Appendix D1. Prefabricated linear drainage channel systems, where applicable, shall conform to BS EN 1433 or BS EN 1340 and with the other requirements in Appendix D1.

3.3.12.2 Linear drainage channel systems shall be suitable for their intended use and place of installation in the Works. The Contractor shall provide evidence of such suitability for the purpose to the Engineer in accordance with Appendix D1.

3.3.12.3 Dimensions of inlet slots for prefabricated linear drainage channel systems shall conform to the requirements of BS EN 1433.

3.3.12.4 Water tightness of joints between units comprising the system and between adjacent construction and the system shall be designed to avoid leakage of surface water.

3.3.12.5 Water tightness of junctions, connecting pipes and other fittings comprising the linear drainage channel system shall comply with sub-Clause 3.3.5.4 and shall be as described in Appendix D1. The linear drainage channel system shall incorporate measures to enable rodding of the outfall pipework and adequate access for jetting by water jetting equipment into the system.

3.3.12.6 The linear drainage channel systems shall be cleaned out by appropriate means and shall be left clean and free from all obstruction on completion of the Works. The completed linear drainage channel systems shall be surveyed by Closed Circuit Television (CCTV) in accordance with Clause 3.3.10.2.

3.3.13 The Cleaning of Existing Drainage Systems

3.3.13.1 Where stated in Appendix D1, the Contractor shall clean existing drainage systems in accordance with this Clause. Wherever the term ‘chamber’ is used in this Clause it shall mean all drainage system chambers, be they - gully, inspection, manhole, catchpit, soakaway, oil separator or other.

3.3.13.2 The Contractor shall take measures when clearing blocked drains to ensure that adjacent water courses or groundwater (whether via soakaways or any other indirect route), will not be contaminated. Contamination includes mud or soil being washed or flushed into streams as well as other more obvious contaminants including diesel fuel, oils and chemicals.

3.3.13.3 Where jetting is required in Appendix D1 the procedures stated in Clause 3.3.14 shall be followed.

3.3.13.4 At each chamber, all mud and vegetation in the vicinity of the chamber likely to impede the flow of water shall be removed. After lifting the cover or grating the chamber shall be cleansed of all water, detritus, debris and silt, and all covers and gratings replaced and evenly bedded.

3.3.13.5 Cleaning of chambers shall be by mechanical means if required by Appendix D1. Otherwise cleaning shall be undertaken manually and in accordance with an approved method statement and all relevant health and safety legislation.

3.3.13.6 Gullies and chambers not cleaned for whatever reason, blocked connections and broken or cracked covers, gratings or frames shall be marked to aid subsequent identification.

3.3.13.7 Oil separators shall be refilled with uncontaminated water following the cleaning operation.

3.3.13.8 The Contractor shall dispose of all surplus water, debris and arisings from the works off Site at an appropriately licensed tip.

3.3.13.9 Where required by Appendix D1, cleaning of piped drainage systems shall be carried out by rodding or jetting in accordance with Clause 3.3.14.

3.3.13.10 The location of any obstruction that cannot be removed by flushing shall be marked on the ground in a manner agreed with the Engineer and reported to the Engineer.

3.3.13.11 All covers and gratings which have been removed for cleaning operations shall be replaced and evenly bedded.

3.3.13.12 The Contractor shall report any damage and defects to the drainage system or components to the Engineer each day, or immediately if considered a safety hazard.

3.3.13.13 After cleansing of chambers, their walls shall be free of any dirt or debris. Catchpit sumps shall have an average depth of silt not exceeding 12 mm. Benched chamber inverts and benching shall be free of any dirt or debris and the invert shall be free flowing.

3.3.13.14 After cleansing of pipes, it shall be possible to pull a scraper through the pipe, chamber to chamber, without accumulating any silt. Scrapers shall have a diameter 12 mm less than the internal bore of the pipe being tested.

3.3.13.15 After cleansing of ditches, they shall:

a) be clear of vegetation other than trees and short grass growing on the banks;

b) be completely free of litter, debris and waste;

c) have an invert falling at an even gradient and which lies a minimum 75mm below the invert of the connecting pipes and culverts;

d) be in a free flowing condition.

3.3.14 Jetting of Drainage Systems

3.3.14.1 Where cleaning by water jetting is required in Appendix D1, the Contractor shall clean existing drainage systems in accordance with this Clause.

3.3.14.2 The Contractor or sub-contractor shall be a member of The Water Jetting Association (WJA) (or other applicable recognised trade body) and operate in strict accordance with its published codes of practice.

3.3.14.3 The Contractor or sub-contractor shall comply with the recommendations of the current edition of the Sewer Jetting Code of Practice published by WRC Plc.

3.3.14.4 The pipe material and structural condition of the drainage systems to be cleaned shall be identified in Appendix D1. Where the material and/or condition is unknown and cannot be verified by either visual inspection without recourse to man-entry, or from drainage records, or damage to the pipeline is the suspected cause of a blockage, cleaning shall proceed on the basis of using the lowest pump pressure advised in the relevant codes of practice identified in sub-clauses 3.3.14.2 and 3.3.14.3.

3.3.14.5 Where possible the Contractor shall clear blockages in linear drainage channels units by rodding.

3.3.14.6 Where silt removal from linear drainage channels and perforated pipes is necessitated, the use of pressure jetting will result in a loss of pressure through the grating, slot or drainage holes together with the escape of silt and debris, unless the apertures can be temporarily covered. The application of pressure shall be regulated such that there is only sufficient to drive the jetting head across the silt to access remote from the point of entry.

3.3.14.7 If necessary, when jetting linear drainage channels or perforated pipes, the jetting head shall be changed for one that can deliver the highest volume of water at low pressure. The water pressure shall be sufficient to agitate the silt.

3.3.14.8 Wherever practical the Contractor shall use equipment to carry debris over a greater depth than one atmosphere and with a capability to suck liquid.

3.3.14.9 All arisings from the cleaning process shall be disposed of in an environmentally sensitive manner in accordance with current legislation.

NOTE:
1) The Contractor should note that use of high pressure water can result in serious internal injuries that may not be apparent at the skin surface.

2) The Contractor should be aware that where overhead electric cables are present, there is a potential danger from accidental strike by a jet of water resulting in electrocution.

3.3.15 Inspection of Drainage Assets

3.3.15.1 General Inspections shall be a visual inspection of non-pipework assets that brings to notice deterioration in condition or visible development of defects. They shall be carried out in accordance with the requirements of LU Category 1 Standard 1-052 Civil Engineering – Gravity Drainage Systems, Clauses 3.3.3 & 5.5.1.

3.3.15.2 CCTV surveys shall be carried out on pipework and linear drainage channel assets and shall comply with the requirements of the current version of the WRc Model Contract Document for Sewer Condition Inspection, except where modified by this specification.

3.3.15.3 If as a result of inspection (or any other activity), any usage or defect which might place at risk the operational railway, passengers, staff or the public, has been identified; it shall be made safe, recorded, and brought to the immediate attention of the Engineer and LU.

3.3.15.4 CCTV Digital Versatile Disk (DVD) data shall be included in the inspection report as coded inspection data in accordance with the current version of the WRc Manual of Sewer Condition Classification.

3.3.15.5 Personnel undertaking the CCTV survey shall hold an appropriate qualification in the survey procedure, the interpretation of CCTV images of drains and in defect coding & classification.

3.3.15.6 The Contractor shall supply copies of all relevant qualification and examination certificates for his staff to the Engineer prior to commencement of work.

NOTE: CCTV work by non-qualified operatives will only be accepted when the operative is training under the direct supervision of a person who is qualified, and that qualified person provides assurance that he has checked the work and that it is in accordance with the WRc requirements.

3.3.16 Line and Level Survey of Drainage Assets

3.3.16.1 All drainage assets to be the subject of line and level surveys shall be listed in Appendix D1.

3.3.16.2 For all drainage in the section to be surveyed:

a) the position of all chamber covers and gratings shall be determined by on-site survey;
b) a level check of Ordnance Survey bench marks shall be undertaken;
c) the level of the lowest point on the upper surface of each cover or grating frame (or seating rebate) shall be recorded;
d) the invert level of each inlet and outlet to each chamber and/or ancillary structure shall be recorded;
e) the level of the base of each chamber shall be recorded;
f) the level of the invert of all outfalls and inlets shall be recorded;
g) the level of the invert to each pumping station shall be recorded;
h) the interior of each chamber shall be surveyed to provide the information necessary to complete the preparation of chamber details, pipe length details and detailed plans & sections;
i) the position (line and level) of all pumping mains shall be determined by on-site survey using suitable tracing techniques;
j) the line of pipes linking two chambers or any of the structures on the sewerage system included in the survey shall be proved by the use of dyes or other suitable means.

3.3.16.3 For all drainage in the section surveyed, a line and level drawing based on Ordnance Survey mapping data (as background) shall be provided and produced in accordance with Clause 3.2.4 Existing and As-Built Survey Drawings. The drawing shall show the positions of:

a) chamber covers and gratings;
b) drainage pipes and channels;
c) drainage pumping mains
d) 100m track marker triangles;
e) bridge centre lines;
f) signal gantries centre lines;

g) temporary bench marks at ends of each station;

h) covers or gratings *cover levels* as text;

i) pipe invert level as text;

j) sump invert level as text.

3.3.16.4 Drawings shall be produced to LU grid and levels quoted relative to Tunnel Datum.

3.3.16.5 For all drainage in the section surveyed, longitudinal sections through each pipeline shall be provided and produced in accordance with Clause 3.2.4 Existing and As-Built Survey Drawings.

3.3.17 Sewer and Drain Renovation

3.3.17.1 Localised cured in place repair systems (CIPR) for making structural repairs to drainage pipes shall comply with The Water Industry Specification (WIS) 4-34-06: Specification for localised sewer repairs using cured in place systems with or without re-rounding : October 2007: Issue 2, published by the Water Research Centre (WRc Plc).

3.3.17.2 The requirements of Cured in Place Pipe (CIPP) lining for the renewal and upgrading of track drainage systems are as follows:

a) CIPP linings shall be designed and specified in accordance with:

i. BS EN 13566-4 Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks – Part 4: Lining with cured-in-place pipes;

ii. Water Industry Specification (WIS) 4-34-04: Specification for renovation of gravity sewers by lining with cured-in-place pipes: March 1995: Issue 2, published by the WRc.

iii. Design procedures for determining the required wall thickness of circular and non-circular sections under different loading conditions are given in the current version of the WRc Sewerage Rehabilitation Manual and the German design code ATV-M 127-2 Structural analysis for the rehabilitation of sewers by lining and prefabrication methods, January 2000.

b) The structural design of the CIPP lining system shall be in accordance with the relevant requirements of the LU Category 1 Standard 1-052 Civil Engineering – Gravity Drainage Systems, Clause 3.1.2.5;

c) The CIPP lining system shall be a WRc approved product and the installer shall be approved by WRc.

d) The use of the CIPP lining system shall be restricted to locations where the existing pipe deformation or deviation from line and level is confirmed as less than 10% (of pipe diameter) from a CCTV survey undertaken in accordance with Clause 3.3.10. The CCTV survey of the pipe shall locate all lateral connections. Lateral connections shall be reconnected to the main pipe following installation of the CIPP system.

e) The use of the CIPP lining system shall be restricted to pipes up to 900mm in diameter.

f) The existing pipe shall be cleared of all silt and debris, and any loose fragments of pipe that could fall onto the liner during installation shall be removed.

g) During CIPP installation and cure, flow diversion or over-pumping will generally be required. Where the drainage flows are very low, it may be possible to plug the incoming pipes and to rely on the storage within the system. The liner will also block lateral connections until reopened, and provision should be made for flow diversion or over-pumping if there is insufficient capacity in the branch system.

h) The CIPP lining system shall be installed as a single continuous length between adjacent chambers on the pipeline.

i) After installation and cure, the CIPP lining shall be visually inspected by CCTV, and tested in accordance with Clause 3.3.10.

j) Any water (heated or ambient) used for the curing of a CIPP lining system shall not be released into surface water systems, it shall be regarded as contaminated, removed from site and disposed of at an appropriately licensed facility. This is due to the high risk of the water being contaminated with resin (even when a fully enclosed liner is used).

3.3.17.3 Additional requirements for the use of CIPP lining systems for perforated pipe are as follows:

a) The pipe (host and liner) shall be perforated or slotted post CIPP lining installation in accordance with sub-Clause 3.3.2.4.

b) The pipe surround and backfill between the pipe and track formation or ground surface shall be replaced (in accordance with the subsequent requirements of this sub-Clause) with new Type B or D filter material complying with Clause 3.3.6, *unless* it can be demonstrated the existing material meets the following requirements:

i. The pipe surround and backfill has an infiltration rate greater than 2×10^{-4} m/s. The infiltration rate shall be demonstrated pre CIPP installation using the following testing procedure:

- Excavate down to formation level (bottom of track support ballast) directly above the perforated (or open jointed) pipe in question. In theory this should typically be approx 300mm but will depend upon the proximity of the drain to the track and the height of any ballast shoulder present.
- Push a 500mm length of unperforated DN150 plastic pipe into the existing soil above the drainage pipe such that its end is buried to a depth of 100mm. Support the pipe as required to enable its filling with water.
- Introduce 25 litres of water into the pipe. The pipe will hold approx 7 litres (in its installed position). The water level in the pipe should be kept topped up such that the depth of water in the pipe doesn't exceed 200mm (this is necessary to avoid excessive hydraulic head leading to distorted results) until all 25 litres has been introduced into the pipe.
- Record the time it takes for all 25 litres of water to infiltrate the ground. The start time is the point when the first litre of water is poured into the pipe. The finish time is when all 25 litres of the water has finally infiltrated the ground through the base area of the pipe.
- The infiltration test shall be undertaken approximately every 10m along the length of the drainage pipe; e.g. for a 30m asset, 2no. tests shall be undertaken. These should correspond to the locations where localised backfill replacement (using free draining material compliant with sub-Clause 3.3.6.4) will take place should the infiltration test results require it.
- Calculate the infiltration rate for each test as a simple function of 25 litres divided by the available soakage area, divided by the infiltration time in seconds, keeping units consistent. Typically thus:
    - (0.025 m^3 / 0.0177m^2) / Infiltration time in seconds = infiltration rate as velocity in metres per second.

- Where the infiltration rate is lower than the specified minimum and localised back fill replacement is an appropriate remedial action at the site. The existing back fill will be excavated in the same locations as the infiltration tests (i.e. every 10m). Each excavation must coincide with a minimum of 2000mm^2 surface area of perforations in the pipe and have minimum plan dimensions of 1.0m length by 0.5m width. The excavation shall be lined with geotextile compliant with Clause 3.3.4.7 and shall be back filled with type B or D filter material compliant with Clause 3.3.6.4. If a track ballast layer is present it shall be replaced with new track ballast if necessary.

4 Responsibilities

4.1 **The LU Civil Engineer** shall have sole responsibility for this specification.

4.2 **The LU Procurement Agent** shall be responsible for incorporating the requirements of this LU Specification in any contract to which it is relevant.

5 Supporting information

5.1 Background

5.1.1 This Specification is one of a series of five (5) specifications covering assets within the Pumps and Drainage discipline.

5.1.2 The complete suite of Pumps and Drainage Specifications comprises the following:

Number	Title
T0001 A1	Track and Off-track Gravity Drainage Systems
T0002 A1	Pump Drainage Systems
T0003 A1	Critical Pump Sites – Control Panels
T0004 A1	Non Critical Pump Sites – Control Panels

Table 5.1.2 – Civil Engineering - Pumps and Drainage Specifications

6 Reference Section

6.1 References

6.1.1 British Standards

Document no.	Title
BS 65	Vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings
BS 197-1	Cement — Part 1: Composition, specifications and conformity criteria for common cements
BS 970-1	Wrought Steels for Mechanical and Allied Engineering Purposes Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
BS 1377-2	Methods of test for Soils for civil engineering purposes — Part 2: Classification tests
BS 3892-2	Pulverized-Fuel Ash Part 2: Specification for Pulverized-Fuel Ash to Be Used as a Type I Addition
BS 5911	Concrete pipes and ancillary concrete products
BS 6100	Building and civil engineering – Vocabulary
BS 8500	Concrete - Complementary British Standard to BS EN 206-1
BS 9124	Specification for steel and aluminium access cover systems with over 1m clear opening
BS EN 124	Gully Tops and Manhole Tops for Vehicular and Pedestrian Areas - Design Requirements, Type Testing, Marking, Quality Control
BS EN 206-1	Concrete — Part 1: Specification, performance, production and conformity
BS EN 295	Vitrified Clay Pipes and Fittings and Pipe Joints for Drains and Sewers
BS EN 752	Drain and sewer systems outside buildings
BS EN 1295-1	Structural design of buried pipelines under various conditions of loading — Part 1: General requirements

Document no.	Title
BS EN 1433	Drainage channels for vehicular and pedestrian areas Classification, design and testing requirements, marking and evaluation of conformity
BS EN 1610	Construction and Testing of Drains and Sewers
BS EN 1744-1	Tests for chemical properties of aggregates Part 1: Chemical analysis
BS EN 1917	Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced
BS EN 12620	Aggregates for concrete
BS EN 12889	Trenchless Construction and Testing of Drains and Sewers
BS EN 13101	Steps for underground man entry chambers Requirements, marking, testing and evaluation of conformity
BS EN 13242	Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
BS EN 13285	Unbound mixtures — Specifications
BS EN 13566-4	Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 4: Lining with cured-in-place pipes
BS EN ISO 4016	Hexagon Head Bolts - Product Grade C
BS EN ISO 4018	Hexagon Head Screws - Product Grade C
BS EN ISO 4034	Hexagon Nuts - Product Grade C
EN ISO 10319	Geosynthetics - Wide-width tensile test
EN ISO 11058	Geotextiles and geotextile-related products - Determination of water permeability characteristics normal to the plane, without load
EN ISO 12236	Geosynthetics Static puncture test (CBR test)
EN ISO 12956	Geotextiles and geotextile-related products — Determination of the characteristic opening size

6.1.2 Other

Document no.	Title
	DfT Specification for Highway Works (SHW).
	WRc Publication. The Civil Engineering Specification for the Water Industry (6th Edition)
	Institution of Civil Engineers Conditions of Contract (Measurement Version) (7th Edition)
	Civil Engineering Standard of Measurement (3rd Edition)
	Highway Works Volume 4 Bills of Quantities for Highway Works
	TRL Report 447
	WRc Publication. Sewers for Adoption
	DfT Highway Construction Details
WIS 4-34-06	WRc Publication. Water Industry Specification (WIS) for Localised Sewer Repairs
WIS 4-34-04	WRc Publication. Water Industry Specification for Renovation of gravity sewers by lining with cured-in-place pipes
	WRC Sewerage Rehabilitation Manual

6.2 Abbreviations

The following abbreviations are created:

a) within London Underground's Glossary of Terms (1-622) (a Category 1 Standard);
b) from published sources that are clearly identified.

Abbreviation	Definition	Source
BS	British Standard.	a
BS EN	British Standard European Norm.	a
EN	European Norm (European Standard).	a
HCD	Highway Construction Details published by the Department for Transport as Volume 3 of the Manual of Contract Documents for Highway Works.	b
ISO	International Standards Organisation (International Standard)	a
LU	London Underground.	a
LUL	London Underground Ltd.	a
MCHW	Manual of Contract Documents for Highway Works.	b
SHW	Specification for Highway Works published by the Department for Transport as Volume 1 of the Manual of Contract Documents for Highway Works.	a
WRc	Water Research Centre.	a
CESWI	Civil Engineering Specification for the Water Industry	b
HPPE	High Performance Polyethylene	a
SRPC	Sulphate Resisting Portland Cement	b
ST#	Standardised Prescribed Mixes (concrete)	b
PSRV	Polished slip resistance value	b
CIPR	Cured in Place Repair Systems	b
CIPP	Cured in Place Pipe	b
TRL	Transport Research Laboratory	a

6.3 Definitions

The following topic specific definitions are created:

a) within London Underground's Glossary of Terms (1-622) (a Category 1 Standard);
b) from published sources that are clearly identified.

Term	Definition	Source
Cess	The space alongside the railway lines extending to a cable run or other boundary	a
Off-track Drainage	Off-track Drainage shall be all drainage assets (including the interstices within the ballast and pipe backfill) that have been designed to carry water from the track, the track formation and associated groundworks and are greater than 2 metres from the nearest running rail. Excluding station and premises drainage.	a
Six Foot	The space between one line and another where the lines are the normal distance apart.	a
Sub-surface Railway	Sub-surface Railway – (formerly referred to as "*Section 12*") locations as defined in *"The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009"*.	a
Ten Foot	The space between one line and another, where a wide space is provided between one pair of lines, where there are three lines or more.	a
Track Drainage	Track Drainage shall be all drainage assets (including the interstices within the ballast and pipe backfill) that have been designed to carry water from the track, the track formation and associated groundworks and are within 2 metres of the nearest running rail.	a

6.4 Technical content manager

Paragraph number	Technical content manager
All	Principal Engineer - Pumps and Drainage

6.5 Document history

Issue no	Date	Changes	Author
A1	February 2011	New Specification as per DRACCT 00093	Ian Uttley

7 Attachments

7.1 Attachment 1 – Notes for Guidance

Civil Engineering Specification for Track and Off-track Gravity Drainage Systems

Introduction

The Notes for Guidance on the Civil Engineering Specification for Track and Off-track Gravity Drainage Systems are substantially based on the Department for Transport's Notes for Guidance on the Specification for Highway Works (SHW), Series NG 500 Drainage and Service Ducts (incorporating November 2009 amendments). This Department for Transport reference document is substantial and contains a large amount of generally relevant information for the compiler of Contract-specific drainage information and requirements. However, only data directly relevant to the specific matters dealt with by the sub-Clauses requiring input to Contract-specific Appendix D1 has been reproduced; it has then been revised or augmented to suit the specific context present in the Specification.

It is recommended (*in light of the above*) that the compiler of the Contract-specific information and requirements makes reference to the general information contained in the Department for Transport's Notes for Guidance on the Specification for Highway Works (SHW), Series NG 500 Drainage and Service Ducts (incorporating November 2009 amendments) when preparing Appendix D1 as well as the specific guidance contained herein.

The Notes for Guidance on the Civil Engineering Specification for Track and Off-track Gravity Drainage Systems are divided into Sections, Clauses and sub-Clauses corresponding to those in the Specification. The NG Clauses and sub-Clauses directly relate to Clauses and sub-Clauses in the Specification; however there are not corresponding NG Clauses (or sub-Clauses) to every Specification Clause (or sub-Clause).

Throughout the Notes for Guidance the term "compiler" has been used to refer to the individual or organisation responsible for the preparation of Contract-specific information and requirements.

Incorporation of the Specification into the Contract

The Specification has been drafted so as to allow its use with a wide range of procurement methods and forms of contract. The use of terms specific to any particular form of contract have thus been avoided and in particular no references to approvals and/or directions by the Engineer are included.

Proprietary Work, Goods or Materials

Proprietary work, goods or materials must not be specified unless their function cannot be described in any other way using specifications which are sufficiently precise and easily understood. Where the specification of proprietary work, goods or materials cannot be avoided, European law requires that the brand name or type be followed by the words 'or equivalent'. Guidance on the assessment of equivalence is given in Department for Transport Advice Note SA2 (MCHW 0.3.2).

Use of the Specification for Track and Off-track Gravity Drainage Systems

The Specification has been widely drawn to cover all track and off-track gravity drainage contracts from the provision of new, to the improvement and rehabilitation of existing, to maintenance and inspection work.

There is no need to reproduce the Specification in the documents as it is incorporated by reference. Contract-specific requirements should be incorporated in Appendix D1 to the Specification (without the need to alter Clauses, etc.) in one of two ways:

1) Specific requirements identified in the Specification. These are generally indicated by the words “as described/stated in Appendix D1”.
2) Alternatives to the Specification requirements. These are generally indicated by the words “unless otherwise described in Appendix D1”.

The compiler’s attention is drawn to the requirements of the Construction (Design and Management) Regulations and in particular the need for a health and safety plan to be prepared and provided at the same time as the tender documents, (Ref. SD 10 (MCHW 6.0.1)). In particular the compiler should ensure consistency between information referred to in the above plan and the detailed information included in Appendix D1 to the Specification.

Parent Clause Number	Parent Clause Title	Sub-Clause (or Table) Numbers
	General	
3.2.4	Existing and As-Built Survey Drawings	3.2.4.1
3.2.6	Contractor Designs	3.2.6.1
	Technical	
3.3.1	General	3.3.1.3, 3.3.1.4
3.3.2	Pipes for Track and Off-Track Drainage	3.3.2.1, 3.3.2.2, Table 3.3.2.1, 3.3.2.4
3.3.3	Excavation for Pipes and Chambers	3.3.3.1, 3.3.3.3, 3.3.3.8
3.3.4	Bedding, Laying and Surrounding of Pipes	3.3.4.3, 3.3.4.4, 3.3.4.7.2, 3.3.4.7.6
3.3.6	Backfilling of Trenches and Filter Drains	3.3.6.3, 3.3.6.4.1, 3.3.6.4.2, Table 3.3.6.1, 3.3.6.9, 3.3.6.10
3.3.7	Connecting to Existing Drains, Chambers and Channels	3.3.7.1, 3.3.7.3
3.3.8	Chambers	3.3.8.1, 3.3.8.2, 3.3.8.3, 3.3.8.4, 3.3.8.5, 3.3.8.7, 3.3.8.8, 3.3.8.10, 3.3.8.13, 3.3.8.14, 3.3.8.19
3.3.9	Gullies and Pipe Junctions	3.3.9.1, 3.3.9.3, 3.3.9.4, 3.3.9.5, 3.3.9.7, 3.3.9.8
3.3.10	Testing and Cleaning of New Drainage Systems	3.3.10.2, 3.3.10.4, 3.3.10.7
3.3.11	Land Drains	3.3.11.1
3.3.12	Linear Drainage Channel Systems	3.3.12.1, 3.3.12.2, 3.3.12.5
3.3.13	The Cleaning of Existing Drainage Systems	3.3.13.1, 3.3.13.3, 3.3.13.5, 3.3.13.9
3.3.14	Jetting of Drainage Systems	3.3.14.1, 3.3.14.4
3.3.16	Line and Level Survey of Drainage Assets	3.3.16.1

Table NG 0.1 – List of sub-Clauses which refer to Contract-specific requirements described in Appendix D1

Design Drawings and Schedules

Appendix D1 should contain an exhaustive list of the design drawings and copies of any schedules required for completion of the works (for example, pipe and chamber schedules).

GENERAL

NG 3.2.4 Existing and As-Built Survey Drawings

NG 3.2.4.1 Appendix D1 shall identify any particular requirements for existing and as-built survey drawings that are above and beyond the requirements listed in the sub-Clause and the LU standard mentioned therein.

NG 3.2.6 Contractor Designs

NG 3.2.6.1 Appendix D1 shall identify all items to be designed by the Contractor. It should include, *for each structure, structural element or feature listed*, a design specification (or design specifications where a choice is offered) incorporating any relevant Appendices, Standards or other requirements appropriate to the design. A Designated Outline should be shown on the Drawings for each structure to be designed by the Contractor and each structure for which a choice of designs is offered.

The compiler should ensure that features based on proprietary products have not been specified in the Contract. Such features should be designed by the Contractor, or where appropriate, by the manufacturer and proposed by the Contractor. Examples of such features are given below:

- combined drainage and kerb systems;
- linear drainage channels.

TECHNICAL

NG 3.3.1 General

NG 3.3.1.3 Appendix D1 shall state whether more than one pipe type is to be used within any individual drain between consecutive chambers. Pipes of more than one type within any individual drain between consecutive chambers will be exceptional. Whatever the circumstance giving rise to the proposal, consideration should be given to whether the joint between the two pipes will provide an appropriately watertight joint and a smooth inner transition for rodding purposes.

NG 3.3.1.4 Appendix D1 shall state the required Design Life of any drainage assets where the requirements differ from the lifetimes stated in Table 3.3.1.1 of the Specification.

NG 3.3.2 Pipes for Track and Off-track Drainage

NG 3.3.2.1 Appendix D1 shall contain a copy of the hydraulic design of the drainage system, such that the Contractor can select pipe types having adequate hydraulic capacity or offer alternative pipe types to those specified in the Contract.

NG 3.3.2.2 Appendix D1 shall include details of required pipe types that are not listed in Specification Table 3.3.2.1.

NG Table 3.3.2.1 Appendix D1 shall state whether precast concrete pipes are to be manufactured using Sulphate-Resisting Portland Cement.

NG 3.3.2.4 Appendix D1 shall state the required width of perforation slots if slot width is required to be different from the standard width range stated in the Specification.

Appendix D1 shall stipulate if there is a requirement for perforations to be present in the bottom half of the pipe. The standard requirement is for perforations only in the top half of the pipe, such that the pipeline acts as an effective carrier system when flowing less than half-full. However, there are circumstances when it may be technically advantageous to employ a fully perforated pipe.

NG 3.3.3 Excavation for Pipes and Chambers

NG 3.3.3.1 Acceptable material is material excavated from within the Site or imported on to the Site which meets the requirements of SHW Table 6/1 and Appendix D1 for acceptability for use in the Permanent Works. Thus any additional requirements for the determination of acceptability that are over and above those contained in SHW Table 6/1 shall be set out in Appendix D1.

NG 3.3.3.3 Appendix D1 shall state whether excavations for pipes and chambers are permitted (or required) to be battered back in order to avoid the need for (or to mitigate the need for) trench sheeting or other forms of positive support. An example where this may be appropriate could be where the presence of other buried services precludes the use of penetrative support systems.

Where the above permission or requirement for battering back excavations has been stipulated, then the battering back shall take the form of benching. The dimensions and configuration of the benching arrangement shall (ideally) be shown on the Contract drawings but may also be described in Appendix D1.

If there is a specific requirement for trench sheeting and/or other support systems to be left in place it shall be so stated in Appendix D1 with the reason for such.

NG 3.3.3.8 Appendix D1 shall contain details of any ground water lowering or other treatment that may be required as a result of excavation for pipes and chambers.

NG 3.3.4 Bedding, Laying and Surrounding of Pipes

NG 3.3.4.3 The Specification contains detailed requirements for the determination of suitable materials for the bedding, laying and surrounding of filter drain pipes. However, there may be unusual circumstances where deviation from the standard requirements is necessary. In such cases Appendix D1 shall state the new requirements and give a brief explanation of the reason for the deviation from the standard requirements.

An example of the above might be where a filter drain is to be provided through or adjacent to strata comprised of finely grained soils. If it has also been determined that provision of geotextile separation is not desirable, it may be appropriate to specify that the bedding, laying and surrounding material should be a graded coarse aggregate, to mitigate the migration of fine particles from the surrounding strata.

NG 3.3.4.4 Tables 3.3.4.2 and 3.3.4.3 contain details of selected physical properties of materials permitted to be used for the bedding, haunching and surrounding of carrier drains. The range of permitted materials includes single-sized aggregate options. However, Specification sub-Clause 3.3.4.4 states that for Track Drainage, single-sized aggregates may not be used for the bedding, haunching and surrounding of carrier drains unless explicitly stated otherwise in Appendix D1. This is because LU standard details explicitly identify graded aggregates as the required carrier pipe bedding material for under track crossing pipes (UTX's); by inference, Track Drains that are non-UTX carrier drains present a similar risk profile to UTX's and are therefore treated in the same way as UTX's within this sub-Clause.

The technical basis for this requirement appears to be three-fold, in order of significance:

- The concern that coarse aggregate (aka single-sized aggregates) may encourage the flow of ground water along the trench invert (through the pipe bedding) with attendant risk of subgrade erosion and associated settlement at surface level;

- The possibility of increased migration of fines from the surrounding strata into the bedding material as a result of the higher porosity of coarse aggregates and associated settlement at surface level;
- The fact that graded aggregates provide a significantly enhanced modulus of soil reaction at high degrees of compaction when compared to coarse aggregates. Thus (subject to degree of compaction), graded aggregates represent the unbound granular pipe bed, haunch and surround option which is capable of yielding the best reaction (as side-fill) to the pipe. In the case of flexible and semi-rigid pipe material options (which are typically used for Track Drainage - including for UTX's), the reaction from the side-fill is critical to the overall performance of the pipe-bed structure. The better the reaction from the side-fill, the lower the deformations under load (both short term and long term) and the higher the factor safety against buckling failure. Therefore, this relationship has an influence on the potential for undesirable changes (transient and permanent) in rail geometry under load.

Even small settlement magnitudes resulting from loss of subgrade fines can be reflected at rail level; in the context of Track Drainage in general and UTX's in particular, the minimisation of the risk of such settlements is critical, as they can cause undesirable changes in rail geometry.

The compiler should take an informed technical view on whether the above concerns are realistic/valid in the context of the particular ground conditions present at the location of any given Track Drainage carrier drain, and in the context of the perceived advantages of utilising coarse aggregates for bedding, haunching and surrounding of them. It may be simpler to just rely upon the standard requirement that no coarse aggregates are to be used for the bedding, haunching and surrounding of Track Drainage carrier drains.

Off-track carrier drains present a different risk profile if settlements caused by loss of subgrade fines get reflected at surface level. The compiler may consider that relaxation of the standard requirement is completely acceptable in such cases; and although each case must be assessed on its own merits, it is worth noting that use of coarse aggregates for bedding, haunching and surrounding of carrier drains is an industry standard approach and is not generally considered to result in a significant increase in the risk of problematic settlement magnitudes. In fact, the reduced necessity for compaction of coarse aggregates can mitigate the risk of settlement along the line of the trench, which is likely to be a far greater risk than the risk of settlement of the existing strata as a result of loss/reduction of its fines component.

Types A and Z beds shown on standard detail drawing SHW HCD F1 are concrete beds. If the compiler requires the bedding concrete to be mixed using Sulphate-Resisting Portland Cement, it shall be so stated in Appendix D1.

NG 3.3.4.7.2 Track and Off-track surface and ground water filter drainage trenches are lined with suitable geotextile fabric when following the LU standard detail. However, if following the filter drain options shown on SHW HCD F2 then the presence of geotextile is not automatic. In either case, if a geotextile *is* required, then it should be noted that the LU standard detail (ST 71670) requires the geotextile to be left open (i.e. unlapped) along the top of the trench. This is to facilitate the migration of fines produced as a result of ballast attrition, into the drainage system for subsequent clearance at system catchpits. If the compiler wishes to deviate from this standard detail via closing/lapping the geotextile longitudinally at the top of the trench for valid technical reasons, then it shall be so stated in Appendix D1.

NG 3.3.4.7.6 Geotextile compliant with sub-Clause 3.3.4.7.5 is to be used at locations where tree root penetration is considered to be a potential problem. Those locations shall be scheduled in Appendix D1.

NG 3.3.6 Backfilling of Trenches and Filter Drains

NG 3.3.6.3 If the standard requirements for backfilling of trenches other than filter drain trenches (as described in sub-Clause 3.3.6.3) are not required or appropriate, then Appendix D1 shall adequately describe the alternative requirement.

NG 3.3.6.4.1 Appendix D1 shall identify the required filter material type for backfilling of filter drain trenches. There are four filter material types specified in the Specification within Table 3.3.6.1.

NG 3.3.6.4.2 If no selection is made in Appendix D1 then sub-Clause 3.3.6.4.2 makes clear that the default requirement for a Type B or Type D filter material shall be invoked; with the decision being made on the basis of lowest cost by the Contractor.

NG Table 3.3.6.1 If Appendix D1 indicates a requirement for Type C filter material (ref. NG 3.3.6.4.1) then the specific grading and geometrical requirements shall also be specified. Type C filter material is a user-specified material and the specification may be driven by knowledge of local sources of aggregate supply. It is unlikely that the Type C option will be required in relation to LU works.

NG 3.3.6.9 Where topsoil is present on the line of a trench, the upper section of trench backfill shall be topsoil of the same thickness and quality as the surrounding ground. This does not apply where the Contract explicitly requires an alternative surface treatment (for example, in areas of carriageway) or where other standard details apply (for example, in the case of a filter drain). If the above specification of like-for-like topsoil replacement on the line of trenches is not required, then Appendix D1 shall identify the alternative requirement.

If trench sheeting and other excavation support is *not* to be removed as backfilling proceeds then it shall be so stated in Appendix D1 together with a brief explanation of why this is to be the case.

NG 3.3.6.10 The method by which service ducts and cables crossing trenches are to be marked at surface level shall be fully articulated in Appendix D1.

NG 3.3.7 Connecting to Existing Drains, Chambers and Channels

NG 3.3.7.1 If existing drains are to be extended, connected or jointed to new drains, chambers or channels, they shall be scheduled as such in Appendix D1. Such extensions, connections and joints shall take place during the construction of the new drain, chamber or channel (or other work) unless the schedule in Appendix D1 indicates an alternate requirement. Where the connections are between pipe drains, special connecting pipes (for example, proprietary pipe junctions) shall be laid and jointed in accordance with the scheduled requirements in Appendix D1.

NG 3.3.7.3 Appendix D1 shall identify the required method of abandonment for existing drains that are no longer required. The options are set out in Specification sub-Clause 3.3.7.3.

NG 3.3.8 Chambers

NG 3.3.8.1 A chamber schedule shall be included in Appendix D1. It shall identify (amongst other relevant technical detail) types of chambers required (for example, benched chambers, catchpits, etc).

NG 3.3.8.2 Where non-brick and non-precast concrete chambers are specified in the works, the foundation details for such chambers shall be specified in Appendix D1.

NG 3.3.8.3 Where the required finishing details for pipes built into brick chambers differ from the standard requirements in Specification sub-Clause 3.3.8.3, the required detail

shall be described in Appendix D1 and shown on scheme design drawings if necessary.

NG 3.3.8.4 Where there are particular requirements for precast concrete chambers (for use in locations subject to highway loading) they shall be stated in Appendix D1. For example, a requirement for units to be precast using Sulphate Resisting Portland Cement.

NG 3.3.8.5 Where there are particular requirements for cast in-situ concrete chambers (for use in locations subject to highway loading) they shall be stated in Appendix D1. For example, a requirement for units to be cast using Sulphate Resisting Portland Cement.

NG 3.3.8.7 Where there are particular requirements for cast in-situ concrete chambers (for use in locations subject to railway loading) they shall be stated in Appendix D1. For example, a requirement for units to be cast using Sulphate Resisting Portland Cement.

NG 3.3.8.8 Where step irons or ladders are required in chambers, the requirement and technical detail shall be explicitly identified in the chamber schedule within Appendix D1.

NG 3.3.8.10 Appendix D1 shall contain details of the types of covers (including cover planks), gratings and frames that are required. This information should be included in the chamber schedule within Appendix D1.

The required degree of skid/slip resistance on covers (including cover planks), gratings and frames shall be stated in Appendix D1. It shall be stated in terms of a polished slip resistance value (PSRV). The compiler may wish to refer to BS 9124: 2008 Table 1 to assist with the process of determining appropriate PSRV's for given circumstances.

NG 3.3.8.13 Where metallic covers, gratings and frames are required to be supplied with a coating. The requirement shall be so stated in Appendix D1 together with the coating specification.

NG 3.3.8.14 Where requirements for special duty covers for use in carriageways exist, they shall be stated in Appendix D1.

NG 3.3.8.19 Where the adjustment or replacement of existing frames and covers or gratings is required, and the standard specification for such work contained in sub-Clause 3.3.8.19 is not considered appropriate for given circumstances, then Appendix D1 shall state the alternate requirement.

Where covers and frames are to be bedded on a proprietary quick setting mortar, then this requirement shall be stated in Appendix D1.

Where covers and frames must not be set flush with the new surface in line with the standard specification, the alternate requirements shall be stated in Appendix D1.

NG 3.3.9 Gullies and Pipe Junctions

NG 3.3.9.1 Appendix D1 shall state the type or types of gully required (i.e. trapped, untrapped or sumpless). It is recommended that these and other technical details pertaining to gullies be provided in the form of a gully schedule.

NG 3.3.9.3 Appendix D1 shall include any additional specification for in-situ cast gullies required, that is over and above the standard specification in Specification sub-Clause 3.3.9.3.

NG 3.3.9.4 Appendix D1 shall contain details of the required strength classes and sizes of all gully gratings, kerb type gully covers and frames required under the Contract. It is recommended that these technical details be provided in the form of a gully schedule.

NG 3.3.9.5 Where the upper surface of gully gratings is required to be anything other than flat, the required arrangement shall be identified in Appendix D1.

The minimum waterway areas of gully gratings shall be specified in Appendix D1.

Where metallic gratings and frames are required to be supplied with a coating. The requirement shall be so stated in Appendix D1 together with the coating specification.

It is recommended that the above technical details be provided in the form of a gully schedule.

NG 3.3.9.7 Gully connecting pipes shall only be jointed to the collector drain using saddles if permitted or required in Appendix D1. The compiler should explicitly state if the use of saddles is permitted or required.

NG 3.3.9.8 Where the adjustment or replacement of existing frames and gratings is required, and the standard specification for such work contained in sub-Clause 3.3.9.8 is not considered appropriate for given circumstances, then Appendix D1 shall state the alternate requirement.

Appendix D1 should state where adjusted or replaced gully units are not to be laid at a level 6mm below the adjoining road surface on a mortar bed.

Where covers and gratings are to be bedded on a proprietary quick setting mortar, then this requirement shall be stated in Appendix D1.

It is recommended that the above technical details be provided in the form of a gully schedule.

NG 3.3.10 Testing and Cleaning of New Drainage Systems

NG 3.3.10.2 Where the Specification requirements for CCTV survey of drains in sub-Clause 3.3.10.2 are not appropriate for given circumstances, the alternate requirement shall be stated in Appendix D1.

NG 3.3.10.4 Where permeability tests are required to be carried out under the Contract. The relevant details shall be provided in Appendix D1. The compiler's attention is drawn to the fact that a simple permeability testing regimen is already included in the Specification under sub-Clause 3.3.17.3; if appropriate, this may be referred to.

NG 3.3.10.7 Appendix D1 shall explicitly identify those unperforated pipelines with watertight joints (excluding chambers) that shall be subjected to air testing and/or water testing. The BS EN test method shall also be stated. The compiler should refer to BS EN 1610 and BS EN 12889 as appropriate to the pipeline construction method for details of air and water test methodologies.

NG 3.3.11 Land Drains

NG 3.3.11.1 Appendix D1 shall describe how and where existing land drains permanently severed by the Works are to be connected into a new drain, pipe or ditch.

NG 3.3.12 Linear Drainage Channel Systems

NG 3.3.12.1 Appendix D1 shall list any required linear drainage channel systems and any particular requirements associated with them.

NG 3.3.12.2 Appendix D1 shall contain the particular requirements for linear drainage channel systems such that the Engineer can confirm the suitability of proprietary systems proposed by the Contractor.

NG 3.3.12.5 Where there are additional requirements above and beyond those given in Specification sub-Clause 3.3.5.4, concerning water tightness of junctions, connecting pipes and other fittings, they shall be stated in Appendix D1.

NG 3.3.13 The Cleaning of Existing Drainage Systems

NG 3.3.13.1 All existing drainage systems that are required to be cleaned in general accordance with Clause 3.3.13 shall be listed in Appendix D1.

NG 3.3.13.3 All existing drainage systems that are required to be cleaned by water jetting shall be listed in Appendix D1.

NG 3.3.13.5 All existing drainage chambers that are required to be cleaned by mechanical means shall be listed in Appendix D1.

NG 3.3.13.9 All existing piped drainage systems required to be cleaned by rodding or jetting shall be listed in Appendix D1. The Compiler shall state which cleaning method is to be used.

NG 3.3.14 Jetting of Drainage Systems

NG 3.3.14.4 For all drainage systems to be cleaned, the pipe materials and structural conditions shall be listed in Appendix D1 if known.

NG 3.3.16 Line and Level Survey of Drainage Assets

NG 3.3.16.1 All drainage assets that are required to be subject to line and level survey shall be listed in Appendix D1.

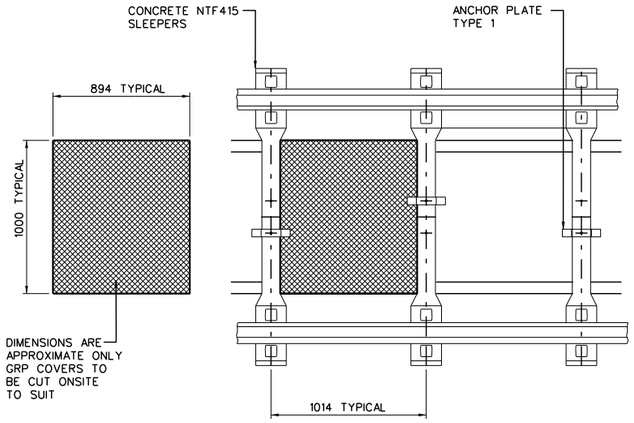
8 Current Written Notices attached to this standard are:

Written Notice No	Issue Date	Written Notice Title
LU-WN-001255	07/03/2014	The use of twin-walled or structured wall plastic pipe

Written Notice	**LU Ref. No.:** LU-WN-01255
	Suppliers Ref. No.:

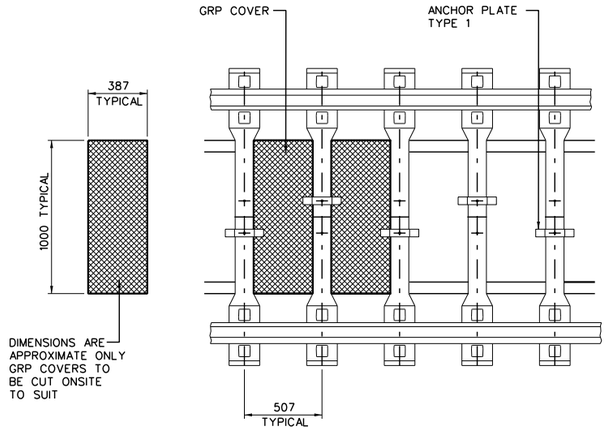
1	**Written Notice Completed By**	
	Person Accountable	Anthony Fernihough
	Directorate	Capital Programmes Directorate
	Date Issued	7th March 2014
2	**Details of the standard Requiring Clarification**	
	Title:	Civil Engineering – Track and Off-track Gravity Drainage Systems
	Standard Reference No.	T0001
	Issue No.	A1
	Clause/Paragraph No.:	3.3.2.3
3	**Details of Definitive LU Interpretation of Requirements**	
	Title of Written Notice	The use of twin-walled or structured wall plastic pipe
	Following a number of detailed discussions and review of pipe structural calculations following methodology in BS EN 1295-1, it is agreed that Clause 3.3.2.3 should be changed from:- The following are not permitted: a) Use of rigid or semi-rigid pipes with rigid joints for any buried pipeline b) The use of twin-walled or structured wall plastic pipes c) The use of open jointed pipes to: - The following are not permitted: a) Use of rigid or semi-rigid pipes with rigid joints for any buried pipeline b) The use of twin-walled or structured wall plastic pipes that are not “accepted for use” on the London Underground Product Register (APR - http://www.lu-apr.co.uk/Pages/Logon.aspx) c) The use of open jointed pipes	

6.3 PCDT116-DWG-CVL-S001-0000001 - Typical Tube Track Drainage, GRP Cover and Details, Sleepers (Drawing)



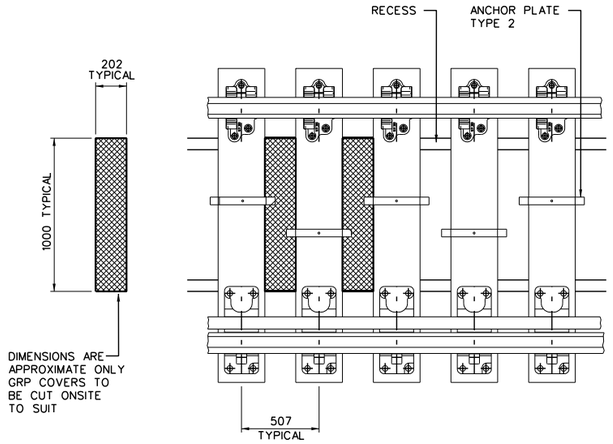
NTF415 SLEEPERS AT 1014mm CENTRES

SCALE 1:20



NTF415 SLEEPERS AT 507mm CENTRES

SCALE 1:20

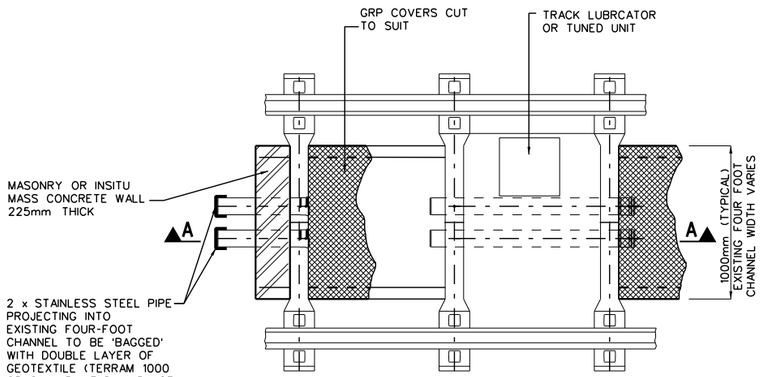


TIMBER SLEEPERS AT 507mm CENTRES

SCALE 1:20

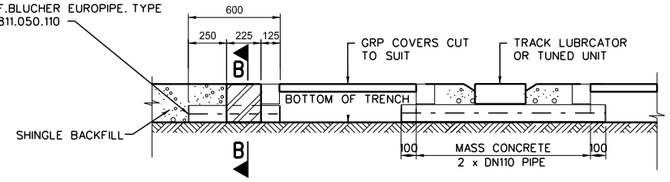
NOTE:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH TRACK SURVEY DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
6. THE CONTRACTOR SHALL CARRY OUT A VISUAL INSPECTION OF ANY EXISTING DRAINAGE SERVICES AND SUBMIT THE RESULTS TO THE PROJECT MANAGER BEFORE WORKS COMMENCE.



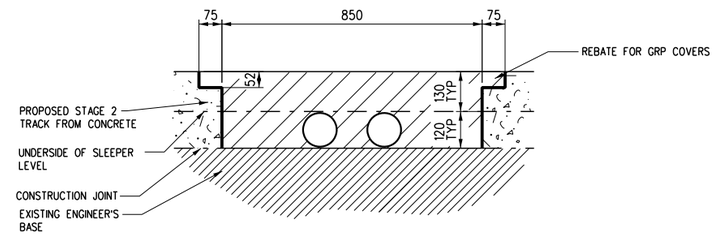
PLAN

SCALE 1:20



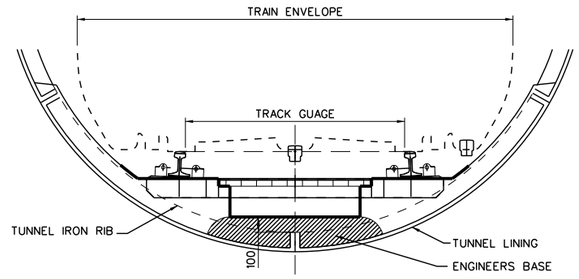
SECTION A-A

SCALE 1:20



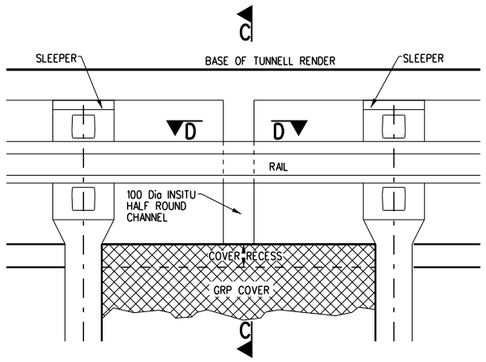
SECTION B - B
TRANSITION DETAIL FOR INTERFACE BETWEEN OPEN CHANNEL AND SHINGLE-FILL CHANNEL

SCALE 1:10



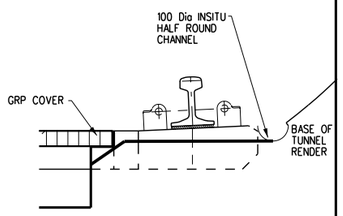
TYPICAL TUNNEL SECTION

SCALE 1:20



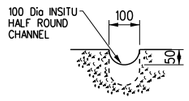
HALF ROUND CHANNEL PLAN

SCALE 1:10



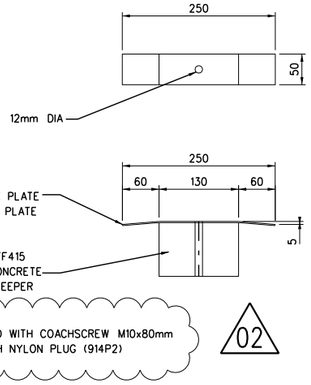
SECTION C - C

SCALE 1:10



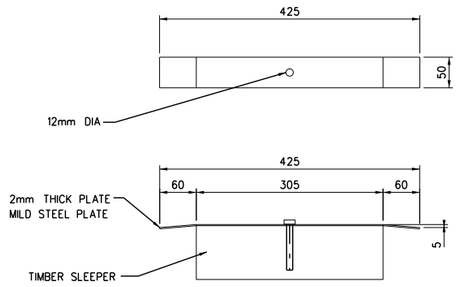
SECTION D - D

SCALE 1:10



TYPE 1 GRP WALKWAY COVER ANCHOR PLATES

SCALE 1:5



NOTE
PLATES FIXED WITH IN COACHSCREW M5sq ½ "x3" (497/6490)

TYPE 2 GRP WALKWAY COVER ANCHOR PLATES

SCALE 1:5

Rev	Date	Description	
02	30/01/14	NOTE REVISED	IU
01	19/11/13	FOR CONSTRUCTION	IU
Scale at A1		AS SHOWN	
Date	19/11/2013	Drawn JASPAL BHAMBRA	Checked SHAWN DORING
Engineer		Approved IAN UTTLEY	Endorsed

Transport for London
London Underground

Location

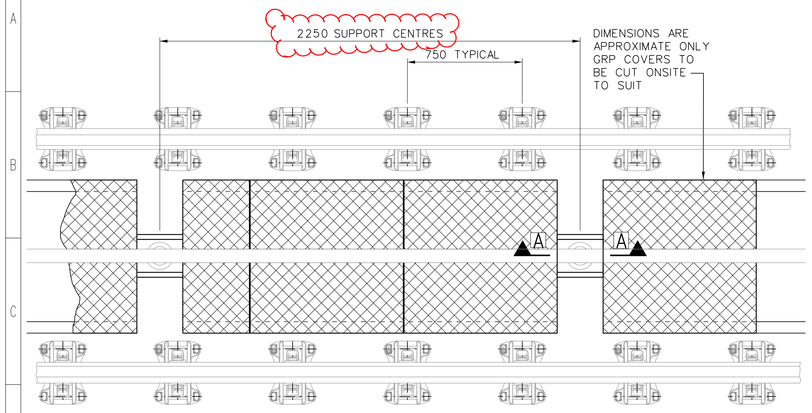
Project
TYPICAL DETAILS

Title
TYPICAL TUBE TRACK DRAINAGE GRP COVER AND DETAILS

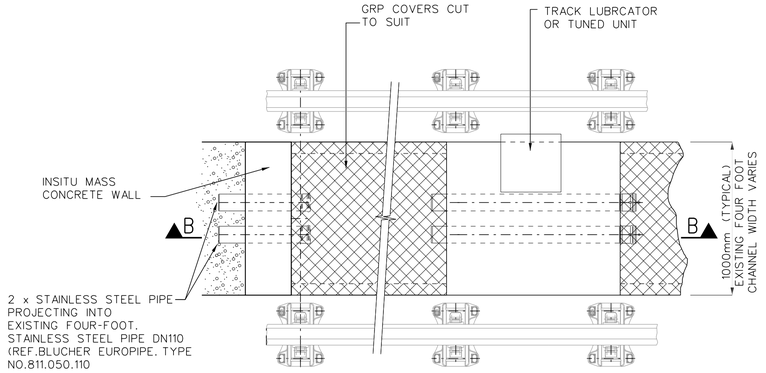
DRAWING NUMBER	REV
PCDT116-DWG-CVL-S001-0000001	02

plot date ******TODAY******

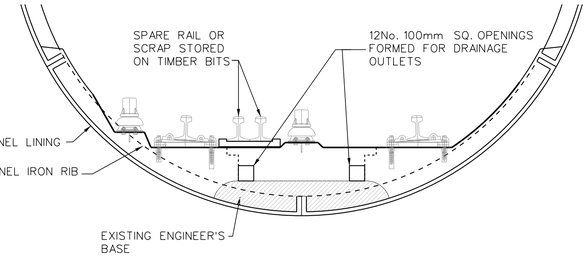
6.4 PCDT1116-DWG-CVL-S001-0000002 - Typical Tube Track Drainage, GRP Cover and Details, Direct Fix (Drawing)



DIRECT FIX LAYOUT
SCALE 1:20



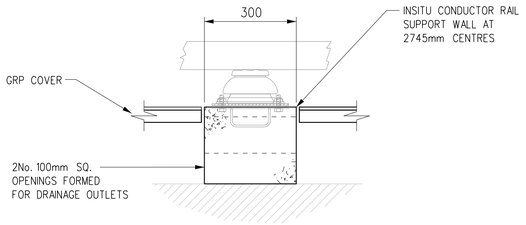
PLAN
SCALE 1:20



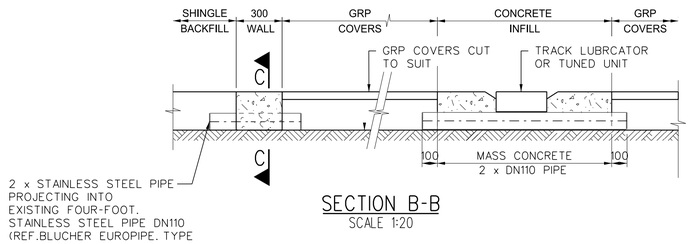
SECTION C - C
SUPPORT WALL
SCALE 1:20

NOTE:

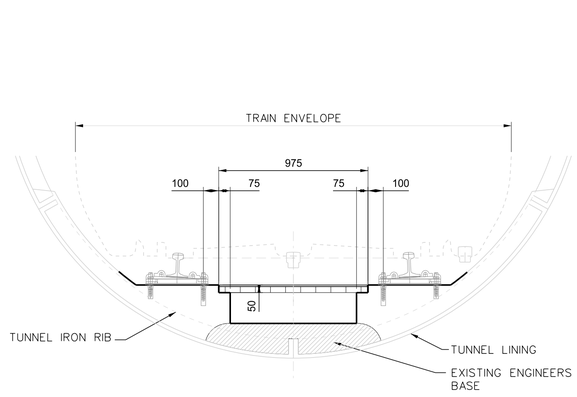
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH TRACK SURVEY DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
6. THE CONTRACTOR SHALL CARRY OUT A VISUAL INSPECTION OF ANY EXISTING DRAINAGE SERVICES AND SUBMIT THE RESULTS TO THE PROJECT MANAGER BEFORE WORKS COMMENCE.



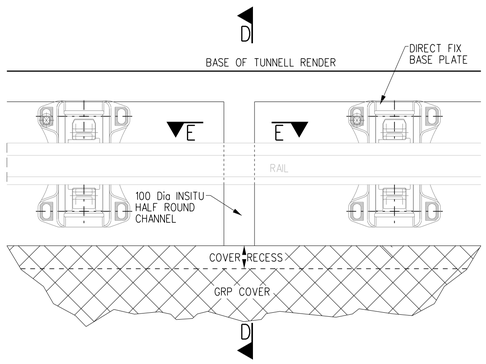
SECTION A-A
SCALE 1:10



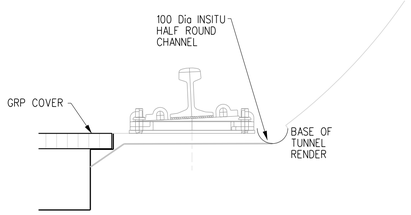
SECTION B-B
SCALE 1:20



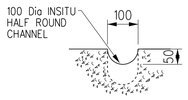
TYPICAL TUNNEL SECTION



HALF ROUND CHANNEL PLAN
SCALE 1:10



SECTION D - D
SCALE 1:10



SECTION E - E
SCALE 1:10

01	22/04/14	FOR CONSTRUCTION	IU
Rev	Date	Description	Eng
Scale at A1	AS SHOWN		
Date 22/04/2014	Drawn JASPAL BHAMBRA	Checked SHAWN DORING	
Engineer	Approved IAN UTTLEY	Endorsed	

Transport for London
London Underground

Location

Project
TYPICAL DETAILS

Title
TYPICAL TUBE TRACK DRAINAGE GRP COVER AND DETAILS DIRECT FIX

DRAWING NUMBER	REV
PCDT1116-DWG-CVL-S001-0000002	01

plot date 22/04/2014 08:33
A1

7.1 Design Compliance Declaration

Template reference	Template file name	Version	Date
F-10579	F-10579	A1	09/10/13

PD reference	PD
PD-10640	Design Compliance Report / Declaration

Programme

Project

Document reference

Design Compliance Declaration

		Signature	Date
Prepared by	<Name> Project Enginer	----------	----------
Approved by	I endorse this deliverable as the designated technical authority for the relevant engineering discipline and am accredited to do so. <Name> Accredited Assurer	----------	----------
Approved by	I confirm that this deliverable meets the requirements of the relevant Pathway Product Description and that all consultation comments have been addressed to the satisfaction of consultees. <Name> Project Manager	----------	----------
Distributed to	<Name>	<Role>	

Document History

Revision	Date	Summary of changes
xx.yy	xx/xx/xx	First draft

Table of Contents

In support of the Railway and Other Guided Transport Systems (Safety) Regulations 2006 and LU Category 1 Standard S1538 Assurance

1 Design and Project Team Declaration

The works to be delivered by this project have been designed in accordance with LU requirements, standards and Railway Safety Principles and Guidance (apart from agreed deviations), and meet the relevant regulations and standards (except for agreed concessions). I hold evidence demonstrating this.

I confirm that this project meets the requirements for assurance documentation specified in LU Category 1 Standard S1538 Assurance

I confirm that sufficient evidence has been provided to assure me that the safety and technical risks associated with the project works have been identified and adequately mitigated and I have "No Objection" with the reviewed design proceeding to Construction.

	Signature	Date
<Name> **Project Manager**	---	---
	Signature	Date
<Name> **Project Engineer [or other competent person with a project wide understanding]**	---	---

2 Project Engineer Endorsement

I confirm that all relevant Accredited Assurers, whose assets are affected by this project, have endorsed this Compliance Declaration of "No Objection"

I confirm that this project has been designed and will be constructed and installed in accordance with applicable LU standards (except for agreed concessions), Railway Safety Principles and Guidance (except for agreed deviations), and other relevant standards. There is auditable documentary evidence demonstrating this design, agreed concessions and deviations.

	Signature	Date
<Name> **Lead Project Engineer**	---	---

7.2 S1011 Product Acceptance and Registration (Cat 1 Std)

Category 1 Standard

S1011 Product Acceptance and Registration

Please read the Written Notices attached to this standard

Issue No.: A2

Issue date: September 2013
Review date: September 2018

MAYOR OF LONDON

Contents

1 Purpose

1.1 The purpose of this Standard is to define the minimum requirements for the acceptance and registration of physical products, processes and services.

1.2 The objective of this Standard is to:-

- Protect LU from unacceptable risk (In this context the risks may relate to safety, service performance, environment and the Company's assets, finance and reputation)
- Provide a consistent and objective basis for the assessment and approval of products, processes and services
- Provide a product acceptance process that is comparable with the system used by the UK national railway in order to assist suppliers and simplify cross acceptance
- Provide a more detailed set of requirements for changes to products related to engineering assets than provided for in the over-arching standard for Assurance S1538

1.3 This standard does not set out a single prescriptive process for Product Acceptance. Each case must be considered on its merits, using a risk based approach. The intention of this standard therefore, is to set out the main principles and minimum requirements for a framework within which products can be assessed for their acceptability for use on the network.

2 Scope

2.1 The requirements set out in this Standard apply to physical products, including components, assemblies, embedded software, firmware and data and systems, and to processes and services which, if not fit for purpose, could expose LU to unacceptable risk. These are referred to collectively as 'Products' throughout this document.

2.2 The requirements set out in this Standard apply in the event of any change to a Product. 'Product Change' is defined as:-

- The introduction of new Products
- Changes to the design, use or maintenance of approved Products
- Changes to the materials or manufacturing process used in the supply of approved Products
- Changes to the supply arrangements of approved Products
- Trials or testing of new products on the railway infrastructure

2.3 This Standard covers the requirements for the:-

- Management of Product Change from the application for acceptance through to approval and registration
- Maintenance of the records associated with Product acceptance
- Management of subsequent changes to approved Products including the provision for the withdrawal of approval
- Essential features of registers for approved Products
- Suppliers of Products and the supply arrangements
- Verification of compliance with limitations or conditions of approval

2.4 There are no restrictions on who can apply to LU for a Product Change to be approved; the 'applicant' may be an LU employee or an external party.

3 Requirements

3.1 General Principles

3.1.1 All Product Changes (as defined in section 2 above) shall be subject to an assessment to determine the following:

- Business justification and commercial acceptability
- Engineering and safety acceptability
- Operational and maintenance readiness

Note:	The scope of the assessment shall be appropriate to the level of potential risk. See section 3.1.11

3.1.2 All applications for Product Change assessment, including those from external parties require a Product Sponsor.

3.1.3 The Product Sponsor shall confirm that there is a requirement for the Product in question.

3.1.4 The Product Sponsor must be an LU employee.

3.1.5 Where the Applicant is an LU employee they may also act as the Product Sponsor for the application.

Note:	The Product Sponsor should not be confused with the 'Sponsor' role in Strategy & Service Development (S&SD). The Product Sponsor can be any LU employee.

3.1.6 All applications must be submitted using the electronic Approved Product Register (see section 3.2).

3.1.7 The Profession Head most relevant to the asset type and its intended use shall make the decision as to whether the Application constitutes a Product Change which requires formal acceptance.

3.1.8 The Product Sponsor shall consult with Commercial and S&SD first, to ensure that any business concerns or opportunities are identified before proceeding with any other aspects of the assessment.

3.1.9 The Profession Head most relevant to the asset type and its application shall lead the remainder of the assessment.

3.1.10 Where the Product Change could reasonably be associated with more than one Profession Head, agreement shall be reached among them for one to take the lead.

3.1.11 Where the Product has multiple uses, the lead Profession Head shall obtain approval from the most relevant Profession Head for each use (i.e. different Profession Heads may approve a single product for different applications/uses). Notwithstanding the number of different approved uses, the Product shall occupy a single entry in the Approved Products Register.

Note: Profession Heads receiving requests to contribute to the assessment of a Product Change must make every effort to provide a suitably competent accredited resource.

3.1.12 The Profession Head shall determine the nature and scope of the assessment, appropriate to the characteristics and potential risk of the Product Change under review. As a minimum, he/she must consider:-

- The credible worst case consequence of the Product Change resulting in a Product that is not fit for purpose
- The probability of the Product Change resulting in a Product that is not fit for purpose, taking into account the novelty, complexity, additionality* and reversibility of the Product Change and the ease, or otherwise, with which an impending failure may be detected and prevented

*Additionality is the amount of change on top of change, as described in the Common Safety Method

Note: Key factors where the level of confidence required is directly proportional to the level of risk include:-

- The competence of the Assessors engaged
- The need for review or independent safety assessment
- The competence of the Supplier
- Assurance relating to the supply arrangements and compliance with any limitations or conditions of approval

To clarify, the lower the risk in terms of impact and probability, the lower the level of assessment required.

3.1.13 The lead Profession Head shall draw up a list of acceptance requirements appropriate to the Product Change. These must include the following:

- instructions on how their achievement is to be measured and/or demonstrated
- demonstration of compliance with relevant Engineering and Safety Standards
- provision of evidence of an appropriate hazard review and risk assessment showing that all credible risks have been identified and that safety risks have either been eliminated or reduced to a level that is tolerable and ALARP
- provision of evidence that the proposed Product Change will not adversely affect the operation of the Railway and that Operational and Maintenance staff are, or will be, equipped with any information, tools, materials and training needed to accommodate the Product Change

Note: Where Products have been used in an equivalent application by other railways or other industries, the evidence of acceptability provided by the other railway or other industry may be used as the basis of the case to demonstrate that the Product is suitable for acceptance by LU.

3.1.14 Where the proposed Product Change involves or affects other asset disciplines, the Professional Head of the lead discipline shall request the Professional

Heads of the other disciplines to define their requirements for acceptance and provide accredited Assessor(s) and/or Reviewer(s).

3.1.15 Products which have been accepted as a result of the assessment process shall be registered in an Approved Product Register (see section 3.2 for the requirements for the register).

3.1.16 Records shall be kept of unsuccessful applications for Product Change.

3.1.17 The decision to approve a Product Change can only be made by a Profession Head or a competent person formally authorised by the Profession Head for the purpose.

3.1.18 The approved status of any Product may be withdrawn at any time by the accountable Profession Head if this is deemed to be in the best interests of LU.

3.1.19 The approval of a Product Change shall always relate to a specific application/use and the Product must be linked to a specific supply chain.

Note:	"Supply chain" refers to the supplier and their supply arrangements for the Product in question. If either the supplier or their sub-contractor supply arrangements change, the approval may no longer be valid

3.1.20 Any request for approval for trials on the LU Network shall include details of the management arrangements and evidence to show that all credible risks have been identified and either eliminated or reduced to a level that is tolerable and ALARP.

3.1.21 All trials involving rail mounted vehicles or plant require a Consent to Test/Trial Report, in accordance with section 3.18 of LU Standard S1538, Assurance.

3.1.22 The process of initially deciding on the need for formal approval and the subsequent acceptance process carried out by the Profession Head must be fully auditable.

3.2 Requirements for Registration

3.2.1 LU shall maintain an electronic Approved Products Register

3.2.2 The register shall be capable of being accessed by parties external to LU as well as internal

3.2.3 LU shall appoint an administrator to manage the Register and control access to it

3.2.4 Approved Products shall be registered with the following minimum level of detail:

- A unique reference number
- Date of original application for approval
- Date of registration
- Name of the authorising Profession Head
- Description of the Product
- Name of supplier
- Specific details of any limitations on the use of the Product

- All evidence submitted in support of the application for approval (test certificates etc.)
- Expiry date (e.g. if any of the evidence on which the approval was predicated has a time limit of any sort, then the Product will require re-assessment after that date)

Note:	The register must make it clear to viewers that the Product is approved for specific applications only. The fact that a Product is 'approved' does not mean it can be used for any application.

3.2.5 The Approved Products Register must be capable of reporting against the following metrics as a minimum:

- Number of new applications per period
- Applications per Discipline (Profession Head)
- Applications against asset type
- Length of time to complete each application
- Outstanding applications awaiting approval and the stage of the process they have reached
- Number of new user account requests per period
- Number of withdrawn Products per period
- Number of completed applications per period
- Number of rejected Products per period

3.2.6 The Approved Product Register must be capable of producing a formal Certificate of Acceptance for each approved Product Change.

3.3 Failure to Agree on Acceptability

3.3.1 Where the parties involved in a multi-discipline approval are unable to agree on the acceptability of the proposed Product Change, the Lead Profession Head must either reject the proposal or submit an explanatory note requesting a decision to:-

- The LU Director of Engineering, where the dispute relates to technical matters and is solely between Engineering disciplines.
- DRACCT, where the dispute involves other Directorates.

3.4 Rejection

3.4.1 Where it is decided that the proposed Product Change is to be rejected, the Profession Head must ensure that the reasons for rejection are justified and that auditable records are available to support this decision.

3.4.2 Where approval is withdrawn on the grounds of safety, existing LU/TLL procedures must be used to communicate the change of status of the Product and the actions required to ensure the immediate and ongoing control of safety risk.

4 Roles & Responsibilities

4.1 Applicant

4.1.1 The Applicant is responsible for submitting the electronic Application form and for providing information as required by the Product sponsor

4.1.2 The Applicant may be internal staff or an external party. Where the applicant is an external party, it must be the manufacturer of the product or their authorised agent.

4.2 Product Sponsor

4.2.1 The Product Sponsor is accountable for confirming that there is a business requirement for the Product in question.

4.2.2 The Product Sponsor is accountable for providing sufficient information to enable LU to decide whether the application should be assessed and subsequently to progress the assessment to its conclusion.

4.2.3 The Product Sponsor shall agree the information requirements with the relevant Profession Head.

4.2.4 Where the acceptance requirements specify that trials are to be conducted on the LU Network the Product Sponsor is accountable for making all of the arrangements for the trials and for obtaining approval from the Lead Assessor for the trials to proceed.

4.3 Profession Head

4.3.1 The relevant Profession Head (depending on the asset type) shall make the decision as to whether an Application constitutes a Product Change which requires formal approval.

4.3.2 The relevant Profession Head shall be responsible for carrying out the role of Approver (see 4.8).

4.3.3 The relevant Profession Head shall also be responsible for fulfilling the Lead Assessor role, either directly or by providing suitably accredited resource.

4.3.4 Where Product Changes involve or affect more than one asset discipline, the Profession Heads concerned must agree who will lead the acceptance process.

4.3.5 The Profession Head has overall accountability for ensuring that appropriate acceptance requirements are defined for all Products within their discipline.

4.3.6 The Profession Head has overall accountability for ensuring that all applications for the acceptance of Product Changes are subject to an appropriate assessment. In discharging this accountability the Profession Head must ensure that the competence and level of independence of the assessors is appropriate for the nature and risk of the Product Change under consideration.

4.3.7 The Profession Head responsible for the approval of a Product Change is accountable for determining what, if any, assurance is required regarding compliance with any limitations or conditions attached to the approval and for ensuring that this assurance is obtained. This accountability shall be discharged through the use of a risk based verification activity plan meeting the requirements of LU Standard S1538.

4.4 Strategy & Service Development (S&SD)

4.4.1 The relevant asset sponsor in S&SD shall be consulted to define the acceptance requirements for the Business aspects of new Products and,

where appropriate, other Product Changes. These requirements shall include compliance with any relevant Business Standards.

4.5 Commercial

4.5.1 Commercial shall be consulted to ensure that any relevant commercial considerations are taken into account when defining the Business acceptance requirements.

4.6 Lead Assessor

4.6.1 The Lead Assessor shall co-ordinate all parties involved in defining the acceptance requirements and undertaking the assessment of proposed Product Change.

4.6.2 The Lead Assessor shall ensure that assessments are undertaken in a logical sequence which optimises the use of available resources and enables early termination of the process should it become evident that the proposed Product Change under consideration is unacceptable.

4.7 Product Register Manager

4.7.1 The Product Register Manager is responsible for overall administration of the Register, setting up users accounts etc., uploading information and producing reports as required

4.7.2 The Product Register Manager is also responsible for ensuring that the Applicant and Product sponsor are advised of approval decisions and for giving access to the relevant details of the assessment should this be requested.

4.8 Reviewer

4.8.1 The Reviewer shall determine Engineering and Safety acceptability and of Operational and Maintenance readiness based on the evidence supplied by the Assessors.

4.9 Approver

4.9.1 The Approver shall take ultimate responsibility for approving or rejecting the Product Change based on the evidence provided by the Assessor and/or Reviewer.

4.10 Manufacturer / Supplier

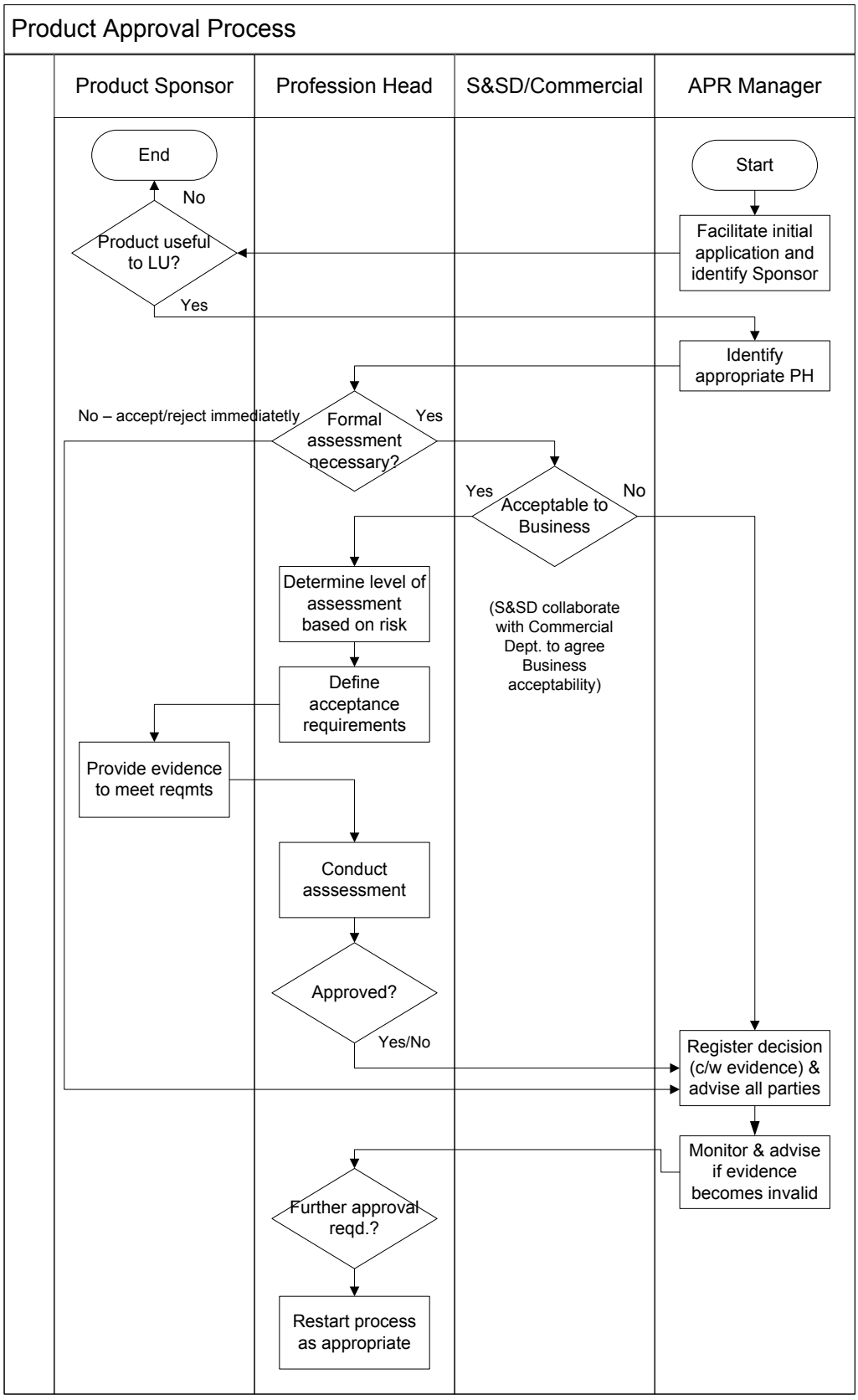
4.10.1 The supplier of the product is responsible for the provision of information and evidence as required by the Product Sponsor to support the assessment.

4.10.2 Where the supplier is also the applicant, the responsibilities of Applicant, as defined in 4.1, apply.

4.10.3 Suppliers are also responsible for notifying LU of any changes to previously approved products, where those changes fall within the definition of Product Change as described in 2.2.

5 Supporting information

5.1 Flowchart



5.2 Reference Documents

5.2.1 LU Company Documents

Document no.	Title
S1538	Assurance

5.3 Abbreviations

The following abbreviations are created:

a) within London Underground's Glossary of Terms (1-622) (a Category 1 Standard);
b) from published sources that are clearly identified.

Abbreviation	Definition	Source
LU	London Underground	a
S&SD	Strategy & Service Development (LU Directorate)	a

5.4 Person accountable for the document

Person accountable for the document
John Park - Head of Engineering Information

5.5 Document history

Issue no	Date	Changes	Author
A1	February 2010	First issue	Jon Jones
A2	September 2013	Revised to incorporate the full Product assessment process and updated requirements for registration. Also, change to the title (previously titled "Registration of Products") as per DRACCT No. 02051.	John Park

6 Current Written Notices attached to this standard

Written Notice No	Issue Date	Written Notice Title
LU-WN-01248	23/01/2014	Enhanced Capital Allowances
LU-WN-01386	06/11/2015	Separate products shall be singularly and separately recorded in the Products Register (APR) according to the manufacturer's product classification taxonomy

Written Notice	**LU Ref. No.:** LU-WN-01248 Version 2
	Suppliers Ref. No.:

1	**Written Notice Completed By**	
	Person Accountable	John Park
	Directorate	CPD
	Date Issued	04/02/2015
2	**Details of the standard Requiring Clarification**	
	Title:	Product Acceptance and Registration
	Standard Reference No.	S1011
	Issue No.	A2
	Clause/Paragraph No.:	3.5 (New Clause to include the Energy Technology List and the Water Technology List)
3	**Details of Definitive LU Interpretation of Requirements**	
	Title of Written Notice	Enhanced Capital Allowances

Preference shall be given to the specification of Products that are included on the Government's **Energy Technology List** (ETL) or the **Water Technology List** (WTL) over those that are not. This is because investment in these Products allows London Underground to apply to Her Majesty's Revenue and Customs (HMRC) for an Enhanced Capital Allowance (ECA), in order to reclaim 19% of the Product cost (including transport and installation).
The Energy Technology List can be browsed using the following link:
https://etl.decc.gov.uk/etl/site.html

The Water Technology List can be browsed using the following link:
http://wtl.defra.gov.uk/product_search_landing.asp?section=66&itemTitle=Product+Search&gclid=CKydroXTs7YCFUnMtAodW3IA_Q

The following categories of technology are not detailed on the ETL, but TfL may still be able to make a claim for an Enhanced Capital Allowance provided that a certificate of compliance with the ECA criteria is obtained from the supplier.

- Lighting
- Pipework insulation
- Component automatic monitoring & targeting equipment

In order to claim ECAs in respect of a combined heat & power cell (CHP), manufacturers themselves must undertake a certification process to obtain the necessary certificates from the Department of Energy and Climate Change (DECC).

The fact that a Product is listed on the Energy Technology List or the Water Technology List is evidence that the DECC have determined the Product to be energy-efficient. Choosing energy-efficient products helps TfL make the business savings required by the Mayor of London.

ETL Products registered on the Approved Product Register shall be identifiable as such.
Projects wishing to specify a non ETL-listed Product where a similar ETL listed Product is available must submit a business case at Pathway Gate 3.

Written Notice	**LU Ref. No.:** LU-WN-01386
	Suppliers Ref. No.:

1	**Written Notice Completed By**	
	Person Accountable	John Park
	Directorate	CPD
	Date Issued	06/11/2015
2	**Details of the standard Requiring Clarification**	
	Title:	Product Acceptance and Registration
	Standard Reference No.	S1011
	Issue No.	A2
	Clause/Paragraph No.:	3.1
3	**Details of Definitive LU Interpretation of Requirements**	
	Title of Written Notice	Separate products shall be singularly and separately recorded in the Products Register (APR) according to the manufacturer's product classification taxonomy

The following sub clause is to be added to Clause 3.1

For the avoidance of doubt, separate products shall be singularly and separately recorded in the Products Register (APR) according to the manufacturer's product classification taxonomy. This should correspond with their individual BIM objects where they exist or are yet to be developed. This is to support London Underground's requirement to manage specific attribute data (e.g. enhanced capital allowances, embedded carbon, energy-related performance, et cetera) for each individual product across its assets.

7.3 S1052 Civil Engineering – Gravity Drainage Systems (Cat 1 Std)

Category 1 Standard

S1052 Civil Engineering - Gravity Drainage Systems

Issue No.: A4

Issue date: September 2011
Review date: September 2016

MAYOR OF LONDON

Contents

1 Purpose

1.1 The purpose of this Standard is to define the life cycle requirements for gravity drainage system assets in performance terms.

1.2 This standard also covers hydraulic and structural design of internal and external building gravity drainage systems (foul and surface water - including roof drainage). It should be noted that buried drainage assets are generally designated as Civil assets and non-buried drainage as Premises assets (except pump drainage assets which are also generally designated as Civil assets).

1.3 Standards for pumped drainage systems are given in London Underground (LU) Standard 1-056.

1.4 In defining requirements specifically applicable to gravity drainage system assets, this Standard complements LU Standard 1-050 that defines mandatory requirements generally applicable to all Civil Engineering assets including gravity drainage system assets.

1.5 A supporting Manual of Good Practice G-052 gives guidance and information specific to LU gravity drainage system assets.

2 Scope

2.1 This standard applies to new and rehabilitated gravity drainage system assets (foul and surface water) owned by LU as part of the following drainage systems:

a) Track and off-track gravity drainage systems (*surface water only*).
b) Stations, depots and other operational buildings gravity drainage systems (*foul and surface water*).
c) Other gravity drainage systems (*foul and surface water*).

2.2 This Standard defines the responsibilities involved during the life cycle of the assets and sets out the requirements for:

a) Design
b) Construction
c) Maintenance (*including Inspection and Assessment*)
d) Decommissioning

2.3 This Standard should be read in conjunction with *LU Technical Specification T0001 Civil Engineering – Track and Off-track Gravity Drainage Systems* and any relevant site-specific application of the National Building Specification (NBS) (*in relation to Stations, Depots and other operational buildings gravity drainage systems)* by the Premises team. The aforementioned specifications state the generic and site-specific materials and workmanship LU requirements.

2.4 This Standard also covers flood protection requirements to LU assets.

3 Requirements

3.1 Design

3.1.1 General

3.1.1.1 The inception and design of works to gravity drainage system assets shall ensure that the assets meet their *Required Duty*.

Note:	The *Required Duty* for Gravity Drainage System assets is as follows:
1	**Meet railway operating requirements (*within the performance specification at system installation or at the most recent system upgrade*).**
1.1	Maintain inherent structural integrity (*support itself so as not to suffer complete or partial collapse*).
1.2	Maintain the ability to carry any permitted applied static and dynamic design loads without restriction.
1.3	Allow adequate clearance to ensure the safe passage of rail vehicles.
1.4	Operate without risk of blockage or failure to minimise the risk of flooding or disruption to railway operations.
1.5	Provide sufficient hydraulic capacity to convey the flow requirements.
1.6	Provide appropriate access and egress for all planned uses, and for reasonably anticipated emergency uses (*including Maintenance*).
1.7	Sustain a Condition and state so as not to cause unplanned interruption to, or restriction of, any aspect of the operating railway.
2	**Ensure support at asset interfaces without undue wear and tear.**
2.1	Minimise the degradation of all interfacing assets (*e.g. as evidenced through Maintenance cycles*). This includes interfaces with the railway and adjacent infrastructure, e.g. track, structures, stations and premises.
3	**Match LU policy in respect of realistic user perceptions.**
3.1	Ensure pumping and gravity drainage systems collect, convey and discharge their content without undue degradation to interfacing assets, disruption to railway operations, unacceptable environmental nuisance, or risk to the health and safety of passengers, employees and members of the general public.
4	**Provide resistance against external interference and events.**
4.1	Provide a drainage system which minimises the likelihood and consequence of asset abuse. Asset abuse encompasses vandalism, damage due to external events, etc.
5	**Present acceptable environmental impact.**
5.1	Provide an acceptable societal environmental impact (*including adverse weather management, outfalls, toxicity, public health, odours, etc.).*
5.2	Protect receiving waters from pollution (*within statutory limits*).
6	**Minimise environmental impact throughout lifecycle.**

6.1	Minimise environmental impact and demands at all stages in the asset lifecycle; this includes effects now and in the future, including successive refurbishment, final decommissioning, and disposal routes.
7	**Function within the legal and standards framework.**
7.1	Ensure the asset functions within the framework defined by legislation (*including environmental legislation*), regulatory guidance, standards (*including LU and applicable National, European & International standards*), and LU policies.
8	**Ensure safe operation as defined by LU.**
8.1	Ensure safe operation and Condition as specified by LU requirements; this includes passengers, employees and members of the general public.
8.2	Ensure safe access/egress by passengers, employees, general public and emergency services (*in planned and reasonably anticipated emergency scenarios*). Appropriate access/egress shall be provided for Maintenance purposes.
8.3	Safeguard the health and safety of passengers, employees and members of the general public.
9	**Provide above within reliability and availability targets.**
9.1	Meet all aspects of the *Required Duty* within the defined LU requirements.
10	**Ensure Required Duty is performed without incurring excessive or prohibitive costs.**

3.1.1.2 An holistic approach to the design and construction of new and rehabilitated gravity drainage systems shall be adopted. Designs shall conform to the principles of *Whole Life Asset Management.*

3.1.1.3 LU supports the use of Sustainable Drainage Systems (SuDS) and a statement justifying the extent of their employment shall be made in the CDS for the work (*in accordance with the relevant assurance process*). Relevant technical requirements are given in Clause 3.1.2.

3.1.1.4 Appropriate pollution control measures shall be designed within LU gravity drainage systems. They shall comply with current statutory requirements *and* best practice. In particular, reference shall be made to the CIRIA publication *C643 The potential for water pollution from railways.*

3.1.1.5 Only materials which meet the requirements of the current version of LU Category 1 Standard *1-085 Fire Safety Performance of Materials*, in respect of flammability, smoke emission and toxic fume emission shall be used in Sub-surface Railway areas, shafts and tunnels (*both bored tunnel and cut & cover tunnel forms*).

Note:	The use of solid-walled polyethylene pipes (*for Track and Off-track Drainage*) in the above context are the subject of two specific and mutually exclusive concessions. These are concession references CR03003 and CR05565, which are a matter of record and are explained in more detail within the LU Technical Specification T0001.

3.1.1.6 Gravity drainage system designs shall be approved by the *Professional Head (Pumps and Drainage)* through the relevant assurance process, in accordance with LU Category 1 Standard 1-538 Assurance.

Conceptual Design Statements (CDS) shall be produced and approved (*prior to the commencement of detailed design*) in accordance with the requirements of LU

Standard 1-538 and the relevant specific requirements for drainage CDS's set out in LU Manual of Good Practice G-052.

3.1.1.7 Each chamber asset shall be equipped with a Radio-frequency Identification (RFID) tag and a plate displaying its unique identification number. Refer to LU Technical Specification T0001 for materials and workmanship requirements associated with these items.

3.1.1.8 Permanent access provision within drainage chambers (*i.e. step irons and/or ladders)* is generally not required unless the designer has sound engineering reasons for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*).

3.1.1.9 New discharges to Public Sewers require the agreement of the Sewerage Undertaker and (*in the case of surface water and groundwater discharges*) can only be made subject to approval of the drainage system by the SuDS Approving Body under the Flood and Water Management Act 2010.

Note: Existing surface water and groundwater discharges to Public Sewers should either be the subject of an existing agreement with the Sewerage Undertaker under the Water Industry Act 1991, or be covered by existing 'prescribed' rights under the relevant Railway Act.

LU sewers and lateral drains are exempt from adoption (by relevant sewerage undertakers) under The Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 regardless of whether such sewers and drains are within railway land or not.

3.1.1.10 The Design Life of drainage assets shall be in accordance with Table 3.1.1.1.

Drainage asset	Design life
Drainage assets (*unless stated otherwise*)	60 years
Pipes and chambers made from hydrocarbon-based materials e.g. High Performance Polyethylene (HPPE); and CIPP lining systems.	40 years
Pipes and chambers made from non hydrocarbon-based materials e.g. clay, concrete, masonry, etc.	100 years
Chamber covers and gratings	20 years

Table 3.1.1.1 – Design Life of Drainage Assets

3.1.1.11 LU maintains a Products Register (http://www.lu-apr.co.uk); only products appearing on that register may be incorporated into the works. Should a supplier or contractor wish to use a product not on the register then special approval from the LU *Professional Head (Pumps and Drainage)* will need to be sought and granted before it can be incorporated in to the works. The product shall then be submitted for formal approval and entry on to the Products Register as soon as practicable thereafter.

3.1.1.12 Pipes passing beneath tracks ('*under-track crossings' (UTX's)*) shall be carrier drains, i.e. imperforate pipes.

UTX's shall generally cross perpendicular to the tracks, but where this isn't possible the length of the UTX shall be minimised.

Note: In the vicinity of points and crossings, where Track Drainage in the six-foot may pass beneath the crossing, it is acceptable for the pipe asset between chambers to transition from filter drain to carrier drain part way along its length. The carrier drain section shall be appropriately positioned beneath the sleepered zone. Bedding,

surround and trench backfill details shall conform to the relevant LU Technical Specification T0001 requirements.

3.1.1.13 Drainage system access points (*e.g. chambers*) shall have internal plan dimensions, clear opening plan dimensions and sump depths that are appropriate for the maintenance regime applied to the drainage system concerned.

3.1.2 Track and Off-track Gravity Drainage Systems (Open Track Sections)

3.1.2.1 Location of drainage systems

3.1.2.1.1 Unless there is a sound engineering reason for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*) and subject to the exceptions stated in sub-Clause 3.1.2.1.2, appropriate positive drainage shall be provided in the following positions:

a) In one side Cess only on single-track lines (*including between platforms*).
b) In both side Cesses on two-track lines.
c) In both side Cesses and between adjacent pairs of tracks (*i.e. in the 'Ten Foot' zones*) on lines with four or more tracks. (*Thus, for example, on a six-track line there would be four drains, one in each of the two side Cesses and one in each of the two 'Ten Foot' zones.*).
d) In the 'Six Foot' if the side Cesses are unavoidably obstructed or insufficient.
e) Off-track Drainage shall be provided as required, to convey track formation and earth structure surface water runoff to a suitable discharge point.

3.1.2.1.2 Omission of positive drainage

3.1.2.1.2.1 Positive drainage may not be required in the positions listed in sub-Clause 3.1.2.1.1 if the following conditions are *all* met:

a) The overlying *and* underlying geology in the side Cesses and 'Ten Foot' zones is sufficiently free-draining, as to permit compliance with the hydraulic design performance criteria stated in sub-Clause 3.1.2.3.4 through infiltration.
b) The prevailing groundwater level during its seasonal high is at least 2m below the apex of the track formation.
c) The absence of positive drainage is considered *not* to have a long term detrimental impact on track formation stability. This point shall be agreed with a competent Geotechnical Engineer.

3.1.2.1.2.2 Irrespective of the overlying and underlying geology, positive drainage shall always be provided at vertical alignment low points within cuttings, where there is an implicit risk of flood water accumulating. Such drainage provision may be localised at the geometric low point but shall be designed to ensure compliance with the hydraulic design performance criteria stated in sub-Clause 3.1.2.3.4. Pumped drainage solutions may need to be considered in such locations (*refer to LU Category 1 Standard 1-056 Civil Engineering – Pumping Systems*).

3.1.2.1.2.3 Unless there is a sound engineering reason for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*), track drainage is not usually provided in the side Cesses of lines on embankment unless it is as carrier drainage to convey non-embankment flows to a remote outfall.

3.1.2.1.3 Depots and sidings areas

3.1.2.1.3.1 Where it is impracticable to meet the requirements of sub-Clause 3.1.2.1.1 or where it gives rise to excessive or prohibitive cost, and subject only to the content of

sub-Clause 3.1.2.1.2, alternative drainage locations may be considered following an assessment of the associated risks (*including any implications for maintenance operations*) and provision of any appropriate mitigation measures.

The assessment of such risks and any mitigation proposals shall accompany the CDS and/or DDR (*Detailed Design Report*) for approval under the relevant assurance process.

3.1.2.1.4 Location of access points

3.1.2.1.4.1 Track and off-track filter gravity drainage systems shall generally have access chambers positioned at intervals no greater than 30m and at all other positions where good engineering design demands them. Such chambers shall be catchpit chambers designed to capture and permit the removal of suspended solid debris.

This maximum spacing may be increased if the proposed maintenance regime supports it (*e.g. high pressure jetting as opposed to manual rodding*) and the strategy has been presented in the CDS or DDR for approval under the relevant assurance process.

3.1.2.1.4.2 It may not be possible to achieve the interval between chambers of no greater than 30m in the vicinity of points and crossings. Under these circumstances chambers should be sited on either side of the points or crossing but as close together as it is practicable to place them.

If the closest distance that can be achieved is greater than 45m, then additional measures to ensure future maintainability shall be considered within the design and be presented in the CDS and/or DDR for approval under the relevant assurance process.

3.1.2.2 Hydrological and hydrogeological parameters

3.1.2.2.1 The time of entry for track filter gravity drainage systems shall be selected by the designer based on the specific catchment characteristics, but generally within the range 30 to 45mins. Selection of values outside this range shall be justified within the CDS for the work (*in accordance with the relevant assurance process*).

3.1.2.2.2 Runoff coefficients assumed in the design of gravity drainage systems accepting surface water shall be selected by the designer based on the site specific surface treatment, underlying geology and topography.

3.1.2.2.3 Subject only to the requirements of sub-Clause 3.1.2.2.4, an allowance shall be made for groundwater infiltration (*where groundwater is accepted into the drainage system*) as a base flow in the drainage system (*where it is believed to be hydraulically significant*), which shall be based on the advice of a competent Geotechnical Engineer or Hydrogeologist.

3.1.2.2.4 Where it is possible to measure the actual groundwater infiltration rate at a site, then the measured value shall be used (*for drainage system hydraulic design purposes*) *after* it has been adjusted to allow for any increases likely over the design horizon as a result of structural or hydrogeological changes. The *adjusted* measured value shall then be multiplied by two to yield the design value.

3.1.2.2.5 Unless there is a sound engineering reason for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*), geotextile fabric compliant with LU Technical Specification T0001 shall always be employed as a trench liner in connection with filter gravity drainage systems, to ensure that fines from the adjacent subgrade cannot migrate into the drainage system.

LU requires that the geotextile fabric lining the filter gravity drainage trench be left open at the top of the trench (*see standard details in LU Manual of Good Practice G-052 Civil Engineering – Gravity Drainage Systems*) to permit the migration of ballast fines into the filter gravity drainage system, so that they can be removed during routine maintenance.

Note:	However, recent research (*appended to G-052*) indicates that where track and drainage renewal is happening simultaneously (*or within a reasonably short time of one another*) or in the case of new railway, that there is merit in closing and lapping the geotextile filter gravity drainage trench liner at the top of the trench, to minimise future maintenance requirements. Such proposals shall be detailed in the CDS for the work (*in accordance with the relevant assurance process*).

3.1.2.2.6 Special requirements for trenchless conduit rehabilitation techniques

3.1.2.2.6.1 Where filter gravity drainage systems are rehabilitated using trenchless techniques, the infiltration rate of the existing material above the pipe shall be measured in accordance with the procedure defined in LU Technical Specification T0001. If the existing material has a measured infiltration rate lower than 1 x 10^{-3} m/sec, then it shall be replaced either, completely or, in discrete 'lenses' in accordance with the requirements of LU Technical Specification T0001.

3.1.2.3 Hydraulic design criteria

3.1.2.3.1 General

3.1.2.3.1.1 Hydraulic design shall be undertaken using industry standard hydraulic modelling software capable of carrying out full hydrodynamic unsteady flow analysis, *unless* the gravity drainage system involved is simple and it has been agreed via a CDS and/or DDR (*approved under the relevant assurance process*) that the design can be reliably progressed manually or using less sophisticated software.

3.1.2.3.1.2 The designer shall select the type of drainage system most appropriate for the site under consideration.

The design of gravity drainage systems shall include consultation with Track and Geotechnical disciplines, to establish whether there is a technical requirement for the drainage system to permanently draw-down the groundwater level below the track formation or earth structure (*for the purpose of ensuring that the design life of the asset is achieved*). If such a requirement exists, then the minimum cover depth for the drainage shall be increased over the designated area in line with the technical advice of a competent Geotechnical Engineer or Hydrogeologist.

3.1.2.3.1.3 Pipe roughness coefficients for use in hydraulic design shall be Colebrook-White linear roughness values, selected by the designer based on pipe material and assuming the worst conditions likely to prevail during the design life of the asset.

Channel roughness coefficients for use in hydraulic design shall be Manning's roughness values, selected by the designer based on conduit material and assuming the worst conditions likely to prevail during the design life of the asset.

3.1.2.3.1.4 Conduits shall be designed with a minimum 0.75m/s flow velocity for self-cleansing purposes. However, this value may be reduced to 0.6m/s where there is a significant base flow within a system or where upstream pumping mains provide regular flushing. This minimum flow velocity applies to the design flow (*which is generally a part-full pipe flow*), i.e. not the theoretical pipe-full flow velocity.

It is acceptable to further reduce the minimum flow velocities stipulated above, at the heads of pipe branches, where design flows may be small in comparison to pipe hydraulic capacities as a result of compliance with minimum pipe size requirements.

3.1.2.3.1.5 Gravity drainage systems shall be protected against back flow from receiving third party drainage systems (*including open watercourses*) through the use of engineered solutions.

3.1.2.3.2 Conduit sizing

3.1.2.3.2.1 Pipe and channel sizing (*if required - see sub-Clause 3.1.2.1*) shall be undertaken in accordance with the Modified Rational Method (*published as Volume 4 of the Wallingford Procedure for design and analysis of urban storm drainage by HR Wallingford Ltd.*).

Conduits shall be sized to convey (*without surcharge*) the peak flow generated by the 1 in 5 year return period storm event of critical duration (*i.e. the Critical Storm*).

In the case of improvement works to existing systems where it may impracticable to meet this requirement, *or* where it gives rise to excessive or prohibitive cost, an alternative storm return period may be used for conduit sizing following an assessment of the associated risks (*including any implications for maintenance operations*) and provision of any appropriate mitigation measures.

The assessment of such risks and any mitigation proposals shall accompany the CDS and/or DDR for approval under the relevant assurance process.

3.1.2.3.2.2 The minimum pipe size is 150mm internal diameter.

3.1.2.3.2.3 If a base flow is included within the hydraulic design, then conduits shall be sized such that the base flow is confined to a maximum of half the conduit cross sectional flow area.

3.1.2.3.3 Full hydrodynamic unsteady flow analyses

3.1.2.3.3.1 Hydraulic modelling to prove compliance with the design criteria stated in sub-Clause 3.1.2.3.4, shall be full hydrodynamic unsteady flow analysis. It shall employ design rainfall hyetographs generated in accordance with both of the following methodologies (*i.e. separate model runs shall be undertaken to determine which yields the critical result*):

a) Flood Studies Report (FSR)(*published by the Institute of Hydrology, 1975*), rainfall-runoff method, assuming both *75% winter* and *50% summer storm* profiles.
b) Revitalised Flood Hydrograph (RefH) model using Flood Estimation Handbook (FEH) based hydrology (*published by the Centre for Ecology and Hydrology, 2007*), assuming both *winter* and *summer storm* profiles.

3.1.2.3.3.2 All rainfall hyetographs used for full hydrodynamic unsteady flow analyses shall have 20% added to them (*throughout the hyetograph*) to account for the potential impact of climate change through to year 2085 (*i.e. consistent with the approximate expected life of the drainage system*), in line with guidance in Planning Policy Statement 25 (PPS25) (*published by HMSO, 2006*).

3.1.2.3.4 The hydraulic design criteria to be adopted for *new* and *rehabilitation* works shall be as follows.

Gravity drainage system designed, such that when it is subjected to the critical storm event with a return period of 1 in 50 years, the following criteria are met:

a) The maximum water level generated shall be *no higher* than 50mm below underside of sleeper (*i.e. surcharging of pipes and chambers and specified limited flooding from the system is permitted*) for ballasted track and tube track with shingle-filled channels.
b) For slab track, no flooding of the slab shall occur.

3.1.2.3.5 The voidage available for temporary storage of water within the pipe bedding, trench backfill and track support ballast shall be assessed and a value adopted that will represent the worst case condition over the Design Life of the system.

3.1.2.3.6 Chamber headloss coefficients appropriate for the types of chambers proposed shall be adopted for use within hydraulic modelling software.

3.1.2.3.7 Special requirements for trenchless conduit rehabilitation techniques

3.1.2.3.7.1 Localised Cured In Place Repair (CIPR) systems (*known as 'Patch Repairs' in the WRc Sewer Rehabilitation Manual)* and Cured In Place Pipe lining (CIPP) for making structural repairs to drainage conduits shall be checked to ensure that the liner does not significantly reduce the conduit cross-sectional flow area and that it yields an approximately equivalent theoretical hydraulic flow capacity - due to its improved roughness coefficient.

3.1.2.3.8 Designing for event exceedence

3.1.2.3.8.1 New and rehabilitated gravity drainage system hydraulic designs shall be checked using full hydrodynamic unsteady flow analysis (*in accordance with sub-Clause 3.1.2.3.3)* against the effects of the critical storm event with a return period of 1 in 100 years (+ *climate change allowance as detailed in sub-Clause 3.1.2.3.3.2*), to ensure that excess water can be safely stored on, or conveyed from, LU land without unacceptable adverse impacts.

3.1.2.3.8.2 During the critical storm event with a return period of 1 in 100 years (+ climate change allowance) the developed rate of runoff into a watercourse, or other receiving body of surface water, shall be no greater than the existing rate of runoff for the same event (*designers should make efforts to reduce runoff rates from previously developed sites as close as practicable to the Greenfield runoff rate*). Volumes of runoff should also be reduced wherever possible using infiltration techniques.

3.1.2.4 Structural Design Criteria

3.1.2.4.1 General pipeline structural design

3.1.2.4.1.1 In-trench pipeline structural design shall consider temporary and permanent loading conditions. Design shall be progressed assuming the most critical combination of live and dead loads, in accordance with BS EN 1295-1 and its supporting standard BS 9295.

3.1.2.4.1.2 Pipelines subject to railway live loading shall generally be designed for the Rail London (RL) load condition as defined in LU Standard 1-051. However, where Train Operating Companies (TOC) have operating rights they shall be designed for *BS EN 1991-2 Load Model 71* with an α factor of 1.0 (*this is equivalent to the now superseded BS 5400-2 Type RU loading*).

3.1.2.4.1.3 Pipelines subject to highway live loading shall generally be designed for one of the three loading categories in BS EN 1295-1, i.e. Main Road, Light Road or Field.

3.1.2.4.1.4 In the context of gravity drainage systems adjacent to or beneath railway track, buried conduits shall be designed with a minimum 450mm of cover to crown, measured from underside of adjacent sleeper. Where this is not practical and

shallower conduits must be proposed, they shall be designed such that no mechanical damage can be caused to them by ballast tamping machines.

In the context of gravity drainage systems adjacent to or beneath highway, buried conduits shall generally be designed to comply with industry good practice or the requirements of an adopting authority.

3.1.2.4.1.5 Pipelines not subject to a recognised vehicular live loading condition (*e.g. from railway or highway traffic*) shall generally be designed for a live uniformly distributed load (UDL) of 5kN/m². If there is reason to believe that the asset in question will be subject to loads in excess of the stated UDL during its design life, it shall be designed for the more onerous condition (*for example, LU cable drum loading is taken as a 20kN load distributed over a 300mm x 300mm area*).

3.1.2.4.1.6 Pipelines shall be capable of sufficient articulation such that they can accommodate differential movements caused by irregular normal loading patterns without suffering unacceptable structural distress.

3.1.2.4.1.6 Where pipes are perforated for use as filter drains, any reduction in pipe stiffness due to the perforations shall be taken into consideration in the structural design.

3.1.2.4.2 In-trench rigid pipe structural design

3.1.2.4.2.1 A minimum factor of safety of 1.25 shall be applied within all rigid pipe structural designs.

3.1.2.4.3 In-trench semi-rigid pipe structural design

3.1.2.4.3.1 The maximum permitted pipe ovalisation is 3% of the mean diameter.

3.1.2.4.4 In-trench flexible pipe structural design

3.1.2.4.4.1 The maximum permitted pipe ovalisation is generally 5% of the mean diameter. However, in the case of under track crossings the maximum permitted pipe ovalisation is 3% of the mean diameter.

3.1.2.4.4.2 The minimum factor of safety against buckling failure (*with soil support*) is 2.0.

3.1.2.4.4.3 The minimum factor of safety against buckling failure (*without soil support*) is 1.5.

3.1.2.4.5 Trenchless conduit (including CIPR & CIPP) structural design

3.1.2.4.5.1 Liner structural design shall be progressed in accordance with the German design code ATV-M 127-2 (*published in January 2000 or the subsequent current revision thereof*) assuming *'State III'* (*host pipe fully deteriorated*) in all cases.

Note:	Use of the *WRc Sewerage Rehabilitation Manual* liner structural design procedures are generally not considered appropriate, as they assume the host pipe makes a significant contribution to the composite structure's overall stability. However, subject to approval of a given WRc approach in a CDS under the relevant assurance process, it can be used for design.

3.1.2.4.6 Access chamber structural design

3.1.2.4.6.1 Access chamber structural design shall consider temporary and permanent loading conditions. Design shall be progressed assuming the most critical combination of live and dead loads. Live loading cases shall generally be selected (*as appropriate*) from those in sub-Clauses 3.1.2.4.1.2 to 5. Structural designs shall be progressed from

first principles in accordance with recognised methodologies by a competent Structural Engineer.

3.1.2.4.6.2 Access chambers shall be designed in such a way that changes in rail level (*or other threshold feature*) of +/- 100mm can be accommodated without major reconstruction work to the chamber.

3.1.2.4.6.3 Access chambers shall be designed with conventional flexibly jointed short and rocker pipe arrangements (*irrespective of connecting pipe material*) to permit adjoining pipeline articulation and the accommodation of differential movements.

3.1.2.4.6.4 Access chamber covers, gratings and frames structural design shall be progressed from first principles in accordance with recognised methodologies by a competent Structural Engineer. Unless there is a sound engineering reason for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*), the relevant specific design criteria shall be as follows:

a) Catchpit covers and gratings, and the covers and gratings to shallow chambers generally (*refer to the WRc publication Sewers for Adoption*), shall be removable to give access to the whole plan area of the chamber. Other chambers shall be provided with a minimum 600mm x 600mm clear opening cover or grating and frame.
b) Catchpit gratings shall be designed to minimise the risk of ballast ingress.
c) All chamber covers, gratings and frames shall generally be designed to withstand a UDL of 5kN/m² without deflection exceeding 0.5% of span, unless there is reason to believe that the asset in question will be subject to loads in excess of the stated UDL during its design life. In which case, it shall be designed for the more onerous condition (*e.g. LU cable drum loading or highway loading*).

3.1.2.5 Use of Sustainable Drainage Systems (SuDS)

3.1.2.5.1 LU supports the use of Sustainable Drainage Systems (SuDS), in line with the London Mayor's *London Plan* policy.

3.1.2.5.2 Notwithstanding any statutory requirement to employ SuDS, where such systems and approaches are compatible with the requirements of this standard and are cost-justifiable, they shall be specified.

3.1.2.5.3 The Flood and Water Management Act 2010 establishes *SuDS Approving Bodies* for the approval (*prior to construction*) of all construction works having *drainage implications*. Obtaining such consent is a statutory requirement and shall be complied with.

3.1.2.5.4 The cornerstones of a sustainable drainage philosophy are, control of runoff at source (*in terms of both water quantity and quality*), and the limiting of discharges to no greater than equivalent green field site runoff rates (*in terms of both peak runoff rate and storm volume*). In the first instance this should be achieved through the use of infiltration drainage systems to mirror the existing hydrological cycle as far as possible. However, this is not always possible due to geological, hydrogeological and other site constraints (*for example, proximity to structures*). Therefore, designers shall follow the simple principle of designing outfalls to the following order of priorities:

a) First, to an infiltration drainage system.
b) Second, to a surface watercourse or other body of surface water.
c) Third, to a Public Sewer or private drain.

3.1.2.5.5 The siting of infiltration drainage systems (IDS) shall take due regard of their effects on adjacent structures (*including earth structures*). Consultation with the relevant Professional Head may be required to ensure they are sited at an appropriate distance.

The design return period for IDS's shall generally be in line with the advice contained in CIRIA C697. However, whatever design return period is selected shall not compromise compliance with the hydraulic design criteria in Clause 3.1.2.3. Therefore, the IDS's effects on the contributing gravity drainage system(s) shall be assessed directly (*through explicit inclusion of the IDS in the hydraulic model)* or indirectly (*through application of a suitable stage/time relationship as the downstream hydraulic boundary condition*).

3.1.2.5.6 Notwithstanding any minimum requirements for use of permeable pavements in order to gain consent under the Flood and Water Management Act 2010; wherever it is practicable, in the context of technical considerations and cost, paved areas shall be designed as permeable pavements to minimise surface runoff.

3.1.2.5.7 SuDS shall generally be designed in accordance with the guidance in CIRIA C697: The SUDS Manual.

3.1.3 Track and Off-track Gravity Drainage Systems (Tunnel Sections)

3.1.3.1 Location of drainage systems

3.1.3.1.1 Unless there is a sound engineering reason for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*), appropriate positive drainage shall be provided in the following positions:

a) In the tunnel invert of all bored tunnels (*termed 'Tube tunnel' within the LU business environment*).
b) In the 'Six Foot' on two-track lines in cut and cover tunnels.

3.1.3.1.2 Depots and sidings areas

3.1.3.1.2.1 Where it is impracticable to meet the requirements of sub-Clause 3.1.3.1.1 or where it gives rise to excessive or prohibitive cost, alternative drainage locations may be considered following an assessment of the associated risks (*including any implications for maintenance operations*) and provision of any appropriate mitigation measures.

The assessment of such risks and any mitigation proposals shall accompany the CDS and/or DDR for approval under the relevant assurance process.

3.1.3.1.3 Location of access points

3.1.3.1.3.1 In cut and cover tunnels, track and off-track filter gravity drainage systems shall generally have access chambers positioned at intervals no greater than 30m and at all other positions where good engineering design demands them. Such chambers shall be catchpit chambers designed to capture and permit the removal of suspended solid debris.

This maximum spacing may be increased if the proposed maintenance regime supports it (*e.g. high pressure jetting as opposed to manual rodding*) and the strategy has been presented in the CDS or DDR for approval under the relevant assurance process.

Refer to sub-Clause 3.1.2.1.4.2 for further requirements related to chambers in the vicinity of points and crossings.

3.1.3.1.3.2 In bored tunnels, track and off-track gravity drainage systems shall generally have access points positioned at intervals no greater than 50m to permit rodding of pipework and clearance of accumulated debris.

3.1.3.2 Hydrogeological parameters

3.1.3.2.1 The minimum groundwater infiltration rate into tunnels and shafts (*for use in drainage system hydraulic design*) shall be calculated as 0.1 litre / day / m² of contributing tunnel (*or shaft*), irrespective of tunnel (*or shaft*) type and ground conditions.

Note: The minimum groundwater infiltration rate stated above is fixed at one tenth of the allowable maximum water ingress to tunnels and shafts stipulated in LU Category 1 Standard 1-055 Civil Engineering – Deep Tube Tunnels and Shafts. The applied reduction factor of ten takes account of the fact that the probability of the entire tunnel or shaft surface area displaying a uniform maximum seepage flow (*of 1 litre / day / m²*) is regarded as extremely low and it should not thus affect drainage sump sizing – even in the event of pump failures.

Furthermore, the theoretical peak inflow can be balanced within the designed drainage system sump via the pumping rate to ensure the minimum sump size requirement given in sub-Clause 3.1.3.3.1.7 remains reasonable in the context of tunnels and shafts.

3.1.3.2.2 Where it is possible to measure the actual groundwater infiltration rate at a site, and if it is higher than the minimum value calculated in accordance with sub-Clause 3.1.3.2.1, then the measured value shall be used (*for drainage system hydraulic design purposes*) *after* it has been adjusted to allow for any increases likely over the design horizon as a result of structural or hydrogeological changes. The *adjusted* measured value shall then be multiplied by two to yield the design value.

3.1.3.2.3 Where there is a risk of water ingress to a tunnel or shaft drainage system as a result of the use of fire suppression systems or accidental damage to fire mains and/or water supply pipework, the potential rate of inflow shall be estimated by the designer. If it exceeds the design groundwater flow calculated in accordance with this Clause (3.1.3.2), consideration shall be given to employing it in the design of the tunnel or shaft drainage system. In such cases the assessment of the risk and rationale for the design approach shall be set out in the CDS or DDR for the work (*in accordance with the relevant assurance process*).

3.1.3.2.4 Unless there is a sound engineering reason for adopting a contrary arrangement (*which must be detailed within the CDS for the work in accordance with the relevant assurance process*), geotextile fabric compliant with LU Technical Specification T0001 shall always be employed as a trench liner in connection with filter gravity drainage systems, to ensure that fines from the adjacent subgrade cannot migrate into the drainage system.

3.1.3.2.4 Special requirements for trenchless conduit rehabilitation techniques

3.1.3.2.4.1 Where filter gravity drainage systems are rehabilitated using trenchless techniques, the infiltration rate of the existing material above the pipe shall be measured in accordance with the procedure defined in LU Technical Specification T0001. The measured value shall then be discussed with the *Professional Head* (*Pumps and Drainage*), who shall decide whether further measures to improve the hydraulic path between track formation and rehabilitated pipe are required.

3.1.3.3 Hydraulic design criteria

3.1.3.3.1 General

3.1.3.3.1.1 Hydraulic design shall be undertaken in accordance with sub-Clause 3.1.2.3.1 and the contents of this Clause (3.1.3.3).

The requirements of sub-Clause 3.1.2.3.1.4 shall generally be complied with in respect of minimum flow velocities for self-cleansing purposes. However, in connection with existing tunnel structures having inverts or base slabs, it may not be possible to comply as the conduit gradient will largely be driven by the tunnel vertical geometry, such a scenario is acceptable when it has been detailed in the CDS or DDR for the work and approved under the relevant assurance process.

3.1.3.3.1.2 Foul and surface water flows originating from stations shall not be routed into drainage systems in tunnels. However, there may be existing pumped discharges of surface or ground water into tunnel gravity drainage systems, and these shall be taken fully in to consideration within the hydraulic design (*as an additional flow over and above any design groundwater flow determined in accordance with sub-Clause 3.1.3.2*).

3.1.3.3.1.3 Tunnels and shafts shall be protected against flood risk in accordance with sub-Clause 3.1.6.2.

3.1.3.3.1.4 New positive drainage systems serving external catchment areas shall not connect into tunnel drainage systems.

3.1.3.3.1.5 Where an existing positive drainage system serving an external catchment, is *already* connected into an existing tunnel drainage system (*as its point of discharge*), and either one of those existing systems is subject to an improvement design, the designer shall, in the first instance, aim to hydraulically separate the two systems *and* introduce the level of tunnel flood protection required by sub-Clause 3.1.6.2.

If such a proposal is considered to give rise to excessive or prohibitive cost, it may remain wholly or partially in place following an assessment of the associated risks (*including any implications for maintenance operations*) and provision of any appropriate mitigation measures.

The assessment of such risks and any mitigation proposals shall accompany the CDS and/or DDR for approval under the relevant assurance process.

Notwithstanding the above, any improvement scheme design which features a connection from an external catchment into an existing tunnel drainage system shall take full consideration of the flows generated by the external catchment (*via full hydrodynamic unsteady flow analysis*); which shall be designed to comply with the relevant design criteria in sub-Clause 3.1.2.3.4.

3.1.3.3.1.6 A sump shall be provided in all new shafts, and at any geometric low points in tunnels, in order that pumps can be installed at a later date if necessary. The sump size, *subject to the minimum requirement in sub-Clause 3.1.3.3.1.7,* shall be presented in the CDS and/or DDR for approval under the relevant assurance process.

3.1.3.3.1.7 Sumps in shafts and tunnels shall be sized to store a minimum 48 hours of groundwater infiltration, calculated in accordance with Clause 3.1.3.2 but subject to a minimum practical size of 1m³.

3.1.3.3.1.8 The untreated tunnel invert shall not be used to convey drainage flows. Formed open channels and/or pipes (*typically in granular surround within the formed channel*) shall be installed to convey flows.

3.1.3.3.1.9 Gravity drainage system designs featuring formed open channels filled with coarse graded aggregate but without a pipe in the channel invert may be acceptable, subject to approval of the proposal in a CDS and/or DDR under the relevant assurance process. In this case the designer shall demonstrate that the hydraulic flow capacity through the aggregate-filled channels is sufficient to convey the design peak flow (*calculated in accordance with Clause 3.1.3.2*). Such calculations shall assume a maximum voidage in the aggregate of 10% to allow for future clogging.

Note:	In general, this is only likely to be an acceptable arrangement where there is currently no discernable existing groundwater flow and no history of it.

3.1.3.3.2 Conduit sizing

3.1.3.3.2.1 Subject to the design case identified in sub-Clause 3.1.3.3.1.5 not being applicable and the minimum requirement in sub-Clause 3.1.3.3.2.2, conduit sizing shall be undertaken via simple comparison of the design flow (*calculated in accordance with Clause 3.1.3.2*), with either:

a) The pipe hydraulic capacities given in Tables for the Hydraulic Design of Pipes, Sewers and Channels Volume 1 (*published by HR Wallingford*).
b) Channel hydraulic capacities calculated in accordance with the Manning equation for open channel flow.

The above shall be followed by selection of a conduit with a hydraulic capacity in excess of the design peak flow.

3.1.3.3.2.2 The minimum pipe size is 100mm internal diameter and the minimum channel width is 100mm.

3.1.3.3.3 Full hydrodynamic unsteady flow analyses

3.1.3.3.3.1 Full hydrodynamic unsteady flow analyses will generally *not* be required for the hydraulic design of tunnel gravity drainage systems (*unless the design case identified in sub-Clause 3.1.3.3.1.5 is applicable)* as all system conduits and downstream hydraulic infrastructure shall be sized for conveyance of the design peak groundwater flow.

3.1.3.4 Structural design criteria

3.1.3.4.1 Pipeline structural design shall generally be in accordance with Clause 3.1.2.4.

3.1.3.4.2 Access chamber structural design shall generally be in accordance with sub-Clause 3.1.2.4.6.

3.1.3.5 Use of Sustainable Drainage Systems (SuDS)

3.1.3.5.1 Refer to Clause 3.1.1.3.

3.1.4 Stations, Depots and Other Operational Buildings Gravity Drainage Systems

3.1.4.1 Location of drainage systems

3.1.4.1.1 Gravity drainage systems serving track formation shall generally be in accordance with Clauses 3.1.2.1 and 3.1.3.1 as appropriate.

3.1.4.1.2 The location and provision of other gravity drainage systems shall be determined by the designer in accordance with The Building Regulations and in the context of good engineering practice.

3.1.4.1.3 An effective platform invert drainage system shall be provided to prevent water collecting and stagnating in the invert.

3.1.4.1.4 Linear channel drainage systems, when installed in locations where there may be a direct pedestrian interface, should be designed with pedestrian safety as a primary objective. A heel-safe type of grating shall be used wherever there will be regular traversing of a channel by customers or staff. In locations where traversing is not possible (*e.g. at the back of a platform, adjacent to a wall*) an open dished channel of minimal depth may be considered.

3.1.4.2 Hydrological and hydrogeological parameters

3.1.4.2.1 Gravity drainage systems shall generally be in accordance with Clauses 3.1.2.2 and 3.1.3.2 as appropriate.

3.1.4.2.2 Groundwater infiltration rates in to structures *other than tunnels and shafts*, for use in design, shall be quantified in consultation with a competent Geotechnical Engineer or Hydrogeologist.

3.1.4.2.3 Where it is possible to measure the actual groundwater infiltration rate in to structures *other than tunnels and shafts*, then the measured values shall be used (*for drainage system hydraulic design purposes*) *after* it has been adjusted to allow for any increases likely over the design horizon as a result of structural or hydrogeological changes. The *adjusted* measured value shall then be multiplied by two to yield the design value.

3.1.4.2.4 Times of entry for gravity drainage systems not serving track formation shall be selected by the designer based on the specific catchment characteristics.

3.1.4.3 Hydraulic design criteria

3.1.4.3.1 General

3.1.4.3.1.1 The design of gravity drainage systems shall generally comply with The Building Regulations (*typically Approved Documents G & H*), the relevant parts of BS EN 752, BS EN 12056 and this Clause (3.1.4.3). Where conflicts arise, the requirements of this Standard shall take precedence.

3.1.4.3.1.2 Hydraulic design of foul drainage systems (*as distinct from sewer systems [refer to BS EN 752, Clause 9.4.2]*) shall be in accordance with the following:

a) Drains shall be designed to achieve a flow velocity of 1.0m/s at the design flowrate.
b) The design waste water flowrate shall be calculated in accordance with BS EN 12056-2 and assuming a frequency factor (K) for *'congested use'*.

3.1.4.3.1.3 Foul and surface water shall be conveyed in separate systems.

3.1.4.3.1.4 Gravity drainage systems serving track formation shall generally be designed in accordance with Clauses 3.1.2.3 and 3.1.3.3 as appropriate.

3.1.4.3.1.5 The requirements of sub-Clause 3.1.2.3.7 shall apply in respect of CIPR and CIPP trenchless conduit rehabilitation techniques.

3.1.4.3.1.6 If the points of access, egress or other threshold from a station, depot or other operational building connect to LU tunnel and shaft assets then the tunnels and shafts shall be protected against the risk of inundation from pluvial, fluvial and tidal flood events in line with the requirements of sub-Clause 3.1.6.2 and the following sub-Clause.

3.1.4.3.1.7 At the entrances to stations there are requirements for *Mat Wells* and *Secure Gates*. Where flood protection devices are also required these shall be designed to work in conjunction with the other requirements and be integral with the prevailing architecture.

3.1.4.3.2 Gravity drainage systems accepting surface water

3.1.4.3.2.1 Design shall generally be in accordance with the requirements of sub-Clause 3.1.2.3.1.

3.1.4.3.2.2 Conduit sizing shall be in accordance with the following:

a) In accordance with paragraph 1 of sub-Clause 3.1.2.3.2.1.
b) Above ground roof drainage elements shall be sized to convey (*without surcharge*) the peak flow from the critical storm with a return period determined in accordance with BS EN 12056-3, National Annex NB.
c) Conduits draining platforms and other public areas (*not including areas accessible to vehicles – like station car parks, etc.*) shall generally be sized to convey (*without surcharge*) the peak flow generated by the 1 in 50 year return period storm event of critical duration (*i.e. the Critical Storm*). If this criterion is considered to give rise to excessive or prohibitive cost, then alternative design proposals may be considered following an assessment of the associated risks (*including any implications for maintenance operations*) and provision of any appropriate mitigation measures. Such proposals shall be presented in the CDS and/or DDR for approval under the relevant assurance process.
d) Minimum conduit sizes shall generally be determined by the designer in the context of good engineering practice.

3.1.4.3.2.3 Full hydrodynamic unsteady flow analyses shall be in accordance with the following:

a) Sub-Clauses 3.1.2.3.3.1 & 2, 3.1.2.3.6 & 3.1.2.3.8.
b) The hydraulic design criteria to be adopted for new *and* improvement works shall be as follows:
    I. Gravity drainage systems serving platforms and other public areas (*not including areas accessible to vehicles – like station car parks, etc.*), designed such that when they are subjected to the critical storm event with a return period of 1 in 50 years, no attenuation of flow occurs at surface level (*as a result of drainage system inadequacy*) prior to their entry into the drainage system and no flows are ejected from the drainage system.
    II. Gravity drainage systems serving areas accessible to vehicles (*e.g. station access roads and car parks, etc.*) designed such that when they are subjected to the critical storm event with a return period of 1 in 30 years, no attenuation of flow occurs at surface level (*as a result of drainage system inadequacy*) prior to their entry into the drainage system and no flows are ejected from the drainage system.

3.1.4.4 Structural design criteria

3.1.4.4.1 General

3.1.4.4.1.1 The structural design of buried gravity drainage system elements shall generally be in accordance with Clause 3.1.2.4, subject only to the following additional requirements.

a) Access chamber covers, gratings and frames shall generally be designed to withstand LU cable drum loading (*20kN load distributed over a 300mm x 300mm area centred mid-span*), without deflection exceeding 0.5% of span, unless there is reason to believe that the asset in question will be subject to even higher loads during its design life. In which case, it shall be designed for the more onerous condition.
b) Where pipework penetrates through structures and differential movement is possible, special measures shall be employed to permit the pipeline to accommodate the predicted movement.

3.1.4.4.1.2 The structural design of above-ground gravity drainage system elements shall generally be in accordance with the relevant manufacturer's guidance.

3.1.4.5 Use of Sustainable Drainage Systems (SuDS)

3.1.4.5.1 Refer to Clause 3.1.1.3.

3.1.5 Other Gravity Drainage Systems

3.1.5.1 Culverted watercourses and watercourse crossings

3.1.5.1.1 Watercourse culverts intended to convey natural catchment flows across LU land shall be hydraulically and structurally designed in accordance with the requirements of the responsible regulatory authority (*Environment Agency, Inland Drainage Board, Highways Agency, SuDS Approving Body, etc.*).

Designs shall ensure that the residual risks to LU assets are maintained ALARP (*As Low As Reasonably Practicable*) and shall be presented in a CDS and/or DDR for approval under the relevant assurance process.

3.1.5.1.2 Where watercourses (*including concentrated overland pluvial flows*) cross LU land (*or the railway crosses a floodplain*), the critical 1 in 50 return period flood event peak water level (*at the crossing location*) shall be no higher than 50mm below underside of sleeper (*or in the case of slab track – it shall not flood the slab*) as a minimum criterion, applicable to pluvial, fluvial and tidal flood risks.

Where it is possible to comply with this criterion through changes to track geometry or hydraulic improvements to a culvert or flood plain, the design shall aim to do so - *assuming* it does not result in excessive or prohibitive costs.

3.1.5.1.3 In all cases the proposals shall be the subject of a risk assessment; the results of which shall accompany the CDS and/or DDR for approval under the relevant assurance process.

3.1.5.2 Public Sewers and water supply mains

3.1.5.2.1 Public Sewers and water supply mains crossing LU land shall be hydraulically and structurally designed by the owner organisation and shall be presented in a CDS and/or DDR for approval by LU under the relevant assurance process.

Works sponsored by external parties shall comply with the requirements of LU Category 1 Standard 1-023 Infrastructure Protection.

3.1.5.2.2 Risks to LU assets as a result of Public Sewer or water supply main structural failure or system hydraulic overload shall be assessed to ensure they are maintained ALARP. The results of that risk assessment shall accompany the CDS and/or DDR for approval under the relevant assurance process.

3.1.5.3 Land drains, ditches and other open channels

3.1.5.3.1 General

3.1.5.3.1.1 Land drains, ditches and other open channels may be required to act as:

a) Cut-off Drainage.
b) Toe Drainage.
c) Slope Drainage.

3.1.5.3.1.2 The structural design of gravity drainage system elements shall generally be in accordance with Clause 3.1.2.4.

3.1.5.3.1.3 Land drains, ditches and other open channels shall not connect in to Track and Off-track drainage systems. Where this is not possible *or* where it is considered to give rise to excessive or prohibitive cost, then alternative design proposals may be considered following an assessment of the associated risks (*including any implications for maintenance operations*) and provision of any appropriate mitigation measures.

The assessment of such risks and any mitigation proposals shall accompany the CDS and/or DDR for approval under the relevant assurance process.

3.1.5.3.2 *Cut-off Drainage*

3.1.5.3.2.1 Cut-off Drainage is generally employed where there is a requirement to intercept surface water flows arising as a result of the topography of adjacent land. The principal scenario for their use in the context of railway infrastructure is as follows.

At the crest of cuttings and tops of retaining walls, to hydrologically isolate track or other drainage catchments during their design events and to promote earth structure and retaining wall structural stability through the prevention of erosive flows and/or increases in pore water pressure (*as a result of accumulated surface water*).

3.1.5.3.2.2 Cut-off Drainage shall (*in the first instance*) be hydraulically designed to the same design requirements as the track gravity drainage system it is protecting - in order to avoid cross-catchment flows during the track drainage critical design event. If this is not possible, then the track gravity drainage system hydraulic design shall take cross-catchment flows into consideration.

If such drainage is hydraulically connected into the track gravity drainage system then it shall be designed as part of the track gravity drainage system.

3.1.5.3.3 Toe Drainage

3.1.5.3.3.1 Toe Drainage is generally employed where there is a requirement to promote earth structure and retaining wall structural stability through the control of pore water pressure, i.e. groundwater (*which may be arising locally as a result accumulated surface water or generally as the pre-existing water table*).

They shall typically be land drains (*filter drains*), and the principle scenario for their use in the context of railway infrastructure is at the toe of embankments and retaining walls, to promote structural stability through the control of pore water pressure.

3.1.5.3.3.2 Toe Drainage shall be hydraulically designed to accommodate the steady state groundwater infiltration rate (*i.e. the long term rate of inflow after initial draw-down phase*), which shall be confined to a maximum of half the conduit cross sectional flow area. The design flow shall be calculated by a competent Geotechnical Engineer or Hydrogeologist.

If such drainage is hydraulically connected into the track gravity drainage system then it shall be designed as part of the track gravity drainage system.

3.1.5.3.3.3 Toe Drainage systems may have a *small* theoretical contributing topographical catchment area (*typically: part of the track formation atop the embankment and the embankment side slope*). However, it will typically not be necessary to hydraulically design the drainage system conduits for surface water flows from those catchments - since the short term attenuation of surface water at the toe of an embankment is not typically a structurally compromising factor. The drainage system would typically eliminate such attenuated flows within minutes of the occurrence of their peak volume.

3.1.5.3.4 Slope Drainage

3.1.5.3.4.1 Slope Drainage is generally employed where there is a requirement to control pore water pressure, i.e. groundwater, in the slopes of structural earthworks.

They shall typically be Counterfort or Herringbone land drains (*filter drains*) connected to Toe Drainage or possibly to Track Drainage (*via positive piped interconnection or by continuity of granular filter material*), and the principle scenario for their use in the context of railway infrastructure is within the slopes of cuttings and embankments, to promote structural stability through the control of pore water pressure.

3.1.5.3.4.2 Slope Drainage shall be hydraulically designed to accommodate the steady state groundwater infiltration rate (*i.e. the long term rate of inflow after initial draw-down phase*). The design flow shall be calculated by a competent Geotechnical Engineer or Hydrogeologist.

If such drainage is hydraulically connected into the track gravity drainage system then it shall be designed as part of the track gravity drainage system.

3.1.5.3.5 Structure drainage

3.1.5.3.5.1 Structure drainage systems include *back-of-wall* drains, weep holes, etc., and are generally applicable to retaining structures and are specified by a Structural Engineer.

Structure drainage takes various forms, including (*but not limited to*) the following:

a) A porous pipe in no-fines concrete surround.
b) A perforated pipe in unbound granular surround, with either the pipe or the trench protected against the ingress of fines via use of an appropriate geotextile membrane.

The primary function of structure drainage is to prevent an increase in hydrostatic pressure at the rear faces of structures through the interception of groundwater.

3.1.5.3.5.2 Structure drainage shall be hydraulically designed in accordance with the principles set out for toe drainage in sub-Clause 3.1.5.3.3.

3.1.1.4 Use of Sustainable Drainage Systems (SuDS)

3.1.5.4.1 Refer to Clause 3.1.1.3.

3.1.6 Flood Protection

3.1.6.1 Flood risk management

3.1.6.1.1 Where proposed works alter the all-sources (*pluvial, fluvial, tidal, sewers, water supply mains, etc*.) flooding risk to existing LU assets, the Flood Mitigation Project (FMP) archive shall be examined and the available data reviewed.

The flood risk estimate shall then be revised (*if necessary*), based on the proposed changes (*or if a completely new asset, a new entry shall be made in the archive*). The FMP archive is owned by the LU *Professional Head of Civil Engineering.*

3.1.6.1.2 Throughout all stages of a Project and at completion, the all sources flooding risk to LU assets shall be maintained ALARP and this shall be demonstrated within the CDS or DDR for the work under the relevant assurance process.

3.1.6.2 Flood protection design criteria

3.1.6.2.1 Tunnels and shafts (*including fan, relief, pump, cable and intervention, etc*.) shall be protected against the risk of inundation from pluvial, fluvial and tidal flood events with a return period of 1 in 200 years (*and in the case of the first, assuming an additional 30% for climate change through to the year 2115; in the case of the second, assuming an additional 20% for climate change through to the year 2115; in the case of the third, assuming an additional 15mm/year through to the year 2115, but applied in line with Planning Policy Statement 25, Annex B, published by HMSO 2010).*

The pluvial and fluvial climate change allowances shall be added throughout the rainfall hyetographs, which shall be generated in accordance with both of the methodologies stated in sub-Clauses 3.1.2.3.3.1 a) & b), (*i.e. separate model runs shall be undertaken to determine which yields the critical result*).

3.1.6.2.2 In the first instance, such protection against inundation shall be provided by inherently safe passive measures (*i.e. measures not requiring intervention*), such as elevating the relevant threshold above the predicted flood level (*plus an additional 300mm of freeboard*). If such measures are not possible or are considered to give rise to excessive or prohibitive cost, then alternative protection measures and/or a reduction in the level of flood protection may be considered by presenting them in a CDS and/or DDR for approval under the relevant assurance process.

3.1.6.2.3 Under all scenarios the residual flood risk shall be demonstrably ALARP and this shall be presented in the CDS or DDR for the work under the relevant assurance process.

3.2 Construction

3.2.1 General

3.2.1.1 The construction phase activities and requirements are generally covered by statutory, advisory and other LU requirements. The principle publications are as follows (*but the list is not exhaustive*):

a) Construction (Design and Management) Regulations 2007
b) The Project Management Framework (PMF)
c) LU Category 1 Standard 1-552 Contract QUENSH Conditions

d) LU Category 1 Standard 1-050 Civil Engineering – Common requirements
e) LU Category 1 Standard 1-021 Works near mains services and structures
f) BS EN 1610 Construction and testing of drains and sewers
g) BS EN 12889 Trenchless construction and testing of drains and sewers
h) LU Technical Specification T0001

3.2.1.2 The testing and commissioning of new and rehabilitated Track and Off-track gravity drainage systems and of Land Drainage shall be in accordance with the relevant requirements of LU Technical Specification T0001.

3.2.1.3 New and rehabilitated gravity drainage system conduits shall meet the WRc Structural and Serviceability Grade 1 criteria prior to bringing into use.

This shall be determined via CCTV survey in accordance with the current edition of the WRc Model Contract Document for Sewer Condition Inspection, and analysed in accordance with the current edition of the WRc Manual of Sewer Condition Classification.

3.2.1.4 Testing of drainage systems serving Stations, depots and other operational buildings may be required to be witnessed by an accredited Building Control Inspector.

3.3 Maintenance (*including Inspection and Assessment*)

3.3.1 General

3.3.1.1 Maintenance work shall be undertaken to ensure assets meet their Required Duty for the Design Life of the asset.

3.3.1.2 Assets that fail to meet their Required Duty shall have restricted operation imposed and/or be scheduled for replacement or improvement work.

3.3.1.3 Maintenance work shall comply with BS EN 752 and the WRc Sewerage Rehabilitation Manual.

3.3.1.4 Maintenance work shall be preventative or remedial action; including repairs to damage and defects.

3.3.1.5 Maintenance work shall be programmed using the principles of whole life cycle asset management.

3.3.1.6 A process shall be operated to control cutting, grinding, drilling, fixing to and supporting from existing structures in accordance with LU Standard 1-050.

3.3.1.7 Maintenance action shall be based on inspection reports, hydraulic and structural analytical assessments (*where required*) and condition assessments.

3.3.2 Standards of Cleanliness

3.3.2.1 Track and Off-track gravity drainage systems

3.3.2.1.1 Cleaning of Track and Off-track gravity drainage system assets shall be in accordance with the relevant requirements of LU Technical Specification T0001.

3.3.2.1.2 After cleansing of chambers, their walls shall be free of any dirt or debris. Catchpit sumps shall have an average depth of silt not exceeding 12mm. Benched chamber inverts and benching shall be free of any dirt or debris and the invert shall be free flowing.

3.3.2.1.3 After cleansing of pipes or other conduits, it shall be possible to pull a scraper through the asset, chamber to chamber, without accumulating any silt. Scrapers shall have a profile 12mm less than the internal profile of the asset being tested.

3.3.2.1.4 After cleansing of ditches, they shall:

a) Be clear of vegetation other than trees and short grass growing on the banks.
b) Be completely free of litter, debris and waste.
c) Have an invert falling at an even gradient and which lies a minimum 75mm below the invert of the connecting pipes and culverts.
d) Be in a free flowing condition.

3.3.2.2 Station, depot and other operational buildings gravity drainage systems

3.3.2.2.1 *Buried* gravity drainage system assets shall be treated as *Track and Off-track Drainage* for the purpose of cleansing performance standards, unless a separate bespoke *National Building Specification* exists, which shall take precedence.

3.3.2.2.2 *Non-buried* gravity drainage system assets shall be cleaned in accordance with recognised industry protocols and good practice, unless a separate bespoke *National Building Specification* exists, which shall take precedence.

3.3.2.3 Other gravity drainage systems

3.3.2.3.1 Other *buried* gravity drainage system assets (*including land drains and open channels & ditches*) shall be treated as *Track and Off-track Drainage* for the purpose of cleansing performance standards, unless a separate bespoke specification exists, which shall take precedence.

3.3.2.3.2 *Non-buried* gravity drainage system assets shall be cleaned in accordance with recognised industry protocols and good practice, unless a separate bespoke specification exists, which shall take precedence.

3.3.3 Inspections

3.3.3.1 Inspections (general)

3.3.3.1.1 Inspections shall be undertaken for the following purposes:

a) To provide information necessary for the Maintenance strategy for gravity drainage system assets in accordance with ALARP principles.
b) To confirm that drainage assets are safe for railway operations and for public and Outside Party use.
c) To provide the necessary information to meet the requirements for the Asset Condition Assessment and Certification (ACAC) process.
d) To provide information enabling the Asset Register to be maintained as an accurate record of the drainage assets.

3.3.3.1.2 Any usage or defect which might place at risk the operational railway, passengers, staff, or the public shall be identified, immediately made safe (*if possible*), recorded and brought to the immediate attention of the Fault Reporting Centre (FRC).

3.3.3.1.3 Prior to carrying out an inspection, previous inspection reports, drawings and other relevant information relating to the assets to be inspected shall be reviewed.

3.3.3.1.4 The LU Asset Register shall be reviewed and updated as part of the inspection reporting process.

3.3.3.1.5 Inspection reports shall be retained for the life of the asset.

3.3.3.1.6 Inspections shall be carried out in accordance with the relevant requirements of LU Technical Specification T0001.

3.3.3.2 Types of Inspection

3.3.3.2.1 General Inspections

3.3.3.2.1.1 General Inspections shall be a visual inspection of chambers and other non-conduit assets that brings to notice deterioration in Condition or visible development of defects.

3.3.3.2.1.2 General Inspections shall be of sufficient quality to detect and report any visual changes since the last inspection, and evidence of circumstances which may impact on the Condition of the asset before the next scheduled inspection.

3.3.3.2.1.3 General Inspections shall employ appropriate proforma for each asset sub-type. Examples of acceptable proforma are provided in LU Manual of Good Practice G-052 Gravity Drainage Systems.

3.3.3.2.1.4 All General Inspections shall review the individual asset sub-components in the context of quality and safety.

3.3.3.2.1.5 A list of assets to be inspected and an annual schedule of inspections shall be created and maintained.

3.3.3.2.1.6 The schedule of inspections shall take account of any works that impact on the Condition of the drainage assets.

3.3.3.2.1.7 The General Inspection report shall:

a) Confirm that the examination has been completed.
b) List any significant defects which have occurred or worsened, or changes which have occurred since the last inspection.
c) Identify whether there is a need for further investigations or other.

3.3.3.2.2 CCTV Inspections

3.3.3.2.2.1 CCTV Inspections shall be carried out on buried pipework and other buried drainage conduits (*unless it is impossible to do so by virtue of the asset's cross section or alignment*) and shall comply with the requirements of the WRc Model Contract Document for Sewer Condition Inspection, and be analysed in accordance with the current edition of the WRc Manual of Sewer Condition Classification.

3.3.3.2.2.2 CCTV Inspection video footage shall be included in the Inspection Report as coded inspection data in accordance with the current edition of the WRc Manual of Sewer Condition Classification. All CCTV surveys shall be recorded in an appropriate digital format and be entered in to a digital library / database for future reference within LU.

3.3.3.2.2.3 Personnel undertaking the CCTV Inspections shall hold the appropriate qualification from Develop Solutions Ltd. (*or other equivalent* provider) in the survey procedure, the interpretation of CCTV images of drains and in defect coding & classification.

3.3.3.3 Inspection frequency

3.3.3.3.1 A list of assets to be inspected and an annual schedule of inspections shall be created and maintained.

3.3.3.3.2 The frequency of inspections shall be consistent with timely identification of defects and deterioration such that railway safety is not compromised.

3.3.3.3.3 The frequency of inspection shall be as given in Table 1.

Gravity drainage asset type	Frequency of inspection	
	Normal	Max*
Stations (and other operational buildings) drainage assets:		
General Inspections of chambers and other non-conduit assets	2 years	5 years
CCTV inspections of pipes and other drainage conduits	3 or 10 years***	20 years**
Track and Off-track drainage assets:		
General Inspections of chambers and other non-conduit assets	2 years	5 years
CCTV inspections of pipes and other drainage conduits	3 or 10 years***	20 years**
Depots and sidings drainage assets:		
General Inspections of chambers and other non-conduit assets	5 years	10 years
CCTV inspections of pipes and other drainage conduits	20 years	N/A
Toe Drainage and Cut-off Drainage assets:		
General Inspections of chambers and other non-conduit assets	2 years	5 years
CCTV inspections of pipes and other drainage conduits	3 or 10 years***	20 years**

** Maximum permissible frequency if current Asset Condition Assessment Classification is 'A' and reactive maintenance costs are minimal.*

*** In addition to the above, the maximum permissible frequency applies if the drain is not defined as a Critical Drain and its current Asset Condition Assessment Classification is 'D' and reactive maintenance costs are minimal. This relates to the fact that non-Critical Drains cannot deteriorate beyond a 'D' classification, so further survey work has little value.*

**** 3 year frequency applies if the drain is defined as a Critical Drain and the current Asset Condition Assessment Classification is 'C' or worse (including 'Grey D'), unless a risk assessment determines that more frequent inspections are required.*

In the case of brick drains, the frequency of inspection should be assessed using quantified risk assessment techniques and worst case deterioration rates.

Table 3.3.2.1 - Inspection frequency

3.3.4 Surveys

3.3.4.1 Line and level surveys

3.3.4.1.1 Line and level surveys shall provide LU with an accurate record of their gravity drainage system assets.

3.3.4.1.2 Surveys shall be executed and output provided to LU in accordance with LU Technical Specification T0001.

3.3.4.2 Flow monitoring surveys

3.3.4.2.1 Flow monitoring surveys shall provide LU with data related to an existing gravity drainage system's hydraulic performance.

3.3.4.2.2 Surveys shall be executed and output provided to LU in accordance with LU Technical Specification T0001.

3.3.5 Hydraulic analytical assessment

3.3.5.1 An hydraulic analytical assessment of the existing gravity drainage system should be considered, if any of the following three circumstances apply:

a) When a significant proportion of the drainage assets within the existing gravity drainage system require improvement work.
b) When there is a history of significant flooding events within a catchment served by the existing gravity drainage system.
c) When a gravity drainage system is exhibiting significant hydraulic deficiencies that require detailed investigation, including a history of development of wet-beds (*when they are not linked to life-expired track support ballast*).

3.3.5.2 The purpose of hydraulic analytical assessment is to objectively review the gravity drainage system hydraulic performance against the design standards in Clauses 3.1.2 to 5, and against the *Required Duty* for each individual asset within the drainage system under consideration.

The results shall be used to determine whether improvement work should be proposed to the gravity drainage system as a whole.

3.3.5.3 Hydraulic analytical assessments shall comply with the following:

a) They shall involve construction of an hydraulic model of the gravity drainage system using industry standard hydraulic modelling software capable of carrying out full hydrodynamic unsteady flow analysis, *unless* the gravity drainage system involved is simple and it has been agreed that the analysis can be reliably progressed manually or using less sophisticated software.
b) The model construction and subsequent hydraulic analysis shall generally be carried out in accordance with the relevant parts of Clauses 3.1.2.2 & 3.1.2.3, 3.1.3.2 & 3.1.3.3 and 3.1.4.2 & 3.1.4.3 as appropriate for the site in question. Excepting that the Clauses mentioned are principally written to cover design of new gravity drainage systems. Therefore, the representation of drainage assets within the hydraulic model shall be of the existing gravity drainage system assets *in their current configuration & condition* and the *full hydrodynamic unsteady flow analysis* shall examine a range of return periods and storm durations (*for the various specified hydrological approaches to rainfall hyetograph generation including climate change allowance*) in order to determine (*as far as it is possible to do so*) the following:
    I. The return period and critical storm duration associated with first system surcharge (*i.e. hydraulic gradient above the soffit of the pipe at any point in the system*).
    II. The degree of system surcharge (*if any*) occurring during the 1 in 5 year return period storm event of critical duration.
    III. The return period and critical storm duration associated with first system flood (*i.e. hydraulic gradient above system cover levels*), including the predicted peak flood level and the duration of flooding.
    IV. The degree of system flooding (*if any*) occurring during the 1 in 50 year return period storm event of critical duration, including the predicted peak flood level and the duration of flooding.
    V. The likely location of flood water accumulation. This may or may not coincide with the point of ejection of flow from the gravity drainage system, as it will largely be a product of topography.

3.3.6 Structural analytical assessment

3.3.6.1 A structural analytical assessment of an existing individual gravity drainage system asset (*e.g. a pipe, a catchpit, other special chamber, etc.*) should be considered if the asset is a *Critical Drain* and is considered to be potentially sub-standard in some way that may affect its structural performance.

Note:	It is expected that structural analytical assessment will not typically be required for assets already displaying signs of structural distress, since these will be identified during routine inspections and appropriate remedial action and/or risk assessment will be undertaken in the normal way.

3.3.6.2 The purpose of structural analytical assessment is to objectively review an individual gravity drainage system asset structural performance against the design standards in Clauses 3.1.2 to 5, and against the *Required Duty* for each individual asset within the drainage system under consideration.

The results shall be used to determine whether the individual gravity drainage system asset in question should be replaced or improved.

3.3.6.3 Structural analytical assessments shall comply with the following:

a) Assets shall be structurally analysed from first principles in accordance with recognised methodologies by a competent Structural Engineer.
b) The Capacity Ratios (*factors of safety*) against all pertinent failure modes shall be calculated and presented in the assessment report.
c) The Structural Engineer's view of residual service life shall be presented in the assessment report.

3.3.7 Condition assessment and certification

3.3.7.1 This section identifies specific requirements and processes for establishing the Asset Condition Assessment and Certification (ACAC) of gravity drainage system assets in accordance with LU Category 1 Standard 1-031, which shall apply in conjunction with the general requirements for ACAC identified in LU Standard 1-050 for all civil assets.

3.3.7.2 The compliant Asset Condition Assessment and Certification shall be used by LU to create an Asset Condition Report (ACR) compliant with LU Standard 1-042.

3.3.7.3 Condition Assessment and Condition Classification of gravity drainage system assets shall be in accordance with the following protocol (*Gravity Drainage System - Asset Condition Assessment Protocol*). Detailed guidance is offered in LU Manual of Good Practice G-052, summary guidance is offered below.

a) ***Stage 1*** - A desk top study of the asset.
b) ***Stage 2*** - An inspection of the asset on site (*if not already undertaken in line with the requirements of Clause 3.3.3*).
c) ***Stage 3*** - Asset Condition Classification.

3.3.7.4 Gravity Drainage System - Asset Condition Assessment Protocol – Summary guidance

3.3.7.4.1 Stage 1 – Desk Top Study

3.3.7.4.1.1 A desk top study shall be undertaken for all assets. The study shall consider all available information about the asset. In particular, it shall involve review of the current and previous inspection reports.

3.3.7.4.1.2 Where inspections are not carried out on an annual basis, a review of the latest desk top study shall be undertaken on an annual basis, and existing and any new information shall be taken into account during the Stage 3 Asset Condition Classification.

3.3.7.4.1.3 If an hydraulic analytical assessment report exists for the gravity drainage system which an individual asset forms part of, it shall be reviewed as part of the desk study.

3.3.7.4.1.4 If a structural analytical assessment report exists for an individual asset, it shall be reviewed as part of the desk study.

3.3.7.4.2 Stage 2 – Inspections

3.3.7.4.2.1 All assets shall be inspected in accordance with the requirements of Clause 3.3.3.

3.3.7.4.3 Stage 3 – Asset Condition Classification

3.3.7.4.3.1 Following completion of Stages 1 and 2, the Condition Classification of the individual gravity drainage system asset shall be determined by identifying the applicable Generic Concern(s) and corresponding indicative Condition Classification (*A to E2*) given in the Foundation Documents (*which can be found appended to LU Category 1 Standard 1-042 Asset Condition Reporting (ACR)*).

3.3.7.4.3.2 The method of allocating the *Modern Equivalent Asset Value* (MEAV) where more than one Generic Concern applies shall be in accordance with LU Standard 1-031 and the Foundation Documents.

3.3.7.4.3.3 The process of Asset Condition Classification requires professional judgement to be exercised by the assessor. Thus there is not a mandated prescription for Asset Condition Classification grade based on specific General Inspection condition ratings or CCTV Inspection Structural Performance Grades.

However, detailed guidance on typical Asset Condition Classification grades for given condition ratings and Structural Performance Grades is provided in LU Manual of Good Practice G-052.

3.3.7.4.3.4 Where a valid inspection report for an individual asset cannot be obtained, and an accurate Condition Classification (*A to E2*) cannot be made, the following rules shall apply.

a) Assets not defined as Critical Drains shall be recorded as *'Grey A'*.
b) Assets defined as Critical Drains shall be recorded as *'Grey D'*.

3.3.7.4.3.5 Where two or more Generic Concerns are applicable to an asset then the most onerous Condition Classification shall apply (*closest to E2*).

3.4 Decommissioning

3.4.1 General

3.4.1.1 No asset shall be decommissioned without prior approval in accordance with the requirements of 1-538.

3.4.1.2 The design and implementation of decommissioning works shall ensure:

a) The long-term stability of the decommissioned asset is not dependant on Maintenance operations.
b) Railway safety is maintained following decommissioning of the asset.

3.4.1.3 In the first instance, decommissioning of gravity drainage system assets shall take place via complete removal of the asset as it removes residual risk and saves the costs of inspection and maintenance. However, where other methods of decommissioning present a lower overall risk profile to the railway, they shall be considered ahead of complete removal.

Note:	For example, it is common within the industry, for *buried* gravity drainage system assets to be decommissioned via grouting of pipes *in situ* and filling of chambers with suitable material.

3.4.2 Planning and implementation

3.4.2.1 Whether the asset remains accessible following decommissioning or is made redundant shall be decided on the basis of the following:

a) Consultation between the Supplier and LU.
b) Which alternative, together with its method of accomplishment, results in the risk to railway operations being maintained ALARP.

3.4.2.2 If the asset remains accessible following decommissioning, continued inspection and Condition Assessment shall be undertaken in accordance with Section 3.3 of this Standard.

3.4.2.3 Planning and implementation of decommissioning shall generally follow the requirements of Section 3.1 of this Standard.

3.4.3 Interfacing assets and systems

3.4.3.1 The impact of decommissioning on interfacing structures and systems shall be evaluated to ensure that the risks to railway operations associated with all aspects of decommissioning are maintained ALARP.

3.5 Evidence of compliance

3.5.1 Compliance with the requirements of this standard shall be demonstrated to LU by each party contracted to LU. Additionally LU may audit compliance as part of its surveillance regime.

4 Responsibilities

4.1 *The Professional Head (Pumps & Drainage)* shall be responsible for ensuring that a co-ordinated programme of audit and inspection is implemented to ensure compliance with this and other related standards.

4.2 *The Professional Head (Pumps & Drainage)* shall have sole responsibility for this standard.

4.3 *The LU Procurement Agent* shall be responsible for incorporating the requirements of this LU Standard in any contract to which it is relevant and shall stipulate that a programme of audits are implemented by the contractor which ensures that these requirements are complied with. This programme and its results shall be available for verification by the Professional Head (Pumps & Drainage).

4.4 *The Supplier* shall be responsible for incorporating the requirements of this LU Standard in any contract to which it is relevant and shall stipulate that a programme of audits are implemented by the Supplier which ensures that these requirements are complied with.

5 Supporting information

5.1 Background

5.1.1 This Standard is one of a suite of eight (8) Standards which cover the life cycle of Civil Engineering assets. Other Standards in this suite have a bearing on the activities covered by this Standard. In many cases a direct reference to another Standard is given; in other instances the need to refer to another Standard is implied.

5.1.2 The complete suite of Civil Engineering Standards comprises the following documents.

Number	Title
1-050	Civil Engineering – Common Requirements
1-051	Civil Engineering – Bridge Structures
1-052	Civil Engineering – Gravity Drainage Systems
1-053	Civil Engineering – Building and Station Structures
1-054	Civil Engineering – Earth Structures
1-055	Civil Engineering – Deep Tube Tunnels and Shafts
1-056	Civil Engineering – Pump Drainage Systems
1-057	Civil Engineering – Miscellaneous Assets

5.1.3 The following Manuals for Good Practice have also been prepared to give guidance and explanation for each of the above Standards.

Number	Title
G-050	Civil Engineering – Common Requirements
G-051	Civil Engineering – Bridge Structures
G-052	Civil Engineering – Gravity Drainage Systems
G-053	Civil Engineering – Building and Station Structures
G-054	Civil Engineering – Earth Structures
G-055	Civil Engineering – Deep Tube Tunnels and Shafts
G-056	Civil Engineering – Pump Drainage Systems
G-057	Civil Engineering – Miscellaneous Assets

5.2 Safety considerations

5.2.1 Safety aspects shall be considered throughout all civil engineering activities and due account shall be taken of the *Construction (Design and Management) Regulations 2007*.

5.2.2 Reliable gravity drainage systems are essential for a healthy railway environment and its continued safe operation. Inadequate drainage systems or failure of the installed systems can cause flooding of the station or track areas with surface water or waste water, causing a significant risk to the health and safety of staff and passengers. Flooded areas may need to be decontaminated or closed, adding to the cost of operation or preventing operation of the full service.

5.2.3 Where track drains run below or close to the track itself, collapse or substantial degradation of the drain structure could lead to deformation of the track, threatening

the safe operation of the railway. Structural failure of a chamber or chamber cover may also represent a significant safety hazard.

5.2.4 Risks to safety can also result from minor flows, including seepage into below ground stations, tunnels and shafts that may cause an electrical or slip safety hazard.

5.3 Environmental considerations

5.3.1 Because of the large quantities of water used in connection with LU operations there is considerable potential for waste. All systems should be designed, installed and maintained in a manner which minimises waste.

5.3.2 The use of recovered rain water (*rain water harvesting*) has significant environmental benefits and should be considered where capture and storage is possible.

5.3.3 Sustainability issues are to be considered for the asset life cycle and should include, but not be limited to, energy management and recycling components and materials.

5.3.4 Refer to sub-Clause 3.1.1.3 in connection with Sustainable Drainage Systems (SuDS) and the *Flood and Water Management Act 2010.*

6 References

6.1 References

6.1.1 Statutory documents

Document No.	Title
SI 2007/320	Construction (Design and Management) Regulations 2007
SI 2010/c.29	Flood and water Management Act 2010
SI 2000/2531	The Building Regulations 2000

6.1.2 British Standards

Document No.	Title
BS 5400-2 (superseded)	Steel, concrete and composite bridges - Part 2: Specification for Loads
BS 9295	Guide to the structural design of buried pipelines
BS EN 752	Drain and sewer systems outside buildings – (*all parts*)
BS EN 1295-1	Structural design of buried pipelines under various conditions of loading - Part 1: General requirements
BS EN 1610	Construction and testing of drains and sewers
BS EN 1991-2	Eurocode 1 – Actions on structures – Part 2: traffic loads on bridges
BS EN 12056-1	Gravity drainage systems inside buildings - (all parts)
BS EN 12889	Trenchless construction and testing of drains and sewers

6.1.3 Industry codes of practice

Document No.	Title
ISBN 1898920 39 7	Sewerage Rehabilitation Manual – 4th Edition, WRc 2001
WP5	Wallingford Procedure for design and analysis of urban storm drainage
Hydraulics Research, Wallingford	Tables for the Hydraulic Design of Pipe, Sewers and Channels
CIRIA C697	The SUDS Manual
CIRIA C643	The potential for water pollution from railways
ISBN 978 1 898920 65 6	Sewers for Adoption – A Design and Construction Guide for Developers

6.1.4 LU company documents

Document No.	Title
1-021	Works near mains services and structures
1-031	Asset Condition Assessment and Certification
1-042	Asset Condition Reporting (ACR)
1-085	Fire Safety Performance of Materials
1-538	Assurance
1-551	Contract QUENSH Conditions
1-622	Glossary of terms and abbreviations used in corporate documents
T0001	Technical Specification – Civil Engineering – Track and Off-track Gravity Drainage Systems

6.1.5 Other

Document no.	Title
German design code ATV-M 127-2	Structural analysis for the rehabilitation of sewers by lining and prefabrication methods January 2000
	Flood Studies Report, Institute of Hydrology 1975
	Flood Estimation Handbook, Centre for Ecology and Hydrology 1999
	Planning Policy Statement 25: Development and Flood Risk, Communities and Local Government 2006
	Model Contract Document for short term sewer flow surveys (published by WRc),

6.2 Abbreviations

The following abbreviations are created:

a) within London Underground's Glossary of Terms 1-622;

b) from published sources that are clearly identified.

Abbreviation	Definition	Source
ACAC	Asset Condition Assessment and Certification	a
ACR	Asset Condition Reporting	b
ALARP	As Low As Reasonably Practicable	a
BS	British Standard	a
BS EN	British Standard European Norm	a
CCTV	Closed Circuit Television	a
CIPP	Cured in Place Pipe	b
CIPR	Cured in Place Repair	b
CIRIA	Construction Industry Research and Information Association	a
FMP	Flood Mitigation Project	a
LU	London Underground	a
MEAV	Modern Equivalent Asset Value	a
PMF	Project Management Framework	a
QUENSH	Quality, Environment, Safety and Health	a
SuDS	Sustainable Drainage Systems	b
TOC	Train Operating Company	a
WRC	Water Research Centre	a

6.3 Definitions

Throughout this Standard, certain terms are given first-letter capitalisation (*i.e. they are given honorary 'Proper Noun' status),* to indicate that they have defined meanings within the LU environment. Such terms are defined within LU Standard 1-622 should a user of this Standard wish to refer to them. Only the headline definitions have been included in the table below for convenience.

Term	Definition
Track Drainage	Track Drainage shall be all drainage assets (*including the pipe surround and trench backfill material*) that have been designed to carry water from the track formation and associated earth structures and are within 2 metres of the nearest running rail; but excluding toe drainage, cut-off drainage and *stations, depots and other operational buildings* gravity drainage system assets.
Off-track Drainage	Off-track Drainage shall be all drainage assets (*including the pipe surround and trench backfill material)* that have been designed to carry water from the track formation and associated earth structures and are more than 2 metres from the nearest running rail; but excluding toe drainage, cut-off drainage and *stations, depots and other operational buildings* gravity drainage system assets.
Toe Drainage	Toe Drainage shall be all drainage assets (*including the pipe surround and trench backfill material)* that are located at the toe of an embankment or at the foot of a retaining wall, *and* have been primarily installed to promote structural stability through the prevention of (*both*) surface water accumulation and unacceptable increases in pore water pressure.

Term	Definition
Cut-off Drainage	Cut-off Drainage shall be all drainage assets (*including the pipe surround and trench backfill material)* that are located at the tops of cutting slopes or retaining walls, *and* have been primarily installed to intercept surface water flows arising as a result of the topography of adjacent land, in order to promote structural stability through prevention of (*both*) erosive flows and unacceptable increases in pore water pressure.
Slope Drainage	Slope Drainage shall be all Counterfort, Herringbone or other land drainage installed within the slopes of cuttings and embankments to promote structural stability through the control of pore water pressure.
Critical Drain	All drainage conduits of 400mm internal diameter (*or clear span*) and larger; and any other drainage asset where structural or serviceability failure would result in restrictions to the operational railway, e.g. by track or station closure.

6.4 Technical Content Manager

Paragraph number	Technical content manager
All	Professional Head (Pumps & Drainage)

6.5 Document history

Edition	Date	Changes	Author
1-052 A1	October 2007	Standard 2-01304-003 re formatted and re-numbered to 1-052, no technical changes have been made to the content other than changing references to other Standards where their numbers have changed. Authorised for use. Previous authorisation is valid	
1-052 A2	July 2010	Added 3.7.3, 3.7.4, 3.6.2.5, 3.6.2.6 and Attachment 7.4. Replaced Section 12 references with Sub surface railway stations. Following PPP contract restated terms requirement of standard review, Clauses amended 3.6.2.5, 3.7.3 and 3.7.4 Clause 3.6.2.6 deleted. Authorised for use. Previous authorisation is valid.	
1-052 A3	July 2010	Section 3.6.3 added following review. Written Notices WN00711 and WN00773 incorporated in accordance with PSC S1-01282. Reformatted in accordance with new template.	
S1052 A4	September 2011	Standard completely re-written, renumbered and reformatted as per DRACCT No. 00422	Ian Uttley

7.4 S1085 Fire Safety Performance of materials – Station and Tunnel Infrastructure (Cat 1 Std)

Standard Category 1

S1085 A4 Fire Safety Performance of Materials - Stations and Tunnel Infrastructure

Contents

Please read the written notices attached

1 Purpose

The purpose of this standard is to define the requirements for the fire safety performance of materials, installed on the London Underground (LU) Stations and Tunnel Infrastructure.

The business objective of this standard is to ensure that the risk to which the public and employees are exposed is controlled to a level that is as low as reasonably practicable.

2 Scope

This standard specifies the requirements for materials within all locations as listed in LU Standard S1086 with regard to:

a) Combustibility

b) Smoke emission

c) Toxic fume emission.

Rolling stock shall comply with BS 6853, Category 1a, with the additions as listed in Attachment C.

Note: This standard does not cover the wider aspects of fire engineering. It may be necessary to invoke other London Underground, National or European Standards to cover fully all aspects of fire safety for a particular application. Guidance is available in G085.

2.1 Installations

This standard shall apply to installations:

a) In stations covered by The Fire Precautions (Sub-surface Railway Stations) England Regulations 2009 and LU Standard S1086;

b) In running tunnels;

c) In other locations that are not effectively separated from locations covered by a) or b) above;

d) In all other locations where risks from combustibility, smoke or toxic fumes are not controlled to a level as low as reasonably practicable by other means.

2.2 Separation

Locations will be considered to be ‘effectively separated’ if they are either:

a) completely divided from the relevant stations and/or running tunnels by construction complying with Table 9, and there is no personnel access via that construction or;

b) configured such that it can be demonstrated that the stations/tunnels are adequately protected by means of fire and smoke control, in accordance with the relevant British Standards. This will require the support of a Fire Strategy, prepared, assured and accepted to be in accordance with LU standard 1-080.

3 General Requirements

All tests for combustibility, smoke emission and toxic fume shall be undertaken by test houses accredited by the National Accreditation bodies within the relevant European Union country. A copy of any test reports shall be made available to LU on request.

All materials shall be tested to replicate their intended application, i.e. a panel or surface to be used free-standing, with no backing or substrate, shall be tested in that manner. Similarly, where a panel or coating is to be used on a particular substrate, that substrate shall be used as backing for the sample to be fire tested. If there are direct application rules available, testing of one substrate can be applicable to other substrates (i.e. BS EN 13238).

Note:	Where it is intended to use the material on a number of substrates or in different applications, it may be prudent to consult the testing body so that the desired range of applications can be covered by the minimum amount of physical testing. It is usually appropriate (for assurance purposes) for the relevant test laboratory to issue a report containing a 'Field of application' that defines the allowed use of the material, substance or treatment, in the context of this standard.

3.1 Toxic Fume emission – All products

Toxic fume emissions shall be tested according to the following process:

a) Evidence shall be provided to confirm that all combustible materials do not contain the following elements, which are known to potentially give rise to toxic fume emission: Halogens, Nitrogen, Sulfur. This evidence shall be in the form of qualitative analysis using x ray fluorescence spectroscopy, and the instrument used shall be able to detect elements with atomic numbers down to Nitrogen. All layers of composite materials shall be tested. This test may however be omitted if the tests described in (b) or (c) below are undertaken;

b) If any of the proscribed elements are detected, the potential for toxic fumes to be produced during combustion shall be quantified using either the area based test detailed in Attachment A.2 for surfaces or the mass based test detailed in Attachment A.1. The requirement shall be that the calculated Immediately Dangerous to Life or Health Concentrations (IDLH) level of the gases detected, as detailed in the The National Institute for Occupational Safety and Health (NIOSH) Guide to Chemical Hazards, shall not impair escape, for the intended location or environment.

Note:	The toxic fume test methodology is described in Attachment A of this standard.

c) Paint materials can be tested in accordance with BS EN 45545-2:2013+A1:2015, Method 1. The requirement shall be a maximum Conventional Index of Toxicity (CIT) value of 0.75. Additionally, the parts per million (PPM) values of the detected gases shall be recorded.

d) In cables, only the outer sheathing materials shall be tested for toxic fume emissions when separated by a non-combustible layer (i.e. continuous layers of metal, steel wire armour, steel tape armour, concentric conductors which offer mechanical protection or fire resistant tapes).

3.2 Vertical & ceiling surfaces

3.2.1 Combustibility - walls and ceiling

All public facing vertical wall and ceiling surfaces shall meet the requirements of class B-s1, d0, when tested in accordance with BS EN 13501-1. Alternatively, products shall comply with the requirements of an index of performance (I) not exceeding 12 and sub-index (i_1) not exceeding 6 when tested to BS 476: Part 6 and class 1 to BS 476: Part 7.

3.2.2 Combustibility - other than walls and ceiling (e.g. small panels)

All vertical and horizontal prone surfaces other than walls and ceilings are considered compliant with combustibility requirements if they meet the criteria given above in clause 3.2.1. Alternately, the following tests can also be carried out to demonstrate compliance:

Test Method	Requirement
ISO 5658-2	*CFE* ≥ 20 kWm^{-2} with no flaming droplets/particles
ISO 5660-1: 50 kWm^{-2}	*MARHE* ≤ 60 kWm^{-2}

Table 1 – Combustibility requirements for surfaces other than walls and ceiling

3.2.3 Smoke Emission

Location	Test method	Requirement
Option 1		
Vertical and ceiling surfaces in tunnels	S1085, Attachment B.6	Ao(ON) < 2.4sq.m/burn area Ao(OFF) < 3.6 m^2/burn area
Vertical and ceiling surfaces in stations	S1085, Attachment B.6	Ao(ON) < 3.6 m^2/burn area Ao(OFF) < 5.4 m^2/burn area
Option 2		
Vertical and ceiling surfaces in stations	EN ISO 5659-2: 50 kWm^{-2}, without pilot flame	*a)* *Ds* maximum, dimensionless, ≤150 b) *VOF*4 minutes ≤ 300

Table 2 – Smoke emission requirements for all vertical and ceiling surfaces

3.3 Flooring surfaces

3.3.1. Combustibility

All flooring surfaces shall comply with the requirements of class B_{fl} outlined in BS EN13501-1 or, alternatively, BS476: Part 7, class 2.

3.3.2 Smoke Emission

Location	Test method	Requirement
Option 1		
Flooring surfaces in tunnels	S1085, Attachment B.7	Ao < 250 m^2/m^2
Flooring surfaces in stations	S1085, Attachment B.7	Ao < 350 m^2/m^2
Option 2		
Flooring surfaces	EN ISO 5659-2: 25 kWm^{-2}, with pilot flame	*D*s maximum, dimensionless, ≤ 150

Table 3 – Smoke emission requirements for floor composites

3.4 Seats

The backs of seats on station platforms shall be considered as vertical surfaces and the bases of seats on station platforms shall be considered as supine surface, i.e. flooring mode. If a seat is formed from a single fabrication, the material shall meet the requirement for vertical surfaces.

3.5 Cables

Cables can be considered compliant for combustibility and smoke emission by meeting the requirements listed in one of the following options.

3.5.1 Option 1

3.5.1.1 Combustibility & smoke emission

Cables that are subject to the Construction Products Regulation (CPR) shall meet the test requirements of class C_{ca}-s1a,d0,a3 as defined in BS EN 13501-6.

3.5.2 Option 2

3.5.2.1 Combustibility

The burn height results obtained from tests described in the following standards, shall comply with the values given below in Table 4.

Cable overall diameter	Test method	Requirement
greater than 12mm	BS EN 60332-3-24	< 2.5 m
equal to or less than 12mm	BS EN 60332-3-25	< 2.5 m

Table 4 – Flame spread requirements for cables

There should not be any flaming droplets and/or particles during the first 10 minutes of the test. Flaming droplets and/or particles are defined in BS EN 13501-6.

Note:	If a cable is fully encased in a non-combustible enclosure (i.e. steel conduit), there is no need to comply with the requirements of flaming droplets and/or particles.

Alternatively, for cables which have an overall diameter of < 3.5 mm, the vertical ladder tests described above may be substituted for a temperature index test, according to the criteria given below in Table 5.

Standard	Radial Thickness of Sheath	Requirement
BS EN ISO 4589-3	>0.4mm <0.4mm	280 °C 350 °C

Table 5 – Combustibility requirements for small diameter cables

3.5.2.2 Smoke Emission

The maximum permitted smoke emission which is related to overall cable diameter as tested in accordance with BS EN 61034-2 shall be:

a) $Ao(ON) < 0.7[\tan^{-1}(d/45)/45 - \tan^{-1}(d)/2025]$

b) $Ao(OFF) < 1.8Ao(ON)$

where d = cable diameter in mm. A minimum of two tests shall be undertaken. If one result represents a failure, a third test shall be required to confirm the result.

3.6 Non-listed items

Small electro-technical components and all other miscellaneous items and materials not included in 3.2, 3.3, 3.4 and 3.5 shall be tested on the basis that the results obtained will relate to the composite construction of the particular item unless otherwise stated.

The results of tests, described in the following standards for extensive and grouped usage, shall comply with the values given below in Table 6:

Test Method	Requirement
Combustibility Test Options	
BS EN ISO 4589-2: Limiting Oxygen Index	LOI > 40% or
BS EN ISO 4589-3: Temperature Index	TI > 350 °C
Smoke Emission Test Options	
S1085, Annex B.5	A0 < 0.005 m^2/g or
EN ISO 5659-2: 25 kWm^{-2}, with pilot flame	*D*s maximum, dimensionless, ≤ 150

Table 6 – Flammability and smoke emission requirements for non-listed items (extensive and grouped usage)

The results of tests described in the following standards for limited and dispersed usage shall comply with the values given below in Table 7:

Test Method	Requirement
Combustibility Test Options	
BS EN ISO 4589-2: Limiting Oxygen Index	LOI > 30% or
BS EN ISO 4589-3: Temperature Index	TI > 300 °C
Smoke Emission Test Options	
S1085, Annex B.5	A0 < 0.02 m^2/g or
EN ISO 5659-2: 25 kWm^{-2}, with pilot flame	*D*s maximum, dimensionless, ≤ 300

Table 7 – Flammability and smoke emission requirements for non-listed items (limited and dispersed usage)

3.7 Commentary on smoke emission tests

The smoke emission test methodology for items detailed in clauses 3.2, 3.3, 3.4 and 3.6 is described in Attachment B of this standard.

If a risk assessment is required for non-compliance with smoke emission, it can only be conducted using data from the test methodology described in Annex B. This risk assessment must form part of a concession application that details other mitigations.

The smoke emission results when tested to EN ISO 5659-2 will only be valid for the specified thickness in the test report.

3.8 Non-applicable and excepted materials and locations

The requirements in this standard shall not apply to:

a) items which are temporarily used and then removed from public areas (including tunnels) prior to start of traffic hours;

b) consumables, portable electrical equipment, portable furniture and personal effects where these items are contained within staff accommodation, ticket offices and administration areas and where those areas are covered by fire detection and alarm systems compliant with LU Standards;

c) items within public and non-public locations, including retail units, where those areas are fitted with fire detection and suppression systems compliant with LU standards. Escalator Machine Chambers (EMCs) are not part of this exemption. Requirements for a smoke management system shall be determined from the Fire Strategy for the specified location in accordance with LU standard 1-080;

d) minor use materials – single, or joined items, providing they have:-

   i) a total mass not more than 100g or;
   ii) an area (in the case of surface coatings) of not greater than 0.2m^2;

e) material samples which differ only in colour from those already tested, providing the colourant does not exceed 5% (w/w);

f) Non-combustible materials or materials of limited combustibility as defined in The Building Regulations, Approved Document B;

g) Materials and enclosures within a fire-resistant structure listed in Table 8. The requirements of a fire-resistant structure are given in Table 9.

Excepted Materials	Conditions
1) All materials	When located within a fire-resistant, non-public room where the volume of the room is <120m^3; and where a fire detection and alarm system compliant with LU standards is installed to cover that room.
2) All materials	When located within a fire-rated, non-public room where the volume of the room is <240m^3; where the room has multiple means of escape, of which

	two will be opposite to each other; and where a fire detection and alarm system compliant with LU standards is installed to cover that room.
3) Materials within minimum IP5X non-combustible enclosures	When located within a fire-resistant, non-public room; and where a fire detection and alarm system compliant with LU standards is installed to cover that room. Multiple enclosures are permitted.
4) Materials within non-combustible enclosures (non IP-rated)	When located within a single non-combustible enclosure in a fire-resistant, non-public room; and where a fire detection and alarm system compliant with LU standards is installed to cover that room. Multiple enclosures are permitted when separated by a minimum distance of 0.7 m.

Table 8 – Excepted materials in fire-resistant structures

Profile	**Test Standard**	**Classification (BS EN 13501-2)**
Walls and glazing	BS EN 1364-1	EI 60
Ceilings	BS EN 1364-2	EI 60 (a↔b)
Floors	BS EN 1365-2	REI 60
Doors	BS EN 1634-1	EI_2 60
Cable Penetrations	BS EN 1366-3	EI 60
Linear gap seals	BS EN 1366-4	EI 60
Profile	**Test Standard**	**Classification (BS EN 13501-3)**
Ducts	BS EN 1366-1	EI 60 (i↔o) ve,ho S
Dampers	BS EN 1366-2	EI 60 (i↔o) ve,ho S

Table 9 – Requirements for fire-resistant structures

3.9 Evidence of compliance

Compliance with the requirements of this standard shall be demonstrated to LU by each party contracted to LU. Additionally, LU may audit compliance as part of its surveillance regime.

4. Responsibilities

Infrastructure companies, PFI Projects shall be responsible for maintaining their own registers of compliant products with design registrations and auditable trails relating to approvals.

The Lead Materials Engineer, Premises, London Underground is responsible for:

a) the custodianship and quality of this standard, and for its programmed review;
b) ensuring that the content is appropriate and correct for the purposes of the standard;

c) operation of the concession process.

The LU Procurement agent shall be responsible for incorporating the requirements of this engineering standard into any contract to which it is relevant and shall stipulate that a programme of audits are implemented by the contractor which ensures that these requirements are met.

5 Supporting information

5.1 Background

The requirements of this standard are separate and independent from the fire resistance, fire protection and fire prevention requirements of The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009, excepting paragraphs 8(1) and 8(2). In particular, a material's installation that complies with those Regulations may not necessarily comply with this standard. This is, in part, because the Regulations do not address the smoke and toxic fume emission requirements, which are covered in this standard.

5.2 Regulations

Users of this standard should note that compliance with the requirements in this standard would not necessarily achieve compliance with the legal requirements of The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009. The technical criteria outlined in this legislation and the associated governmental guidance reproduced are therefore to be considered as applying to all materials used in the construction of an internal wall or ceiling in any public area of all railway stations within the scope of this standard.

Note: The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009 has two prescriptive requirements in relation to this standard

"*Materials used in internal construction of premises*

8. (1) Any material which is used in the construction of an internal wall or ceiling in any public area must be of limited combustibility.

(2) To inhibit the spread of fire within the premises, any material which is applied to the surface of an internal wall or ceiling in any public area must—

(a) adequately resist the spread of flame over the surface; and

(b) have, if ignited, either a rate of heat release or a rate of fire growth, which is reasonable in the circumstances"

The definition of "limited combustibility" can be found in the guidance to the Regulations, which refers to the England & Wales Building Regulations Approved Document B, Table A7.

5.3 Safety considerations

Failure to meet the test criteria or the requirements set out in this document may mean that an installation does not meet the requirements of the Fire Precautions

(Sub-Surface Railway Stations) Regulations 2009, paragraphs 8(1) and 8(2) or other safety-related legislation.

6 Person accountable for the document

Name	Job title
Simon Newton	Head of Engineering Stations & Crossrail

7 Definitions

The following topic specific definitions are created:

a) within LU standard S1622, Glossary of Terms and Abbreviations
b) from published sources that are clearly identified.

Term	Definition	Source
Smoke	visible part of fire effluent	b BS 4422: 2005
Technical liquids	Lubricants (including greases) and electrically insulating liquids, such as transformer oils and refrigerants.	a
Limited / dispersed materials	Where the mass is greater than 100g and less than 500g, and where there is a separation of not less than 0.5m between materials.	a
Extensive / grouped materials	Where the mass and separation exceed the definition of limited/dispersed materials.	a
Minor use materials	Where total mass and surface area do not exceed 100g or 0.2sqm respectively, regardless of separation between materials.	a

8 Abbreviations

The following abbreviations are created:

a) from within LU standard S1622, Glossary of Terms and Abbreviations
b) from other, identified published sources.

Abbreviation	Definition	Source
IDLH	Immediately Dangerous to Life or Health	a
LOI	Limiting Oxygen Index	a
TI	Flammability Temperature Index	a
CPR	Construction Products Regulation	a

9 Document history

Issue no.	Date	Changes	Author
2-01001-	December	Standard E1042 A6, re-formatted and	Mr Martin Weller

002 A1	2003	re-numbered to 2-01001-002,	
1-085 A1	March 2008	Re-written by LU in consultation with Infracos between July 2004 and July 2007	Mr Martin Weller
1-085 A2	December 2008	Clause 3.2.4.2 amended in line with outcome from the October 2007 Concessions Forum	Mr Martin Weller
1-085 A3	March 2011	Update as per DRACCT 00274 – Correction of references to British and European Standards	Mr Martin Weller
S1085 A4	December 2015	Renumbered and re-written to reflect the changes to the national and European standards, regulations and the industry best practice as per DRACCT No.04304.	Dr Sam Sambasivan

10 References

Document no.	Title or URL
SI 2009/782	The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009
BS 4422: 2005	Fire - Vocabulary
BS 6853: 1999 Incorporating Amendment No. 1	Code of practice for fire precautions in the design and construction of passenger carrying trains
BS EN 13238:2010	Reaction to fire tests for building product — Conditioning procedures and general rules for selection of substrates
BS EN 45545-2:2013+A1:2015	Railway applications. Fire protection on railway vehicles. Requirements for fire behaviour of materials and components
BS EN ISO 4589-2: 1999	Plastics. Determination of burning behaviour by oxygen index. Ambient-temperature test
BS EN ISO 4589-3:1996	Plastics. Determination of burning behaviour by oxygen index. Elevated temperature test
BS EN 60332-3-24:2009	Tests on electric and optical fibre cables under fire conditions. Test for vertical flame spread of vertically-mounted bunched wires or cables. Category C
BS EN 60332-3-25:2009	Tests on electric and optical fibre cables under fire conditions. Test for vertical flame spread of vertically-mounted bunched wires or cables. Category D
BS EN 13501-6:2014	Fire classification of construction products and building elements. Classification using data from reaction to fire tests on electric cables
BS EN 13501-1:2007+A1:2009	Fire classification of construction products and building elements. Classification using test data from reaction to fire tests
BS 476-6:1989+A1:2009	Fire tests on building materials and structures.

	Method of test for fire propagation for products
BS 476-7:1997	Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
BS ISO 5658-2:2006+A1:2011	Reaction to fire tests. Spread of flame. Lateral spread on building and transport products in vertical configuration
BS ISO 5660-1:2015	Reaction-to-fire tests. Heat release, smoke production and mass loss rate. Heat release rate (cone calorimeter method) and smoke production rate (dynamic measurement)
BS EN 61034-1:2005	Measurement of smoke density of cables burning under defined conditions. Test apparatus
BS EN 61034-2:2005	Measurement of smoke density of cables burning under defined conditions. Test procedure and requirements
BS EN 1364-1:2015	Fire resistance tests for non-loadbearing elements. Walls
BS EN 1364-2:1999	Fire resistance tests for non-loadbearing elements. Ceilings
BS EN 1365-2:2014	Fire resistance tests for loadbearing elements. Floors and roofs
BS EN 1634-1:2014	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows
BS EN 1366-1:2014	Fire resistance tests for service installations. Ventilation ducts
BS EN 1366-2:2015	Fire resistance tests for service installations. Fire dampers
BS EN 1366-3:2009	Fire resistance tests for service installations. Penetration seals
BS EN 1366-4:2006+A1:2010	Fire resistance tests for service installations. Linear joint seals
BS EN 13501-2:2007+A1:2009	Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services
BS EN 13501-3:2005+A1:2009	Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers
BS 7671:2008+A3:2015	Requirements for Electrical Installations. IET Wiring Regulations
S1622	Glossary of Terms and Abbreviations
G085	Code Of Practice - Fire Safety Of Materials And Fire

	Safety Of Specific Items And Materials Used In The Underground
S1086	Fire safety classifications of stations

11 Attachments

11.1 Attachment A - Determination toxic fume

A.1 Mass based test method (NF X 70-100)

The test method given in NF X 70-100 should be used with the following modifications. Qualitative screening should not be used. All species should be quantified in all cases. Test should be carried out at 600°C.

Note: There is a requirement to determine nitrogen dioxide and nitric oxide and to express the results as nitrogen dioxide.

A.2 Area based test method (BS EN 2826)

The area based test method should be in accordance with BS EN 2826, with the following modifications.

The test fire model should be replaced by the heating arrangement specified in BS ISO 5659-2; i.e. a conical heating element with a horizontal test piece.

The flux used should be 25 $kW \cdot m^{-2}$, in the flaming mode only.

A single smoke emission only test should be carried out and the time at which 85 % of the peak smoke emission is reached, (or the value at 20 min if no maximum is reached), should be determined.

Toxic fume emission testing should then be carried out in triplicate and the average of these used to calculate the R value in accordance with clause A.4.

The collection/measurement of toxic fume should commence at the previously determined time to reach 85 % of the peak smoke emission.

The toxic fume emission should be expressed in grams per square metre of material, assuming that the area of the test piece is 0.005 8 m2. This is calculated as follows:

$TFE = (VF \times V_{chamber} \times M) / (V_m \times A)$

where:

VF = the measured volume fraction of the toxic species under consideration, usually measured in parts per million (ppm);

$V_{chamber}$ = the volume of the test chamber = 0.51 m^3;

M = the molar mass of the toxic species under consideration;

V_m = the molar volume at 25 °C and 1 atm (assuming ideal gas behaviour)

= 0.024 5 $m^3 \cdot mol^{-1}$;

A = the area of the test specimen = 0.005 8 m^2.

Example

Given that the measured volume fraction of carbon monoxide is 200 ppm, (200×10^{-6}), then:

TFE = $(200 \times 10^{-6} \times 0.51\ m^3 \times 28\ g \cdot mol^{-1}) / (0.024\ 5\ m^3 \cdot mol^{-1} \times 0.005\ 8\ m^2)$

= 20.1 $g \cdot m^{-2}$

There is a requirement to determine nitrogen dioxide and nitric oxide and to express the results as nitrogen dioxide.

A.3 Gases to be analysed

The eight gases listed in Table A.1 with their common limiting values (IDLH values, see A.4) should be the minimum set for which analysis is performed.

Gases	IDLH value	
	ppm	mg/m^3
Carbon dioxide	40000	73000
Carbon monoxide	1200	1400
Hydrogen fluoride	30	25
Hydrogen chloride	50	76
Hydrogen bromide	30	101
Hydrogen cyanide	50	56
Nitrogen dioxide	20	38
Sulfur dioxide	100	270
NOTE: Nitrogen dioxide includes nitric oxide expressed as nitrogen dioxide.		

Table A.1 - IDLH Values

A.4 Calculation of Toxicity Index (R)

A.4.1 General

The quantities listed in columns 2 and 3 of Table A.1 are the parts per million and milligrams per cubic metre levels used as the basis for generating the reference values which convert the analytical results for the combustion products generated in the test into an overall toxicity rating. The values in Table A.1 are the IDLH values of the listed gases (the concentration of the gas in the atmosphere which for an exposure time of 30 min is Immediately Dangerous to Life or Health) given in The National Institute for Occupational Safety and Health (NIOSH) Guide.

These values have been chosen because it is anticipated that much of the hazard analysis will be carried out using data generated in cumulative tests which generate single point potency values for each gas or where time based data is used to generate a single point value.

The values in Table A.1 have been converted into reference values and these are given in Table A.2. The values in Table A.2 have units of milligrams per gram if used with NF X 70-100 data or grams per square meter if used with BS EN 2826. This coincidence of numerical values arises because of the selection of 0.5 m, (0.5 m width, 1.0 m height) and 500 g as the general design levels for surfaces and materials respectively. The values in Table A.2 are given to two significant figures which is sufficient for, and consistent with, the general nature of the analysis and guidance.

Gases	**Reference value** $Mg\ g^{-1}$ or $g\ m^{-2}$
Carbon dioxide	14000
Carbon monoxide	280
Hydrogen fluoride	4.9
Hydrogen chloride	15
Hydrogen bromide	20
Hydrogen cyanide	11
Nitrogen dioxide	7.6
Sulfur dioxide	53

Table A.2 - Reference values for gases

A.4.2 Calculation

Calculate the weighted summation index, R, from the data obtained in accordance with A.1 or A.2 as follows.

Divide the value for each species by its reference value given in Table A.2 to obtain its individual index, r, and then sum the individual indices to give the weighted summation index, R, in accordance with the following equations:

$$r_x = c_x / f_x$$
$$R = \sum r$$

where:

c_x is the emission of the x^{th} species, in the appropriate units;
f_x is the reference value for the x^{th} species, as given in Table A.2;
r_x is the individual index for the x^{th} species.

If the requirement of R < 1 is achieved, the material can be considered compliant with this standard. For materials that do not meet this requirement, additional calculations can also be carried out to determine the risk in accordance with LU Code of practice G085.

11.2 Attachment B: Methods for measuring smoke density

B.1 General

This annex gives the test apparatus and verification procedure to be used for the measurement of smoke density of the products of combustion of materials. It

includes details of the 3 m cube test apparatus, the photometric system for light measurement, the qualification procedure, the fire sources appropriate to the different materials to be tested, and the smoke mixing method.

B.2 Apparatus

The details of the test apparatus for measuring smoke emission and the verifications procedures shall be as defined in the BS EN 61034-1.

B.3 Fire Sources

B.3.1 Fire source 1

The fire source shall be as defined in BS EN 61034-1.

B.3.2 Fire source 2

The fire source should consist of 0.5 kg of softwood charcoal, cut and sieved so that the particles pass through a 37 mm sieve but are retained by a 25 mm sieve; any bark or uncharred wood should be discarded. The charcoal should be conditioned immediately before the test by maintaining it for 16 h at 20 ^{o}C ± 5 ^{o}C and at 50 % ± 20 % relative humidity.

A wire frame should be constructed from metal wire of nominal diameter 2 mm, arranged into a square construction as follows:

- four wire corner posts 50 mm high;
- connecting wires 200 mm long connecting the posts at the top and a second row of connecting wires connecting the posts at their mid-points.

Prior to performing a test, the measured amount of charcoal should be immersed in alcohol, as used in fire source 1, for a minimum of 20 min before being placed on a wire mesh over a tray and allowed to drain for a period of 5 min ± 1 min. The fire source should then be positioned evenly within the wire frame and ignited within 5 min of being drained.

B.4 Numbers of specimens to be tested

Initially two specimens should be tested for each sample of material. Where there is greater than 20 % variation in the results, a third test should be performed. The mean value of all tests should be used to establish the category of performance.

B.5 Small-scale test

Note: Where small specimens, such as will be consumed within 5 min, are to be tested, fire source 1 would continue to burn long after smoke levels have stabilized. In such cases, testing time may be reduced by using half the quantity of alcohol given for fire source 1, but in the same container. Care needs to be taken to ensure that the specimen is mounted at the correct height above the alcohol surface.

The nature of any irregularly shaped article should be stated in the test report. Comparisons between specimens are only valid if testing is carried out in the same manner, using the same support.

Fire source 1 should be used for this test.

The test specimen size should be 140 mm x 60 mm x 3 mm and the specimen should be supported horizontally over the tray, with the long side of the specimen parallel to the long side of the tray, at a height of 175 mm ± 5 mm above the surface of the alcohol. A schematic arrangement is shown below in Figure B.1.

All dimensions are in millimetres

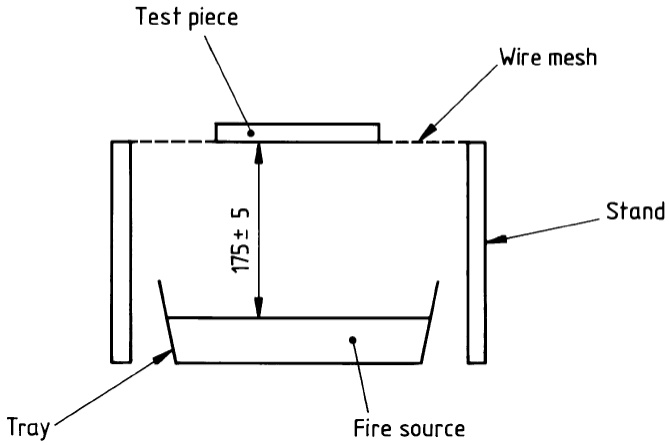


Figure B.1: Schematic arrangement of small-scale test

A wire mat of nominal 25 mm mesh should be used for samples which are self-supporting throughout the test; a wire mat of nominal 12 mm mesh should be used for samples which show some thermoplasticity and are inclined to sag, and a copper foil tray (having a thickness of copper of 0.1 mm) should be used for samples which form a mobile phase. The mat should be at least 10 mm wider and longer than the sample, with turned up edges of nominally 5 mm.

Test pieces which do not conform to the defined size and thickness can be used provided this is noted in the test report. Where the material is either significantly thinner than 3 mm or is of low density and where this results in levels of smoke emission which are so low as to compromise accuracy, the material can be piled to increase the mass combusted. The number of layers used should be noted in the test report.

Ignite the fire source and record the optical density in the cube. Calculate A_0 in accordance with B.8.

B.6 Panel Test

NOTE: This test gives reliable information about the smoke emission from surfaces and relatively thin panels. It is not suitable for testing thermoplastic materials. Where multi-layer constructions are used, great care should be taken in the interpretation of the results because of the modest rate of heat input of the test. For example, an organic material faced with a thin (e.g. 0.7 mm) aluminium sheet may perform extremely well, whereas under larger or real fire conditions, penetration may occur giving much higher levels of smoke.

CAUTION: If a specimen collapses this test method may result in the burning alcohol becoming spread over the floor of the cube.

Use fire source 1 for this test.

The test specimen size should be 1 000 mm x 500 mm and of thickness appropriate to the intended end use. The sample should be supported continuously along all edges on an angle frame of 25 mm maximum width and inclined at 60° to the horizontal with the short side of the specimen horizontal and with the unexposed surface facing the back wall.

The general arrangement is shown schematically in Figure B.2.

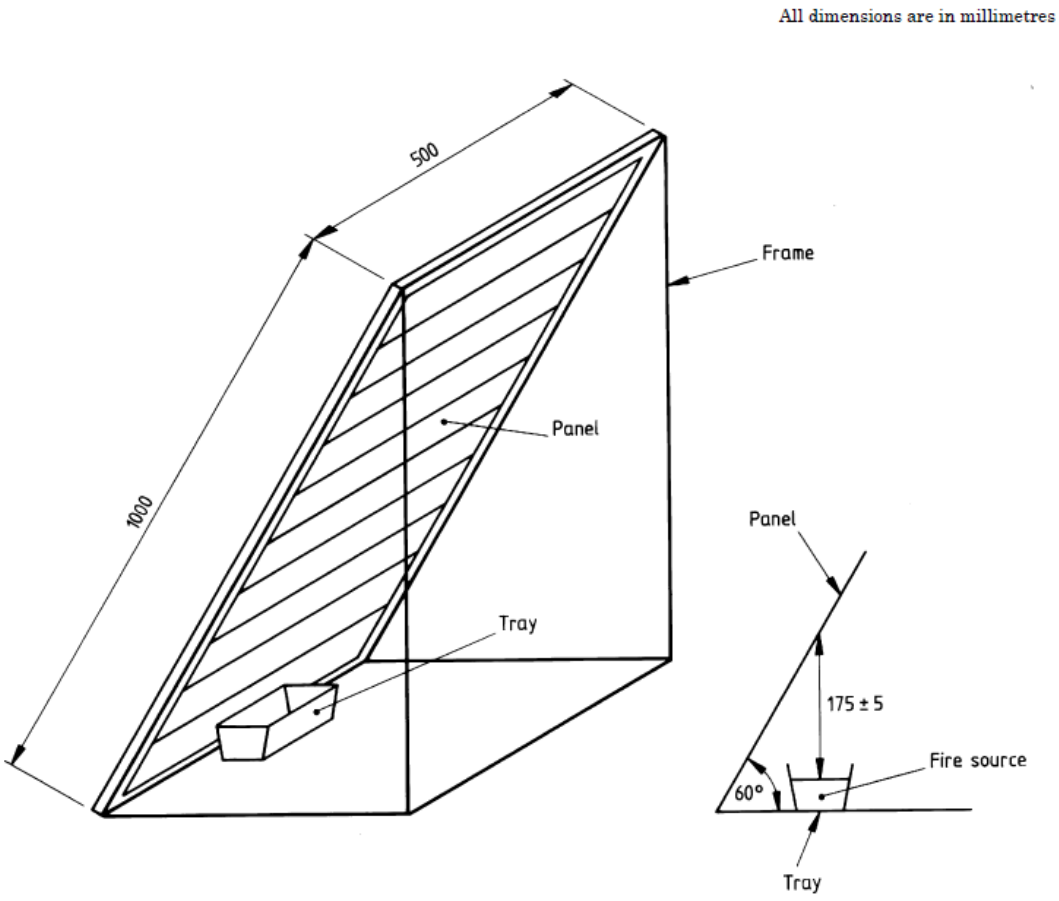


Figure B.2: Schematic arrangement of panel test

The fire source should be placed so that the centre of the surface of the alcohol is 175 mm ± 5 mm from the surface of the specimen when measured normal to the alcohol surface, with the long side of the tray parallel to the short side of the specimen. With this arrangement there is an approximate 10 mm gap between the long side of the tray (nearest to the test piece) and the test piece. With some specimens it may be necessary for restraining clips or bolts to be used to prevent excessive movement in the test.

Ignite the fire source and record the optical density in the cube. Record the depth of burn. Calculate A_0 in accordance with clause B.8.

B.7 Flooring test

The specimen tested should be of the total proposed flooring system including, for example, the fixing technique (e.g. adhesive).

Note:	Individual flooring materials may be tested for development or comparison purposes, but the results cannot be taken as necessarily representing the performance of the material as it will be used.

Use fire source 2 for this test.

The test specimen size should be a minimum of 300 mm x 300 mm and a maximum of 600 mm x 600 mm.

For a mattress, a whole mattress should be tested. The fire source should be positioned centrally on the specimen. Figure B.3 shows a schematic arrangement for the test.

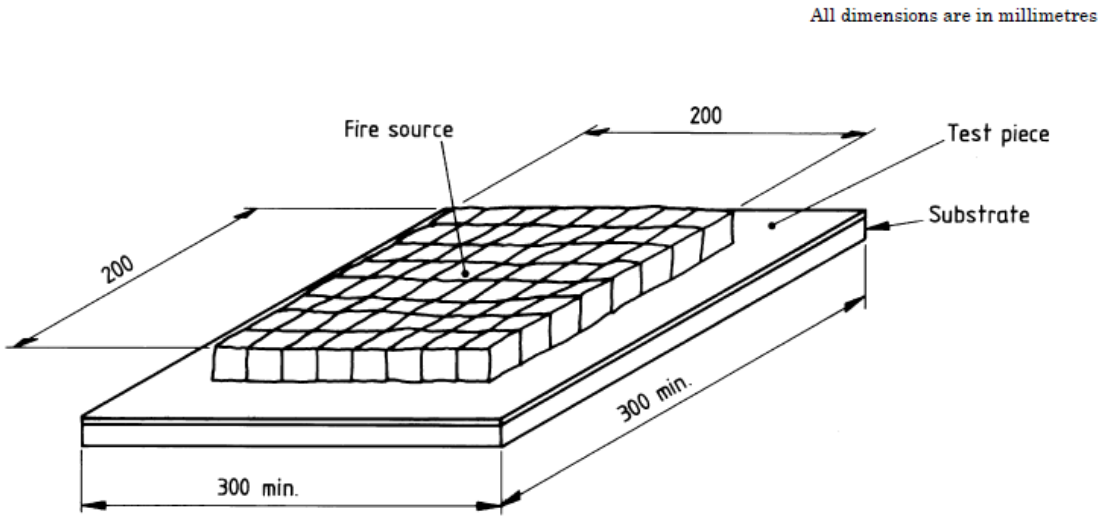


Figure B.3: Schematic arrangement of flooring test

Ignite the fire source and record the optical density in the cube. Calculate A_0. The depth of burn shall be recorded.

B.8 Calculation and expression of results

The measured optical density (Am) is calculated as follows:

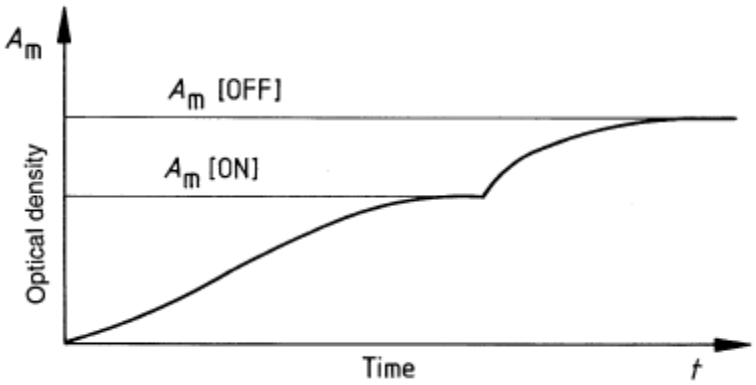
$A_m = \log_{10} (I_0/I_t)$

where

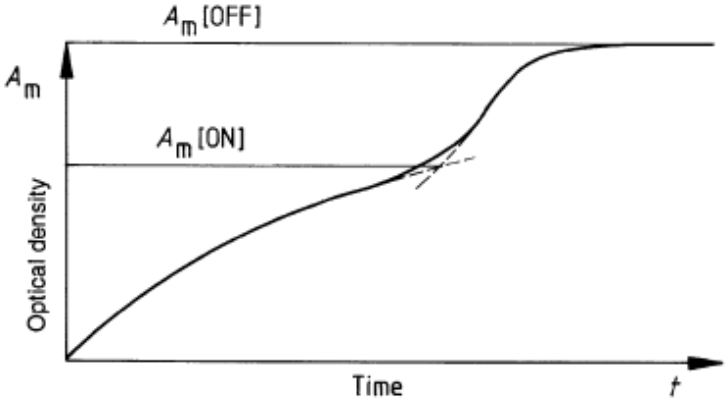
I_0 is the initial luminous intensity;

I_t is the transmitted luminous intensity.

In two-phase tests, i.e. where a smouldering phase occurs, the value of A_m is calculated for the two points shown below in Figure B.4.

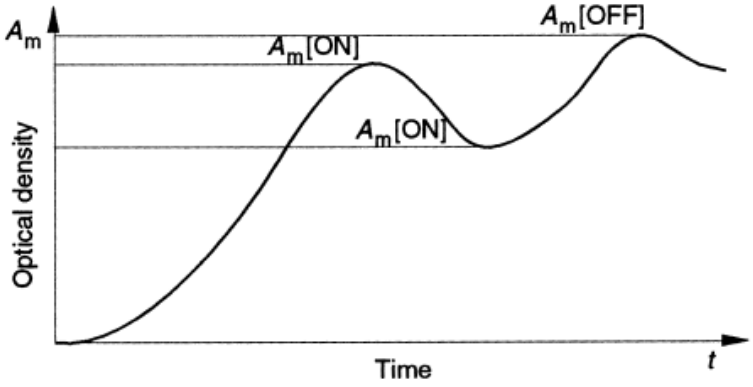


a) Ideal curve



b)

b) Extrapolation of “knee” point



b) Variation in A_m(ON) due to various loss mechanisms

Figure B.4: Smoke emission curves

The A_0 value is the optical density produced across the opposite faces of a cube of side 1 m when one unit of material is burnt under the specified conditions, and is calculated to three significant figures using the following equation:

$A_0 = A_m \times V/(k \times l)$

Where

A_m is the optical density measured in the cube;

V is the volume of the cube (m3);

l is the length of the optical path between windows (m);

k is the number of units of material constituting the test specimen.

The value of k is 1 for the panel and seat tests, 0.04 m^2 for the floor test and the mass of the test piece (g) for the small scale test.

Where a maximum is reached in the (OFF) phase this is defined as the end point of the test. Thus:

$A_0\ (OFF)_{end} = A_0\ (OFF)_{max}$

Where a maximum occurs during the (ON) phase of a two-phase test, the A_0 (OFF) value is corrected for the reduction in optical density between the maximum value and the end of the ON phase in accordance with the following equation:

$A_0\ (OFF)_{corr} = A_0\ (OFF)_{end} + A_0\ (ON)_{max} - A_0\ (ON)_{end}$

Note: The values quoted shall be as follows:

- A_0 (ON)max, which for the purposes of reporting is designated A_0 (ON); and

- A_0 (OFF)corr, which for the purposes of reporting is designated A_0 (OFF).

B.9 Test report

The test report should include the following information:

- the name of the testing establishment;
- the date of the test;
- a reference to this Standard;
- identification of the material tested;
- the test specimen form and any variation from the recommended dimensions;
- the bundling arrangements (for cable tests);
- the A_0 value recommended for the material;
- the A_0 value obtained in each test;
- mean and standard deviation of the A_0 values;
- the number of specimens tested;
- the % transmittance/time (and preferably A_0/time) graphs. These data should be made available electronically, for example in ASCII format on a disc;

- observations about timings for the ignition and extinction of the specimen;
- the depth of burn (where appropriate);
- observations and any unusual or unsatisfactory phenomenon observed, such as migration (by collapsing or otherwise) of the test material from the source (e.g. see **B.6**). Any numerical results to which such observations apply should have the letter X appended to them. Thus, A_0 3.9(X).

11.3 Attachment C Additional information for rolling stock materials

C.1 General

Rolling stock shall comply with BS 6853, Category 1a with the following additions.

C.2 Technical liquids

Technical liquids (including electrical components) shall be subject of a risk assessment to quantify the risks associated with fire.

C.3 Flammable gas

C.3.1 Pressurised flammable gas installations shall not be used.

C.3.2 Battery installations and all other flammable gas installations not covered by 3.2.3.1 shall be the subject of separate risk assessment for every application.

Note:	Guidance is given in LU Guidance Document G-085

C.4 Flat Surfaces

C.4.1 Flat surfaces shall be subject to toxic fume test B2 in Annex B of BS 6853. In order to ensure that the amount of toxic gas produced is above the threshold of detection, test samples shall have a mass of combustible material (as opposed to inert substrate) of not less than 5g.

C.4.2 If the requirement in 3.2.4.1 is not practical (on the basis of low mass per unit area), then the test B1 in BS 6853 shall be used. The resulting mass based R value shall be converted to an area based R value by scaling using the mass per unit area of the combustible material. The pass or fail criteria shall be against the area based R value requirement in the relevant table in BS 6853. The basis for conversion shall be: Calculated B2 R value = Measured B1 R value x (mass per unit area [g/sq.m.]/1000). A single sample shall be tested in the tube furnace, representing the percentage components of any composite material.

C.4.3 If B2 method is used it shall be ensured that samples taken to determine toxicity performance include all gases liberated during the testing process.

Note:	An appropriate method to be used could be a fan to ensure all gases are mixed.

12 Current written notices attached to this document

Written Notice No	Issue Date	Written Notice Title
LU-WN-01444	12/10/2016	Intergrity only Fire Doors

Written Notice	**LU Ref. No.:** LU-WN-01444
	Suppliers Ref. No.:

1	**Written Notice Completed By**	
	Person Accountable	Stephen Banks
	Directorate	Capital Programmes Directorate
	Date Issued	12/10/2016
2	**Details of the Standard Requiring Clarification or Correction**	
	Title:	Fire Safety Performance of Materials - Stations and Tunnel Infrastructure
	Standard Reference No.	S1085
	Issue No.	A4
	Clause/Paragraph No.	Clause 3.8, Paragraph g), Table 9
3	**Details of Clarification or Correction**	
	Title of Written Notice	Intergrity only Fire Doors
	Fire doors with a minimum classification of E 60 (Integrity) are also acceptable with reference to Clause 3.8, Paragraph g), Table 9 - Requirement for fire-resistant structures, provided they satisfy the requirements of BS 9999 and the Approved Document B and are suitable for the proposed use.	

7.5 S1168 Track Asset walkways (Cat 1 Std)

Transport for London
London Underground

Category 1 Standard

S1168 Track Asset Walkways

Please read the written notices attached

Issue date: June 2013
Issue No.: A3 **Review date:** June 2018

MAYOR OF LONDON

Contents

1 Purpose

1.1 The purpose of this standard is to define the requirements for the design, inspection and maintenance of track asset walkways and access thereto.

2 Scope

2.1 This standard applies to all track asset walkways.

2.2 This standard does not apply to the following:

a) walkways that are sited on a non-ballasted underbridge;

b) the structure forming a walkway where it is an integral part of a bridge or other structure adjacent to or supporting the track. This is covered by the Civil Engineer (LU)'s standard;

c) walkways within buildings.

2.3 This standard covers the categorisation, location, design, construction, demarcation, signage, inspection and maintenance of track asset walkways. It includes access points and routes to track asset walkways.

2.4 Where it is mandatory that any of the supporting information in Section 5 of this standard is to be applied, the appropriate requirement is set in Section 3.

3 Requirements

3.1 General

3.1.1 Track asset walkways shall provide safe walking routes for persons to move about the track.

3.1.2 New or re-configured track layouts shall take into account the need for safe walkway routes.

3.1.3 Walkways shall be designed to minimise the need for persons to cross the track. New cross-track and four-foot walkways shall be provided, or existing ones retained, only where a risk assessment shows that it is not reasonably practical to provide alternative routes.

3.1.4 Walkways shall be provided on longitudinal-timbered bridges. However, detailed requirements for their configuration are outside the scope of this standard.

3.2 Categorisation

3.2.1 For the purpose of setting requirements in this standard, track asset walkways are classified as follows:

a) Type 'R' track asset walkway:
Restricted walkways that can be used only by persons certificated to be on or near the track. They are normally places of safety, but where not they are identified by appropriate surface marking.

b) Type 'A' track asset walkway:
Access walkways where train crews and other certificated railway personnel regularly need to walk in close proximity to trains or rail mounted vehicles, or

along the four-foot to gain access to or egress from trains or rail mounted vehicles. Such walkways may provide a link to other walkways or they may be self-contained, for example at the approach to certain type of lineside equipment. By their nature they are not places of safety and surface marking is required to denote this (but see exceptions in clause 3.10.3).

c) **Type 'G' track asset walkway:**
General walkways that may be used by railway personnel not certificated to be on or near the track and the general public. Such walkways can also be used to provide public rights of way. Other than where they cross the track they are always in places of safety and will be separated from nearby tracks by barriers.

3.3 Design principles

3.3.1 The design of a track asset walkway shall be preceded by a risk assessment which shall consider:

a) the operational use of the walkway: this shall take account of footfall, and the need for users to pass each other or to carry equipment, which may indicate a need for a greater walkway width than the minimum in this standard;
b) workplace risk assessments: these should address as a minimum the possibility of the walkway being obstructed by, for example, the opening of doors of cabinets, and the need for handrails where the walkway is elevated;
c) factors that might present risks to persons using the walkways, particularly the possibility of falls;
d) the need for measures to manage and mitigate the risks identified.

3.3.2 The design of a track asset walkway shall ensure that:

a) the walkway is suitable for the specified type and frequency of use;
b) it provides unobstructed sighting of approaching trains or rail-mounted vehicles;
c) it is free from slipping and tripping hazards;
d) it has minimum maintenance requirements;
e) it will not act as a litter trap;
f) it will not run alongside or cross conductor rails, except if necessary in the case of four-foot walkways;
g) it is demarcated from the adjacent ground;
h) it has effective drainage.

3.3.3 Walkways should be constructed at a level relative to the surrounding ground which minimises the risks of

a) injury to users inadvertently stepping off the side of the walkway;
b) ground material migrating onto the walkway surface.

3.4 Clearance from track and protection from trains

3.4.1 The minimum distance between the closest edge of type "R" and type "G" track asset walkways and the nearest running edge shall be in accordance with the "walking" places of safety requirements in LU standard S1156.

3.4.2 A type 'A' track asset walkway shall be positioned so as to enable railway personnel to safely alight from, access or board trains or rail-mounted vehicles directly to or from the walkway.

3.4.3 Lineside walkways forming part of type 'G' track asset walkways shall be guarded by a barrier to deter users from straying onto the track.

3.5 Clearance and protection from conductor rail

3.5.1 Lineside and cross-track track asset walkways shall be designed to provide a minimum 2m clearance between their edge and the nearest unprotected conductor rail. In circumstances where it can be shown to be unreasonable to achieve 2m, approved protection planking shall be installed on both sides of the conductor rail and, except as in clause 3.5.2, the gap not permitted to be reduced below 1m.

3.5.2 Where it is not practicable to provide a conductor rail gap at a cross-track walkway, the protection planking shall be demarcated in yellow for the full width of the walkway, to minimise the tripping hazard.

3.5.3 All conductor rails and their connections adjacent to or in the vicinity of four-foot walkways shall be fitted with protection planking on both sides of the conductor rail, clearly demarcated in yellow on the face alongside the walkway, for the full length of the walkway.

3.5.4 Where four-foot walkways are provided in tube section stabling sidings, conductor rails shall be gapped to provide a minimum of 2m clearance from the front of rail-mounted vehicles when in their closest normal stabling position.

3.5.5 The design brief for a track asset walkway shall include a specific requirement for the approval of any proposed alterations to the existing conductor rail layout.

3.6 Dimensions

3.6.1 Track asset walkways shall be designed to provide:

a) a minimum headroom of 2300mm;

b) with the exception of cross-track and four-foot walkways, a minimum width of 700mm: in determining the width a risk assessment shall be carried out and a greater width used if, for example, there is a regular need for users to pass each other or to carry equipment – see also clause 7.1;

c) in the case of a cross-track walkway, a minimum width of 1730mm;

d) in the case of a four-foot walkway, a minimum width of 550mm.

3.7 Layout of cross-track walkways

3.7.1 Track asset walkways that cross the track shall do so in a straight line at 90° to the track. Where it is not reasonably practicable to cross the line at 90°, access shall be at 90° ±20°.

3.7.2 Walkways across stabling sidings shall, where reasonably practicable, be located sufficiently clear of the trains' stabled position to enable train drivers to obtain a full view of persons on the walkway. Where this is precluded by space constraints, the distance between the walkway and stabled trains shall allow the train driver to see at least the upper part (i.e. above the waist) of a walkway user from a seated position.

3.7.3 Where a track asset walkway crosses two or more tracks, and there is a section of the walkway between tracks which meets the criteria for a place of safety, the crossings either side of the section shall be signed as separate crossings. Consideration shall be given to the number of people likely to be using the place of safety simultaneously. A chicane shall be provided where practicable to make the position of the place of safety clear.

3.8 Steps, ramps and walkways at height

3.8.1 Track asset walkways shall avoid the use of steps and steep ramps as far as reasonably practicable.

3.8.2 Dimensions of steps shall comply with the recommendations of BS 5395 Part 3.

3.8.3 Except where their provision would foul the structure gauge or obstruct the walkway, all steps shall have handrails complying with the recommendations of BS 5395 Part 3.

3.8.4 The gradient of any ramp shall not exceed 1 in 8. Steps may be provided within the ramp in order to reduce its gradient, subject to such steps being not less than 1m apart.

3.8.5 Track asset walkways at height shall be provided with a barrier conforming to the recommendations of BS 6180 where there is an identified risk of a person falling 500mm or more.

3.9 Construction

3.9.1 Materials for the surface of new or refurbished track asset walkways shall be suitable for the usage and locations concerned. They shall provide a hard and even non-slip surface. Slip resistance, when assessed using the method in BS EN 13036-4, shall be not less than 36..

3.9.2 Where hardwood for decking and associated steps is used, it shall be supplied, installed and preserved in accordance with the requirements for crossing timbers specified in LU standard T0403.

3.9.3 Walkway components in tube and sub-surface sections of line shall be inherently, or shall be treated to be, fire-resistant to current legislative requirements.

3.10 Demarcation

3.10.1 The outer edges of the surface of a track asset walkway shall be clearly demarcated by painted yellow lines of 75mm minimum width except in the case of public foot crossings where the entire surface shall be coloured yellow. Where the edges are demarcated, the two 75mm markings may be included within the walkway's nominal width, i.e. they are not required to be additional to the width.

3.10.2 Risers and nosings of steps shall be demarcated by painted yellow lines of 75mm minimum width.

3.10.3 Any part of a lineside or between-tracks walkway surface which is not a place of safety shall be clearly identified as follows:

a) the surface shall be marked with hatching or stripes comprising non-slip painted lines at an angle of 45° to the relevant rail, at 300mm intervals measured along the border and of 75mm minimum width;

b) the colour of the hatching or stripes shall be yellow, or black if the surface is already solid yellow;

c) the hatching or stripes shall be applied to the entire width of the walkway if the unmarked width would otherwise be less than 700mm in the case of a lineside walkway or 900mm in the case of a between-tracks walkway.

Note 1: An alternative hatching configuration as shown in BS ISO 3864-1, comprising alternating adjoining yellow and black stripes at an angle of 45° to the relevant rail, is acceptable.

Note 2: There is no requirement for cross-track or four-foot walkways to be hatched, as it is assumed that these are self-evidently not places of safety.

3.11 Signage

3.11.1 A track asset walkway shall be signed to make persons using it aware of risks from railway operations and live electrical equipment.

3.11.2 Where five or more depot or siding tracks must be crossed before a place of safety is reached the following signage shall be provided:

a) a sign shall be provided at each end of the cross-track walkway, indicating the number of tracks to be crossed before a place of safety is reached. The sign shall be a yellow warning sign with a black border carrying a black pictogram of an exclamation mark, indicating 'caution';

b) it shall be accompanied by a supplementary sign with the same horizontal dimension as the triangle. The supplementary sign shall be the same yellow colour as the warning sign. The text, in black, shall state the number of tracks to be crossed.

3.11.3 Type 'R' and type 'A' track asset walkways shall have the following signs provided indicating that access is restricted:

a) a red and white prohibition sign depicting a black pictogram of a walking man;

b) a supplementary sign in red colour (as the prohibition sign) with white text shall state 'No admittance without LU track safety certificate';

c) a blue mandatory sign carrying a white pictogram of an exclamation mark;

d) a supplementary sign in blue colour (as the mandatory sign) with white text shall state 'High visibility clothing must be worn beyond this point'.

3.11.4 The signs described in this section shall be formed in accordance with LU standard S1004.

3.12 Lighting

Depot and siding track asset walkways shall be provided with lighting in conformity with LU standard 1-066.

3.13 Inspection

Inspection of track asset walkways shall conform with the requirements of LU standard S1158.

3.14 Maintenance

3.14.1 Track asset walkways shall at all times be maintained in a condition that ensures safe use for the permitted purpose.

3.14.2 Conditions identified in the course of a scheduled inspection which present a risk of reducing the safety or effectiveness of a track asset walkway shall be rectified within 5 days or in a timescale commensurate with the risk, whichever is the sooner.

3.14.3 Track asset walkway maintenance works shall include the immediate clearance of litter that may collect on, underneath, or adjacent to a walkway.

3.14.4 In the event that a track asset walkway becomes unsafe, its use shall be prohibited or warning signs erected or both until corrective maintenance has been completed.

3.15 Access points and routes

3.15.1 Routes from access points to track asset walkways shall be planned to ensure that railway personnel are in a place of safety (as defined in S1156) at all times.

3.15.2 The design of an access point or route shall ensure that:

a) it is suitable for the specified type and frequency of use;

b) any gates:
   I) conform with clearance requirements;
   II) do not obstruct walkways;
   III) are capable of being secured;
   IV) can be opened and closed by staff standing in a place of safety as defined in S1156;

c) it has the necessary signage to make users aware of risks from railway operations;

d) when providing access to the lineside:
   I) there are areas for parking and turning staff and emergency services road vehicles;
   II) there are barriers to prevent such vehicles overrunning onto the track.

3.15.3 Personnel access points outside stations shall not be provided unless there is a need for access by maintenance or emergency staff that cannot be met by existing access arrangements at stations, depots or sidings.

3.15.4 Access routes to track asset walkways shall be aligned or fenced so that persons approaching the lineside do not have their backs to trains and other rail-mounted vehicles approaching in the normal direction.

3.15.5 On single or bi-directional lines, access shall be at 90° ±20° to the track.

3.15.6 Physical barriers shall be provided to prevent users of the access route walking straight across the track asset walkway onto the track.

3.15.7 Where the access route includes steps or ramps that lead directly to the lineside, an adequate area of level hard standing shall be provided at the end of the steps or ramp, clear of the lineside or cross-track walkway and in a place of safety (as defined in S1156).

3.15.8 Access gates shall be securely locked when not in actual use. The availability of keys for the locks shall take into account the possible need to provide access for the emergency services.

3.15.9 Maintenance of routes from access points to lineside walkways shall take account of the usage, including the handling of plant.

3.16 Records

Appropriate records shall be developed to cover major events and inspection and maintenance activities throughout the asset life cycle. All records shall conform with LU standard 1-691 unless otherwise stated.

3.17 Evidence of compliance

Compliance with the requirements of this standard shall be demonstrated to LU by each party contracted to LU. Additionally LU may audit compliance as part of its surveillance regime.

4 Responsibilities

4.1 **The Professional Head of Track Engineering** is responsible for the technical content of this standard. Any concessions in relation to this standard shall be directed to the Professional Head of Track Engineering who has overall accountability for compliance with this standard. The Professional Head of Track Engineering may request support from the other technical authorities when reviewing concessions or queries arising from the application of this standard.

4.2 **LU and LU Suppliers** shall be responsible for compliance with the requirements of this standard.

5 Supporting information

5.1 Safety considerations

5.1.1 Failure to provide a correctly designed, installed, sited and maintained track asset walkway or access route where one is required increases the risk of:

a) trains or rail mounted vehicles striking incorrectly sited or dimensioned track asset walkways;

b) the track asset walkway acting as a trap for litter, with consequent risk of fire;

c) the track asset walkway incorporating untreated or inadequately treated timber, with consequent risk of fire;

d) persons walking or crossing the tracks suffering death or injury through:
I) coming into contact with conductor rails;
II) being struck by a train or rail mounted vehicle;
III) using unauthorised routes where other dangers exist;
IV) slipping or tripping.

5.1.2 Hazards leading to a risk of slipping or tripping include:

a) failure of the decking, including failure from decay;

b) omitted, obscured or obliterated markings;

c) vegetation encroachment;

d) extraneous material, including ballast and spoil;

e) omission or failure of non-slip surfaces.

5.1.3 Except in the case of type ‘A’ track asset walkways, lineside walkways that comply with the dimensional and material requirements of this standard are places of safety as defined in the Glossary of Terms. However, adequate clearances do not in isolation determine the suitability of a location as a place of safety. Other requirements such as ease of access also need to be met.

5.1.4 Type ‘A’ track asset walkways are positioned so that railway personnel are able to alight safely from trains or rail mounted vehicles directly onto the walkway, or to access and board trains or rail mounted vehicles safely directly from the track asset walkway. In all such cases, part of the track asset walkway is not necessarily a place of safety as defined in the Glossary of Terms.

6 Reference Section

6.1 References

6.1.1 British Standards

Document no.	Title
BS 5395:Part 3	Code of Practice for the design of industrial type stairs, permanent ladders and walkways
BS 6180	Code of Practice for protective barriers in and about buildings
BS EN 13036-4	Road and airfield surface characteristics – test methods. Part 4: Method of measurement of slip/skid resistance of a surface: the pendulum test.
BS EN ISO 14122-2	Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways
BS ISO 3864-1	Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings

6.1.2 LU company documents

Document no.	Title
S1004	Signage for Operational Purposes
1-066	Lighting of London Underground Assets
S1156	Gauging and clearances
T0403	Wood sleepers, pitblocks, pit sleepers and bearers
S1158	Track – Inspection and Maintenance
1-691	Information
S1622	Glossary of terms and abbreviations

6.2 Abbreviations

The following abbreviations are created:

e) within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
f) from published sources that are clearly identified.

Abbreviation	Definition	Source
BS (EN) (ISO)	British Standard (Euronorme) (International Standards Organisation)	a
LU	London Underground	a

6.3 Definitions

The following topic specific definitions are created:

a) within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
b) from published sources that are clearly identified.

Term	Definition	Source

Term	Definition	Source
Alongside conductor rails	Where the nearest edge of a track asset walkway to the nearest conductor rail is less than 2m or no close screen barrier separates it.	a
Chicane	A deviation in the alignment of a walkway running between two adjacent tracks to make the position of a place of safety clear.	a
Cross-track walkway	A track asset walkway that crosses one or more tracks.	a
Four-foot walkway	A track asset walkway that runs along the four-foot of a track, to give access to or egress from a stabled train or rail mounted vehicle. All four-foot walkways are type 'A' assets.	a
Place of safety	A location beside the track where people can walk or stand safely when trains pass.	a
Track asset	The track, its support structure down to the soil stratum immediately beneath the ballast or sub-ballast, and related fixed equipment and systems used on a continuing basis in the company's business. The track asset is part of the company's infrastructure assets.	a
Track asset walkway	A defined route. It does not include work areas where staff move and work freely, possibly subject to protection arrangements, in the course of their duties. A track asset walkway may be demarcated or constructed across such an area.	a

6.4 Person accountable for the document

Person accountable for the document
Stephen Barber - Head of Track Engineering, LU

6.5 Document history

Issue no	Date	Changes	Author
1-168 A1	October 2007	Standard 2-01302-470 re-formatted and re-numbered to 1-168, no technical changes have been made to the content other than changing references to other Standards where their numbers have changed	
1-168 A2	March 2011	Updated as per DRACCT 00159 Re-ordering of clauses. Minor additions from E8052.	Quentin Phillips
S1168 A3	May 2013	Per DRACCT proposal No. 01811: guidance on increased walkway dimensions (including from international standard), clarification of measurement of slip resistance and of demarcation where not a place of safety, incorporation of Written Notice 01101, and spacing of cross-track walkway from end of stabled train.	Quentin Phillips

7 Attachments

7.1 Guidance on walkway dimensions

The following guidance is copied from BS EN ISO 14122-2:2001+A1:2010 clause 4.2.2.

Note:	It will be seen that the requirements set in standard S1168 are in general alignment with this BS EN ISO, but the guidance in the latter will assist when it is desirable to exceed the minimum requirements or when a concession is required because it is not reasonably practicable to comply with them.

The clear length and width of walkways and working platforms intended for operation and maintenance shall be determined by:

a) the demands of the task e.g. positions, nature and speed of movement, application of force, etc.;
b) whether or not tools, spare parts etc. are being carried;
c) frequency and duration of task and use;
d) number of operators on walkways or working platforms at the same time ;
e) possibility of operators meeting ;
f) whether or not additional equipment such as safety clothing is being worn or personal protective equipment is being carried ;
g) the presence of isolated obstacles ;
h) the evacuation of an injured person ;
i) walkway ending in a dead end ;
j) walls likely to damage or mark operators' clothing ;
k) the need for unrestricted work-movements, and the need for space when using foreseeable tools.

Unless exceptional circumstances exist the minimum headroom over walkways shall be 2100mm [note that S1168 requires 2300mm].

Note: When justified by risk assessment and restrictions due to the machinery or environment, the clear height may be reduced to no less than 1900 mm if the walkway is used only occasionally or the reduction is made only for a short distance.

Unless there are exceptional circumstances, the clear width of a walkway shall be minimum 600mm but preferably 800mm [note that S1168 requires 700mm as a minimum]. When the walkway is usually subject to passage or crossing of several persons simultaneously, the width shall be increased to 1000mm. The width of the walkway when designated as an escape way shall meet the requirements of appropriate regulations.

Note: When justified by risk assessment and restrictions due to the machinery or environment, the free width may be reduced to no less than 500 mm if the walkway is used only occasionally, and the reduction is made only for a short distance.

If there are isolated obstacles on a wall or under a ceiling that restrict the required width or height, guarding shall be provided. Moreover, safety measures, e.g. padding, shall be fitted to prevent injuries. Warning signs should also be considered.

8 Current written notices attached to this document

Written Notice No	Issue date	Written Notice Title
LU-WN-01490	26/06/2017	Track Asset Walkways in Depot Buildings

Written Notice	**LU Ref. No.:** LU-WN-01490
	Suppliers Ref. No.:

1	**Written Notice Completed By**	
	Person Accountable	Stephen Barber
	Directorate	CPD
	Date Issued	26 June 2017
2	**Details of the Standard Requiring Clarification or Correction**	
	Title:	Track Asset Walkways
	Standard Reference No.	S1168
	Issue No.	A3
	Clause/Paragraph No.	2.2
3	**Details of Clarification or Correction**	
	Title of Written Notice	Track Asset Walkways in Depot Buildings

Presently, Clause 2.2 c) of S1168 states that the requirements of the standard do not apply to walkways in buildings. The response to QTS LU-Q-01445 confirmed that walkways within train sheds in sidings and depots are classed as 'walkways within buildings', and therefore the requirements of S1168 do not directly apply. However, there is a need to differentiate between buildings which are used for repair and maintenance of trains compared to those which provide stabling.

S1622 Glossary of Terms and Abbreviations contains the following terms:-

- Depot - includes the a) track; b) buildings; c) equipment d) facilities where trains stable and staff carry out general train maintenance and overhaul (not just preventative maintenance).
- Depot sidings - Tracks where trains can normally be stabled in a depot
- Sidings (1) - means such part of Train Facilities that comprise the track, buildings,equipment and facilities where Trains may be stabled overnight
- Sidings (2) - A place where trains can normally be stabled, other than in a depot.

It is confirmed that the requirements for Track Asset Walkways apply to locations where trains are stabled, i.e. Sidings and Depot sidings, as defined above. The requirements do NOT apply in Depots, as defined above.

Clause 2.2 of S1168 is therefore reworded as follows:-

'The requirements of this standard apply to *Sidings* and *Depot sidings*, as defined by S1622.

This standard does not apply to the following:

a) walkways that are sited on a non-ballasted underbridge;

b) the structure forming a walkway where it is an integral part of a bridge or other structure adjacent to or supporting the track. This is covered by the Civil Engineer (LU)'s standard;

c) walkways within Depots, (as defined by S1622).'

7.6 S1538 Assurance (Cat 1 Std)

Category 1 Standard

S1538 Assurance

Issue date: March 2015
Issue No.: A10
Review date: March 2020

MAYOR OF LONDON

Contents

1 Purpose

1.1 The purpose of this Standard is to define the requirements for the management and delivery of assurance by both providers and receivers of assurance.

2 Scope

2.1 This Standard applies to all parties introducing changes or delivering contracts for service on or about LU's infrastructure, or premises, or affecting LU. This shall include any enabling works, temporary works or temporary measures to facilitate delivery.

3 Requirements

3.1 Assurance arrangements for changes, projects or contracts for service

3.1.1 LU and its suppliers shall establish documented and controlled processes and procedures for both receiving and providing risk based assurance in respect of:

a) Health, safety and technical systems and their associated management systems and LU requirements;
b) Initiation, development, design, construction, delivery, testing, commissioning and handover of new, refurbished or altered systems or assets;
c) Maintenance operation and management of systems and assets;
d) Withdrawal, decommissioning, demolition and disposal of systems and assets.

3.1.2 Suppliers shall make their processes and procedures for assurance available to LU and, on request, to other LU Suppliers.

3.1.3 Assurance arrangements and activities, including the provision and receipt of assurance, shall reflect the LU Assurance Principles in Section 3.22.

3.1.4 LU, Suppliers or Third Parties initiating a change or delivering a contracted service shall provide LU with sufficient evidence, in good time that:

a) Compliance will be achieved with LU's technical, safety, environmental, operational and customer facing requirements, including :
   i) Legislation;
   ii) European, National and LU Category 1 Standards (subject to any controlled variation).
b) LU will be notified in good time of any residual risks to health, safety or the environment which requires LU action to mitigate.
c) LU operational service impacts arising from the delivery of a change, project or contracted service are mitigated and where this requires action by LU, LU is notified in good time.
d) Any change or contracted service intended to support or improve LU operational service to customers, will do so reliably and consistently, in accordance with contractual requirements or pre-determined benefits.
e) Affected parties have been consulted.

3.1.5 All changes, projects or contracts for service shall be supported by an implementation programme that includes the identification of risk control measures that must be in place before, during and after implementation of the change.

3.1.6 Suppliers shall assure LU that a valid process exists for controlling other building works, which include surfacing, finishes and other work within the civil engineering and premises asset areas and which are not subject to the Building Act and Regulations.

3.1.7 No change, project or contract for service shall be commenced until:

a) an Assurance Plan / Project Execution Plan (PEP) / Change Assurance Plan (CAP) is approved by LU,
b) all pre-implementation risk control measures have been established and pre-implementation actions and conditions complied with, in accordance with the relevant Assurance Plan / PEP / Change Assurance Plan or management system arrangements.

3.1.8 The reasons for submitting items for DRACCT acceptance shall be clearly shown.

3.2 Assurance where a change, project or contract for service is managed by LU (the requirements in this clause apply to LU only)

3.2.1 LU shall arrange for a single point of contact to project manage:

a) a change, project, or contract for service initiated by LU;
b) LU aspects of a change, project, or contract for service initiated by a Supplier or Third Party.

For changes or projects NOT applying version 2 or subsequent versions of the Project Management Framework (PMF).

3.2.2 At an early planning stage, supported by the relevant specialists, the single point of contact shall arrange for an initial assessment of the potential impact of the change, project or contract for service on:

a) The health and safety of LU's customers, staff or other persons affected by LU's operations;
b) The environment.;
c) Service to LU's customers;
d) Compliance with LU Standards;
e) LU reputation.

3.2.3 The outcome of the initial assessment shall be documented.

3.2.4 Where this initial assessment indicates that a risk of any significance exists, the single point of contact shall, supported by the relevant specialists produce a Change Assurance Plan detailing:

a) The proposed change or project
b) The reasons for the change of project
c) Options considered and reason for selecting / deselecting options (if already covered in other documents reference out to them)
d) Lessons learned from similar changes
e) The nature of any risks to health, safety and environment service to LU customers, compliance with LU standards or LU reputation, during and post- change;
f) Accountability for introduction of change, including details of the accountable manager, risk owner, individuals involved and the governance arrangements.
g) The actions (including timescales and accountability) for ensuring that the change will be introduced in a controlled manner so that risk is mitigated and, in the case of health and safety risk, maintained as low as is reasonably practicable, including where relevant:
    i) Further assessments and analysis to be undertaken
    ii) Consultation/ communication / liaison arrangements
    iii) Any changes required to corporate documents e.g. standards
    iv) Arrangements for assurance of all LU deliverances
    v) Arrangements for external suppliers to assure LU
h) The assurance evidence to be produced.
i) The arrangements to be enacted after the change to confirm the purpose of the change has been met and all risks have been effectively mitigated.

3.2.5 The following parties shall be consulted where appropriate during the initial assessment, identification of risk and development of the Change Assurance Plan:

a) Affected directorates within LU;
b) PPP Suppliers;
c) PFIs;
d) Train Operating Companies;
e) Any other parties affected by the proposal;
f) Health and Safety Representatives where employee health, safety or welfare is affected by the change or project.

3.2.6 Project Managers receiving comments as the result of consultation shall ensure that the comments are documented and responded to.

3.2.7 The Change Assurance Plan shall be approved by the management level appropriate to the nature and scope of the change, project or contracted service and the associated risks i.e. Change Assurance Plans may be reviewed within project teams and be approved by the relevant Business Manager or General Manager overseeing the project.

3.2.8 Prior to approving the Change Assurance Plan, the authorising body shall:

a) seek the expertise required from the relevant specialists,
b) capture their assessments and recommendations in the Change Assurance Plan.

3.2.9 Whether or not an item is submitted for DRACCT acceptance all properly authorised CAPs and PEPs (subject to meeting the requirement of clause 3.2.13) shall be sent to the DRACCT mailbox directorsriskandassurancechangecontrolteamDRACCT@tfl.gov.uk for record purposes.

3.2.10 Delivery against the Change Assurance Plan shall be reviewed by the single point of contact in consultation as necessary with other directorates.

3.2.11 The single point of contact shall include the assurance deliverables in the relevant project or change documentation.

For changes or projects applying version 2 or subsequent versions of the Project Management Framework (PMF).

3.2.12 The requirements of 3.2.2 and 3.2.3 shall be met through the development of the Project Requirements.

3.2.13 The intent of the requirements of 3.2.4 to 3.2.11 shall be met through the development of the Project Execution Plan (PEP).

3.3 Assurance arrangements and evidence for Supplier or Third Party changes and delivery of contracts for service

3.3.1 Suppliers or Third Parties shall, in good time, submit a risk based Assurance Plan for proposed changes, projects and contracts for service to LU for approval.

3.3.2 The LU Project Manager shall ensure that the Assurance Plan is provided to and reviewed for acceptability by those with assurance responsibilities within LU.

3.3.3 The Assurance Plan shall include or reference documents containing the following:

a) a description of the activity, including reference to the key elements of any design;

b) 'V', or other valid project model, that will be applied, where the activities relate to project work;
c) programme of target dates (based on information which aligns with that in the Master Project Database) for submissions to LU (as applicable) in accordance with the stages of the project shown on the project V diagram;
d) assurance roles, responsibilities and accountabilities;
e) standards applicable and any concessions sought;
f) surveillance plan;
g) details of accredited entities;
h) assurance evidence to be produced, clearly identifying those elements that it intends to provide to LU;
i) means of controlling changes, whether temporary or permanent, to any of the above items;
j) controls to be applied.

3.3.4 In determining the assurance evidence to be provided for a project, change, or contract for service, providers and receivers of assurance shall assess:

a) the impact on health and safety of LU customers, staff and the general public;
b) the impact on the environment;
c) the impact on LU operational service;
d) the impact on LU's reputation;
e) the level of understanding of asset condition;
f) how compliance with requirements will be demonstrated;
g) the complexity of the mitigation regimes and interfaces;
h) the previous performance of the provider of assurance in respect of the activity;
i) the outputs from the assurance process.

3.3.5 Assessments to determine the appropriate level of assurance evidence shall be undertaken by those with knowledge, skills and experience of the aspects they are assessing.

3.3.6 Where information from LU is required to adequately assess risk, the Supplier or Third Party shall request this from LU.

3.3.7 Any proposed alternatives to the assurance requirements outlined in this standard shall be made through the Assurance Plan and require approval by LU.

3.3.8 Where the LU response to an Assurance Plan cannot be provided within the agreed timescale, LU shall provide an estimated response time.

3.3.9 Where approval of an Assurance Plan or revisions to an Assurance Plan is withheld, LU shall identify the amendments required and the associated justification.

3.3.10 The assurance plan shall be followed and change control processes applied by the Supplier to ensure that all changes to the Assurance Plan are approved by LU and communicated to relevant parties.

3.3.11 The Supplier or Third Party shall include the Assurance deliverables and milestones in the delivery programme for the change, project, or contract for service.

3.3.12 LU shall indicate the acceptability of the assurance evidence provided to LU.

3.4 Supplementary requirements for the Assurance of Project / Programme Works delivering new or altered assets

3.4.1 Suppliers shall adopt a project lifecycle representation, in which assurance in respect of critical items in one stage have to be completed prior to commencement of the subsequent stage.

3.4.2 Critical items to be provided prior to the commencement of the subsequent stage shall be identified in the Assurance Plan.

3.4.3 During the Outcome Definition and before the Feasibility stages of the Project Management Framework (PMF) commences, LU shall be provided with assurance that:

a) The project is aligned with either contractual obligations where the project is being managed by a Supplier or LU's strategic objectives (i.e. Customer / Operational requirements) where the project is being managed by LU.
b) The business case is robust (i.e. affordable, achievable) (LU managed projects/changes/contracts only).
c) Risks have been identified and controls have been developed to ensure such risks remain acceptable to LU and health and safety risks are ALARP, following and throughout the course of the project.
d) Integration and impacts of the change at a systems level have been identified, including interfaces with Third Parties.
e) Function, requirements, specifications and scope have been captured and agreed with LU and other relevant stakeholders, including fixed requirements that apply to all activities including legislation, internal and external standards and variable requirements that are specific to a particular activity, such as works specifications or instructions.

3.4.4 During the Feasibility stage and before the Concept Design stage commences, LU shall be provided with assurance that:

(a) The selected option has been developed in sufficient detail to ensure that LU operational, technical, health and safety and customer facing requirements have been met including satisfying the original concept / business requirement where relevant.

3.4.5 During Concept Design and before Detailed Design commences, LU shall be provided with assurance that:

a) Operational and technical solutions will fully integrate at a systems level, with all identified impacts and interfaces controlled.
b) Project organisational controls are defined and in place and competent resources are available, or are planned for, to ensure appropriate and manageable delivery.
c) The outline design complies with the design brief.
d) Non-compliances associated with existing assets, have been identified where the works proposed:
    i) Include the alteration of existing assets; or,
    ii) Are in direct physical connection with the assets; or,
    iii) Have the potential to alter the relationship with or between existing assets; or,
    iv) Might introduce compatibilities or inconsistencies with existing assets that could have implications for health and safety.
e) Unless the approved Assurance Plan / PEP indicates otherwise, a Conceptual Design Statement in accordance with 3.15 has been produced and approved in principle by the recognised assurance authority prior to commencement of detailed design.
f) Unless the approved Assurance Plan / PEP indicates otherwise, the Conceptual Design Statement approved in principal by the supplier organisation has been submitted to LU, and a letter of "no objection to concept" obtained.

3.4.6 During Detailed Design and before Delivery commences, LU shall be provided with assurance that:

a) The proposed design is compliant with all relevant LU Standards subject to any concessions and risks associated with the assets are ALARP.
b) The proposed design meets the operational, customer-facing, technical and health and safety requirements, subject to any agreed variations.
c) Management controls are in place to manage the project through to completion, including contract management aspects, management and control of transitional conditions (including health and safety risks, risks to LU operations and LU reputation) and change management (technical and operational).
d) Risks to LU customers, staff and the public from the works have been assessed, any necessary mitigation put in place and LU informed of the assessment and mitigations.
e) LU has been informed of, and accepts any risk requiring LU operational management.
f) Certification is available confirming that all designs have been checked in accordance with section 3.16, including design reviews with LU where appropriate and critical findings have been addressed.
g) All design checks include, to the extent required in 3.16
    i) the validity of the criteria and assumptions made;
    ii) the arithmetical accuracy of calculations;
    iii) the compliance of the calculations and designs with the relevant engineering standards, including concessions;
    iv) the accurate translation of the designs into the contract drawings, where relevant;
    v) the compliance with and resolution of the requirements for the conceptual design statement, approved in principle, as described, with those relating to human factors to include all operability and other training procedures and other human factors implied in the design.
h) That drawings issued for manufacture or construction are signed to confirm that they comply with 3.4.6(g)(iv) and are authorised.
i) A compliant position has been achieved. Unless the approved Assurance Plan / PEP indicates otherwise, this shall be in accordance with 3.17 and approved in principle by the recognised assurance authority.

3.4.7 During Delivery and before entry of any asset into operational service, LU shall be provided with assurance that:

a) The original LU operational, customer-facing, technical and health and safety requirements have been met.
b) The original projected business benefit is likely to be achieved (LU managed changes/contracts only).
c) The assets subject to change conform to all relevant LU Standards, subject to any concessions and risks associated with the assets are ALARP.
d) The health and safety, operational, technical and customer facing impacts of the works are managed.
e) Works on or interfacing with the Operational Railway shall only commence when the resources, plans and management are in place to complete the task ahead of the next scheduled customer service.
f) There are agreed plans for inspection and testing within the Assurance Plan / PEP, and where testing impacts on the Operational Railway, this shall include Consent to Test submission in accordance with 3.18, endorsed by the recognised assurance authority and accepted by LU.
g) There are feasible and tested contingency and reversion arrangements.
h) All necessary inspection and testing outlined in the Assurance Plan / PEP is complete to the satisfaction of LU, subject to any agreed outstanding actions, such that LU may approve commencement of operations.
i) There are agreed plans for LU and where applicable, Supplier, training, communication, roll-out and support for operations where these are contracted for and they have been completed to enable staff to use new or altered assets, subject to any agreed outstanding actions.
j) Maintenance arrangements have been implemented.

k) The works are complete. For each stage of completion, unless the approved Assurance Plan / PEP indicates otherwise, a report shall be produced in accordance with 3.19 and endorsed by the recognised assurance authority.

3.4.8 Prior to Close Out, unless the approved Assurance Plan / PEP indicates otherwise, a Completion and Consent to Operate report in accordance with 3.20 shall be produced and endorsed by the recognised assurance authority.

3.4.9 Before Close Out LU shall be assured that:

a) All records associated with the project, change or contract are complete, in accordance with statutory requirements, LU standards and the internal governance arrangements of the organisations involved.
b) The anticipated benefits at this stage are being delivered.

3.5 Supplementary requirements for the assurance of Organisational and Management Change

3.5.1 Suppliers shall provide assurance to LU prior to:

a) A change of ownership.
b) A significant organisational change.
c) Any other organisational change that may impact on a contractual relationship between LU and a supplier or on contract or project deliverables.

3.5.2 Assurance shall be provided in respect of all LU organisational and management changes.

3.5.3 Assurance shall be provided to LU that:

a) The change has no adverse impact on either contract or project deliverables (for suppliers organisational or management changes) or LU's strategic objectives (for LU organisational or management changes).
b) Assessment(s) of risk and impacts to LU resulting directly and indirectly from the change have been undertaken (i.e. significant interfaces with / within LU, required changes to standards, working practices etc) and mitigated and that health and safety risks are ALARP.
c) All parties who may be affected by the change have been consulted.
d) Plans have been developed for the controlled implementation and management of the change.

3.6 Supplementary requirements for the assurance of Maintenance or Inspection Regimes and Changes to these regimes

3.6.1 Assurance Plans, in respect of Supplier asset maintenance and inspection activities by asset area, shall be submitted to LU at least annually.

3.6.2 LU shall be provided with assurance that:

a) The choice of, or change in, a maintenance or inspection regime will not result in an adverse effect on LU.
b) Risks have been identified and controls have been developed to ensure that risks which could affect LU remain ALARP during the maintenance activity and after completion of the maintenance activity.
c) Assets will remain safe, reliable, fit for purpose and continue to meet performance requirements.
d) Assets will be maintained to a level that ensures all relevant LU Standards and requirements are satisfied, subject to any concessions.

e) Proposed maintenance regimes will ensure the required life of the asset is achieved.
f) Mechanisms are in place to monitor the effectiveness of new, changed or existing maintenance or inspection regimes and provide preventative or remedial action(s) where required.
g) Direct impacts and indirect impacts at a systems level as a result of maintenance activity have been identified and mitigated.
h) Assets will be available for use in service as determined by contractual obligations.
i) Measures are in place to ensure that relevant information is shared with LU, Suppliers or third parties where appropriate.
j) Any effect on LU operational services arising from the change is minimised.

3.7 Supplementary requirements for the assurance of New or Modified Rolling Stock

3.7.1 Approval for the introduction of new or modified rolling stock into service, including testing, shall be obtained from LU prior to the commencement of the operation of:

a) New or modified passenger vehicles operated by LU or another train operating company over LU infrastructure;
b) New or modified Engineering vehicles;
c) New or modified on-track plant;
d) New or modified infrastructure support vehicles;
e) The widening of the operational area of approved rolling stock.

3.7.2 Before entry into service (including testing), LU shall be provided with assurance that:

a) New, modified or changed Rolling Stock has been assessed for direct and indirect risks arising from the change and that corresponding actions to mitigate risks, or reduce them to ALARP, are in place;
b) Any new or amended operating procedures have been incorporated into the LU Rule Book, concessions sought, or temporary rules established in accordance with 3.10 in cases where no rule exists;
c) The Emergency Response Unit (ERU) has been consulted as necessary and provided with all information that may be required in the event of a significant incident or accident;
d) Vehicles proposed to be operated over LU infrastructure are covered by an accepted Safety Certificate (e.g. LU, Transplant, Mainline train operating company etc.);
e) Where appropriate, all National Rail approvals have been obtained;
f) Approval and a Certificate of Technical Conformance has been obtained from LU in accordance with section 3.21.

3.8 Supplementary requirements for the assurance of New or Modified Signalling and Signalling Control systems

3.8.1 Before delivery commences, LU shall be provided with:

a) A documented safety justification for each system, which:
   i) contains a safety analysis covering all parts of the system (hardware and software), including, for any safety critical system, the unprotected wrong side failure rate of that system;
   ii) applies appropriate methods of safety assessment;
   iii) embraces all parts of the system that have an effect on its safe operation.
b) A preliminary hazard assessment based upon the preliminary design, using appropriate risk assessment techniques;

c) The specification for the data content of the Table of Controls proposed by the designer;
d) The Table of Controls and associated scale plans.

3.8.2 The preliminary hazard assessment shall be reviewed by the Design Authority before the start of detailed application design.

3.8.3 The safety analysis shall be reviewed and resubmitted to LU when:

a) data changes;
b) the assumptions made in the analysis are no longer valid;
c) modifications are made to the systems design.

3.8.4 Proposals to change LU Railway signal arrangements in areas where the rolling stock of other train operators also run, shall only be made with the agreement of the LU Director of Engineering.

3.9 Supplementary requirements for the assurance of Works impacting on the Operational Railway

3.9.1 For all infrastructure changes that have the potential to impact the operation of any approved passenger trains, heritage trains, engineer's vehicles or 3rd party vehicles that currently have approval to operate on LU Infrastructure the change manager shall:

a) Undertake an assessment of the infrastructure changes to determine whether these changes affect the compatibility of vehicles listed in the schedules of permitted running routes for passenger vehicles and engineer's vehicles.

b) Consult with those affected parties.

c) Provide the necessary assurance documentation to amend the permitted running route schedules in accordance with Category 1 Standard S1181 - Permitted Running Routes for Passenger, Engineer's and Heritage Vehicles.

3.9.2 Prior to delivery commencing, the scope and impact of the works on the running of the Operational Railway shall be communicated by the supplier to the LU Access Team on either an Operational Assurance Notification (OAN) form or via a Works Request though the Access Portal.

3.9.3 The OAN form and/or Works Request shall:

a) Provide details of the duration and locations of the work;
b) Describe the works in non-technical terms, such that an assessment of the scale and nature of the impact, the consultation required and any local action that may be required;

3.9.4 Prior to delivery commencing, LU shall be provided with assurance that:

a) Health and safety risks to customers and employees are reduced to, or maintained ALARP.

b) Risks to the operational railway and LU assets are reduced to, or maintained ALARP.

c) Working arrangements and inspections have been agreed in advance of the works.

3.9.5 The LU Station Access Planning Managers/Infrastructure Planning Managers are authorised delegates for Landlord Managers in accordance with London Underground's Safety Certificate and Safety Authorisation Document.

3.9.6 The LU Station Access Planning Manager/Infrastructure Planning Manager will:

a) Ensure that an operational impact assessment of the planned works is undertaken and that appropriate consultation has taken place between the Landlord Manager, other affected parties and those conducting work on railway infrastructure or stations.
b) Ensure that Landlord Managers are provided with notification of any works which are likely to impact station or train operations via an Operational Assurance Notification form prior to works commencing.
c) Authorise access though the issue of approved SABRE number(s) once satisfied that operational safety requirements have been satisfied

3.9.7 The OAN shall be valid for the duration of the works, unless there is a change to the position stated on the OAN, in which case a new OAN shall be submitted.

3.9.8 There is no additional requirement under this standard to notify the local LU manager of:

a) Emergency works or immediate fault rectification works under a Fault Report Centre number;
b) Works for which generic access has been granted;
c) Planned maintenance works undertaken within the Line Clear Line Safe areas.
d) Non intrusive surveys;
e) Access to the track via station locations where access has no impact on station operation and material movements are in accordance with the LU Rule Book;
f) Works in depots or engineering workshops.

3.9.9 The OAN number shall be entered on the Site Access Booking for Railway Engineering System (SABRE), to indicate that operational assurance has been provided.

3.10 Supplementary requirements for the assurance of temporary rules affecting the Operational Railway

3.10.1 Approval for the application of rules affecting the Operational Railway shall be obtained from LU and accepted by DRACCT prior to their application.

3.10.2 The following shall be provided to LU in support of the proposal for a temporary rule:

a) An overview of the proposal, including the duration of the proposed task;
b) The reason(s) why a Rule Book cannot be followed;
c) A description of the tasks and how they are to be carried out;
d) Assurance that the risks associated with the proposal have been identified and controls established;
e) A description of the rule(s) and controls for the temporary way of working;
f) Details of contingencies;
g) References to any appropriate supporting documentation.

3.11 Supplementary requirements for the assurance of permanent and temporary works that affect Fire Precautions on LU stations

3.11.1 Where works on LU stations/premises require permanent changes to Fire Precautions when such works are completed, suppliers shall, in advance of the commencement of works:

a) provide LU with assurance that fire safety requirements will continue to be achieved on completion and that the works comply with all relevant LU Standards and;
b) obtain acceptance of the changes from the LU Fire Compliance Manager.

3.11.2 Following the acceptance of the change by LU, the Supplier shall, in Good Time, advise LU of the proposed start of works.

3.11.3 The LU Fire Compliance Manager shall inform the following parties of the permanent changes:

c) The relevant PPP supplier (where the applicant is not a PPP Supplier);
d) The responsible Landlord Manager;
e) Where the premises are not managed by a PPP Supplier, the relevant asset management or facilities management provider.

3.11.4 Where, during works, temporary changes to the Fire Precautions are required suppliers shall communicate such changes to the LU Fire Compliance Manager for acceptance and provide assurance that fire safety requirements and compliance with all relevant LU standards will be achieved for the duration of the works. This acceptance shall be gained before any such works commence.

3.11.5 The LU Fire Compliance Manager shall inform the responsible Landlord Manager of the proposed temporary changes to Fire Precautions.

3.11.6 On completion of works, and before those works are put into use, the Supplier shall:

a) provide LU with assurance that relevant fire safety requirements, including all relevant LU Standards, have been met and;
b) obtain acceptance of the changes from the LU Fire Compliance Manager.

3.11.7 Following the acceptance of the change the responsible PPP Supplier shall amend the Station Layout Plan to reflect the permanent changes implemented including Station Area Identification (SID) numbers.

3.12 LU Verification Activity

3.12.1 LU shall determine the verification activities to be undertaken by LU, if any, to verify the assurance evidence provided by those delivering projects or changes.

3.12.2 LU shall produce a risk-based Verification Activity Plan (VAP) which includes:

a) the activities to be undertaken throughout the lifecycle of the proposed change or contract for service;
b) any evidence detailed in a Suppliers or third party's Assurance plan which will be required to be submitted to LU to assist in verification activity, including any evidence required to support the safety verification activities of LU's Independent Competent Person (ICP);
c) any evidence required for LU to grant approval for projects to progress between project stages.

3.12.3 Suppliers or Third Parties shall be provided with a copy of the VAP.

3.12.4 LU shall reserve the right to change the scope of the VAP or extent of its verification activities and the level of supplier or third party assurance evidence sought at any time and, in particular, in the event of:

a) Assurance evidence provided being significantly inadequate;
b) A significant non-compliance affecting risk being identified;
c) A major change with significant risk implications;
d) A major incident;
e) A degradation of supplier assurance and/or corrective action arrangements.

Where LU considers necessary this shall include seeking assurance directly from lower levels in the assurance chain.

3.12.5 Any amendments to the VAP or the extent of verification activities shall be notified to the Supplier or Third Party in Good Time.

3.12.6 All parties in the supply chain shall co-operate with the verification activities outlined in the VAP.

3.13 Items requiring LU DRACCT Acceptance

3.13.1 All items to which Schedule 4 of ROGS "Written Safety Verification Requirements" applies shall be reviewed by the LU Directors' Risk Assurance and Change Control Team (DRACCT).

3.13.2 Change Assurance Plans, supplier assurance evidence and VAPs for changes, projects or contracts for service that are complex, or pose significant risk shall be referred to LU DRACCT for acceptance. This may include those where the most likely outcome if controls fail is:

a) One or more fatalities;
b) Prosecution for failure to comply with legislation;
c) Significant non-compliance with requirements having either an adverse health and safety or operational impact;
d) Significant environmental damage, likely to result in enforcement action;
e) Significant loss of customer benefit;
f) Significant risk to LU reputation.

3.13.3 Submissions to DRACCT shall be made by the LU sponsor via the DRACCT Secretariat.

3.13.4 Where required by LU, Suppliers, third parties and LU sponsor shall attend DRACCT.

3.13.5 The outcome of DRACCT, including any conditions of acceptance or amendments required, shall be notified to the applicant in writing within 7 working days of the completion of the review.

3.13.6 The applicant shall complete the required action within the agreed timescales, or seek dispensation from the DRACCT Chair.

3.14 Assurance Records

3.14.1 Copies of all documentation associated with assurance activity shall be maintained by the organisation managing the change, project or contract for service in accordance with statutory requirements, LU standards and the internal governance arrangements of the organisations involved.

3.14.2 The LU Chief Operating Officer (or representative) and Line General Managers shall maintain records of all rolling stock operational approvals granted, as required by section 3.21.

3.14.3 Records of all engineering approvals shall be held by LU Capital Programmes Directorate and the appropriate Supplier engineering department.

3.15 Content of a Conceptual Design Statement

3.15.1 A Conceptual Design Statement shall include, as appropriate to the nature of the works:

a) the standards applicable;
b) concessions, as identified at this stage, to be sought;

c) how health and safety risks have been identified and are being managed in accordance with best practice and demonstrated to be reduced to ALARP levels;
d) drawings and diagrams applicable for all assets, showing the general arrangement of the project works, including the existing arrangements;
e) evidence that all the requirements of the design brief will be met;
f) identification of the systems, sub-systems and equipment which will subsequently be developed to form the final design;
g) identification of the function of each system, sub-system and equipment;
h) identification of the relationship and interfaces between systems, sub-systems, equipment and components, between different asset areas and those with other parties;
i) control points and controlling authorities in the design and development and other project lifecycle phases;
j) identification of all the human factors, the requirements for operability, health and safety, availability, reliability and maintainability and how they will be met and proved;
k) evidence of consideration of the operational conditions or states and all other relevant matters described in Railway Safety Principles and Guidelines (RSPG);
l) where building work is included, confirmation of how clause 3.1.6 will be complied with;
m) identification of all relevant statutory obligations and description of how they will be complied with;
n) evidence of consideration of the appearance of the completed project and it's component parts visible to the public, conducted in conjunction with LU and liable to peer review by independent architects;
o) compliance with guidance on environmental assessments issued by statutory authorities and current best practice in the industry relevant to the engineering works involved;
p) intended testing arrangements and associated pass or fail criteria;
q) evidence of consideration of additional criteria relevant in specific asset areas;
r) the acceptance criteria applicable to any other relevant matters outstanding;
s) intended list of operating and maintenance manuals and record drawings, where applicable, in a form acceptable to a recognised relevant independent standards organisation.

3.15.2 The following comprise the minimum content of a Conceptual Design Statement for all structures:

a) Name of design organisation;
b) Identification of structure:
    i) Location
    ii) Description
c) Title of scheme;
d) Name of Supplier or Third Party;
e) Proposed dates of project start and completion;
f) Brief description of existing conditions:
    i) Site investigation reports
    ii) Environmental conditions (including possible changes)
    iii) Proposed additional surveys or investigations
g) Description of proposed works and method of construction with reasons for choosing. (Attach general arrangement & scheme drawing nos.):
    i) Foundations
    ii) Structure
    iii) Method of construction
    iv) Special finishes or features
    v) Clearances from other structures
h) Brief description of other structural forms considered and reasons for their rejection;
i) Design criteria:

i) Live loads including partial safety factors where appropriate
ii) Soil parameters

j) Proposed method of structural analysis;
k) Standards and codes of practice to be used in design, including temporary works (state any departures);
l) Safety considerations;
m) Clearances;
n) Functional requirement;
o) Maintenance requirements;
p) Design check category specified in design brief;
q) Proposals for independent category 2 or 3 design checks in 3.16 (where applicable).

3.15.3 The following are additional or substituted requirements for bridges for the corresponding requirements in 3.15.2:

a) Bridge type: under/over/foot; Road or river name;
b) Substructure investigations;
c) Span arrangements, Superstructure, Outline temporary works proposals and influence of traffic constraints;
d) Underbridge (RL/RU loading): Traffic type (H/M/L), Annual traffic tonnage, Speed for centrifugal force, Minimum ballast depth & sleeper type, Track lift' Construction depth (rail to soffit);
e) Overbridge: Proportion of HA loading adopted with reasons if less than full), HB loading, Provision for exceptional abnormal loads (gross weight in tonnes, axle load and spacing), Standard of parapet containment, Road profile and sighting distance, Road and footpath arrangement, Surfacing details;
f) Substitute:- Places of safety.
g) Existing minimum headroom, Proposed minimum headroom.

3.15.4 The following comprise the minimum content of a Conceptual design Statement for permanent way engineering projects:

a) Project/scheme title;
b) Proposed project/scheme commencement and completion dates;
c) Identifying reference for project/scheme;
d) Location(s) of project;
e) Name of design organisation;
f) Name of supplier to LU;
g) Description/scope of works and objectives of scheme;
h) Track removed or altered under project;
i) Confirmation of project specific assurance and/or quality plan in place;
j) Key health and safety issues, Health and Safety File (under The Construction (design and Management) Regulations 1994 and amendments thereto);
k) Design principles, basic equipment ratings and key drawings;
l) Confirmation of equipment functionality, performance, reliability, availability and operability, health and safety, human factors and maintainability assessment;
m) Standards, Railway Safety Principles and Guidance, compliance and codes of practice used in design (state any departures and concessions required);
n) Interfaces with other asset areas across systems;
o) Name of maintainer;
p) Confirmation of asset maintenance and renewal regime in place;
q) Proposals for independent design check category 2 or 3 in clause 3.16;
r) Analysis of alternative options and reason for rejection;
s) Reference to contractual compliance documentation;
t) Details of any proposed innovation in track construction or design;
u) Likely impact on asset health, maintenance requirements and asset performance.

3.16 Design Checks

Cat	Description of items or elements of work	Check by (as minimum)
0	Unlikely to affect health and safety or operational performance, as a consequence of failure, and are not normally subject to calculation, but excluding any work covered by Categories C and S.	Another member within the Design Team.
1	Not critical to health and safety or operational performance and which may be designed using standard methods of analysis, but excluding any work covered by Categories C and S.	Another member within the Design Team, checking against the design calculations and assumptions and critically considering whether the base assumptions are valid.
2	a) Critical to health and safety or operational performance which may be designed using standard methods of analysis, but excluding any work covered by Categories C and S, or: b) Not critical to health and safety or operational performance, but which require complex or unusual methods of analysis, but excluding any work covered by Categories C and S.	Another Design Team within the same design organisation, but independent of the original Design Team, critically challenging the original Design Team's base assumptions.
3	a) Complex civil engineering works and other structures or permanent way schemes using non-standard or rarely-used components or design parameters which are critical to health and safety or operational performance and which require complex or unusual methods of analysis. b) Civil engineering works and other structures or permanent way schemes, otherwise subject to Categories 1 and 2 checks, which have been designed by the contractor responsible for their construction. c) Systems or equipment in asset areas other than civil engineering, which are critical to health and safety or operational performance. , the adequacy of which cannot be proved in tests or pre-commissioning trials and which require complex, novel, or unusual methods of analysis, but excluding software for control or protection of systems and signaling systems (covered by Categories C and S	An Independent Design Organisation having relevant knowledge and experience of the particular class of work, supplied with relevant drawings of the final designs, carrying out analyses and assessments to validate the designs without sight of those of the original design organisation.
C	Software for railway control and protection systems	Application of BS EN 50128
S	a) Signalling control systems b) Vital signaling, including data for computer based signaling systems but excluding components such as cables.	As for b), except, if justified by an independent risk assessment, the check by the Principles Approver may be omitted. The Preparer, Checker and Principles Approver. The check by the Preparer and Checker shall encompass the full details of the design to achieve freedom from error. The check by the Principles Approver shall: 1) validate the design in terms of standards, safety principles and operability; and 2) include the signalling logic, a review of interface issues and the correct application of equipment

3.17 Content of a Compliance Submission

3.17.1 A Compliance Submission shall include, as appropriate to the nature of the works:

a) background and scope including:
   i) a detailed description under each asset discipline of the scope of the work;
   ii) confirmation that existing assets incorporated in the project have been assessed for compliance with LU Standards, any concessions sought and risks associated with the assets are ALARP;
   iii) identification of any significant interfaces with other assets (including outside party and PFI assets);
   iv) reference to the Conceptual Design Statement and the Approval In Principle where applicable.
b) a programme, with key dates of the stages of the project;
c) drawings and diagrams applicable for all assets, showing the general arrangement of the project works, including the existing arrangements;
d) evidence that the specification of user requirements has been met with respect to the design stage;
e) health and safety issues, including:
   i) a brief description of the main health and safety issues and how these have been identified and addressed;
   ii) a statement of whether the project has been notified under CDM;
   iii) a statement as to whether there are any Railways and Other Guided Transport (Safety) Regulations implications or requirements;
   iv) a statement of whether there are any impacts on the Local Fire Management Strategy.
f) a list of the main standards applicable to each asset area. Confirmation that the design work is in accordance with LU standards or, if in accordance with other standards, the reason for their use shall be stated. If any concessions to standards have been sought or granted, the details shall be listed in the report or as an attachment;
g) a list of all deviations from RSPG;
h) evidence that the persons and organisations responsible for the design and checking of various elements are in accordance with the Conceptual Design Statement and Approval in Principle documents. Copies of the signed off Design Check Certificates, and the Design Review documentation shall be provided in accordance with the Assurance Plan / PEP Plan;
i) evidence that systems integration issues have been dealt with;
j) evidence that human factors have been dealt with;
k) evidence of operability under normal, abnormal, degraded and emergency conditions;
l) a summary of the law applicable to the works and confirmation that all relevant legal obligations have been or will be met;
m) evidence of compliance with guidance on environmental assessments issued by statutory authorities and current best practice in the industry relevant to the engineering works involved;
n) evidence that any necessary applications for planning permission or other licence, permit or other statutory requirements have been made;
o) evidence of details of intended testing arrangements and associated pass and fail criteria;
p) a description of any impacts on:
   i) changes or differences to maintenance requirements;
   ii) asset performance;
   iii) asset health.
q) an explanation, in cases where provision is to be made for additional assets to be installed at a later date, indicating how this will be achieved and the anticipated dates for installation and completion;

r) a list of proposed operating and maintenance manuals and record drawings, where applicable, in a form acceptable to a recognised relevant independent standards organisation;
s) evidence that, where the project includes work which may affect existing railway operations:
   i) signal sight lines will not be obscured;
   ii) track clearances will be maintained.
t) a list of persons accredited in each asset area, who will make declarations that the design of the project complies with LU requirements and RSPG, together with any additional declarations at a systems level. Copies of the Declaration Certificates shall be provided.

3.18 Content of a Consent to Test/Trial report

3.18.1 A Consent to Test/Trial report shall include, as appropriate to the nature of the works:

a) a brief description of the project which refers back to the Compliance Submission;
b) a programme, with key dates of remaining stages of the project;
c) a summary of the objectives and the scope of the tests or trials;
d) a description of how it will be ensured that it is safe to commence the tests or trials, identifying how the state of systems and equipment will be verified and how a boundary will be established between the system under test or trial and operational systems or areas;
e) a description of how health and safety will be ensured during the tests or trials;
f) a description of how health and safety will be ensured at the completion of tests or trials (this being particularly important in “over and back testing” where systems require to be returned to their pre-test state after tests);
g) schedule of tests or trials identifying for each:
   i) the name or number of the test or trial;
   ii) the method, referenced to British Standards or LU standards, where appropriate;
   iii) the pass and fail criteria.
h) evidence that, where the project includes work which may affect the existing railway in operation:
   i) signal sight lines will not be obscured;
   ii) track clearances will be maintained.
i) the list of persons accredited in each asset area, who will make declarations that the construction or manufacture of the project has been completed in accordance with LU requirements and RSPG (noting any deviations) in order that testing can be carried out, together with any additional declarations at a systems level. Copies of the Declaration Certificates shall be attached as evidence.

3.19 Content of a Staged Completion Report

3.19.1 A Staged Completion report shall include, as appropriate to the nature of the works:

a) a brief description of the project which refers back to the Compliance Submission or, if made, a Consent to Test Submission and its report;
b) a programme, with key dates of remaining stages of the project;
c) identification of any changes to the scope of work as compared to that given in the Compliance Submission. (Supporting drawings to allow the changes to be easily understood shall be attached). Such changes shall be notified to LU as work proceeds and a confirmation of “no objection” obtained;
d) a clear definition of what is and what is not being brought into use;
e) a clear description of how a boundary will be maintained between areas or systems in use and those that are not;

f) a clear description of how health and safety is maintained in areas in use while work goes on in those that are not;
g) evidence that the specification of user requirements has been met;
h) evidence that all relevant legal obligations have been met;
i) evidence that human factors integration and systems integration issues have been dealt with in accordance with standards;
j) evidence of operability under normal, abnormal, degraded and emergency conditions;
k) evidence of compliance with guidance on environmental assessments issued by statutory authorities and current best practice in the industry relevant to the environmental impact of the engineering works involved;
l) evidence that all LU and, where relevant, supplier staff training or familiarisation to enable staff to use new or altered works being brought into use at this stage, has been completed;
m) evidence that all tests and trials (including lighting levels and electromagnetic compatibility certificates) have been successfully completed;
n) a list of operating and maintenance manuals;
o) identification of all deviations from standards and guidance by regulatory authorities, together with confirmation that all necessary concessions have been granted;
p) clear identification of any minor items yet to be completed (commonly called a "snagging list") together with a programme for completion before bringing the stage into use;
q) evidence that all pre-conditions arising from risk assessments have been met for the appropriate stage;
r) evidence that, where the stage includes work which may affect the existing railway in operation:
    i) signal sight lines will not be obscured;
    ii) track clearances will be maintained.
s) evidence of the handback or handover arrangements.

3.20 Content of a Completion and Consent to Operate Report

3.20.1 A Completion and Consent to Operate report shall include, as appropriate to the nature of the works:

a) background and scope including:
    i) confirmation that the scope is as detailed in the Compliance Submission and, if otherwise, detailing all changes;
    ii) reference to the report, previously submitted, confirming the compliance of the design and, if made, to the Declaration for Staged Completion (or Use before Completion) and its report.
b) evidence that the specification of user requirements has been met with respect to the construction or manufacture stage;
c) health and safety issues, including:
    i) confirmation that the requirements of Construction, Design and Management Regulations have been met and of the location of the Health and Safety file information;
    ii) a statement that any health and safety requirements e.g. risk controls, have been met;
    iii) confirmation that any actions required by the Railways and Other Guided Transport Systems (Safety) Regulations have been met;
d) if any concessions to standards have been sought or granted during the construction or manufacture stage, the details shall be listed in the report or as an attachment;
e) a list of all deviations from RSPG during the construction or manufacture stage;
f) evidence that human factors have been dealt with;
g) evidence of operability under normal, degraded and emergency conditions;
h) evidence that all relevant legal obligations have been met;

i) evidence that any necessary requirements of the planning permission or other licence, permit or other statutory requirements have been met;
j) evidence of details of all testing prior to commissioning (including lighting levels and electromagnetic compatibility certificates) have been completed satisfactorily. Confirmation of the location of all materials and other test results. Copies of all test certificates for any statutory tests shall be provided;
k) a list of operating and maintenance manuals and record drawings;
l) evidence that, where the project includes work which may affect existing railway operations signal sight lines are not obscured and track clearance have been maintained. A copy of the Track Clearance Certificate shall be provided;
m) a list of persons accredited in each asset area, who will make declarations that the completed project complies with LU requirements and RSPG (noting any deviations), together with any additional declarations at a systems level. Copies of the Declaration Certificates shall be provided;
n) evidence that all LU staff training or familiarisation to enable staff to use new or altered works being brought into use, has been completed;
o) evidence of the handback or handover arrangements.

3.21 New or modified rolling stock requiring LU approval

C = Consent given. IMA = Infrastructure Manager Approval given. CTC = Endorsed a Certificate of Technical Conformance for the train(s) or vehicle(s). WA = Gives written acceptance confirming any affected LU operational staff will receive a briefing or instruction/training (as and when necessary) and that the line is ready for the change. * = Infrastructure Manager Approval will only be given following the endorsement of a CTC and, for passenger stock only, written acceptance from the appropriate Line General Manager confirming that any affected LU operational staff will receive a briefing or instruction/training (as and when necessary) and that the line is ready for the change. ** = Not required for engineering trains and infrastructure maintenance support trains. *** = Infrastructure Manager Approval will only be given following the endorsement of a CTC, confirmation that any affected LU operational staff will receive a briefing or instruction/training (as and when necessary) and that the line is ready for the change.	Required assurance			
	LU Chief Operating Officer (or representative)	LU Professional Head of Rolling Stock	LU Line General Manager	Tube Lines engineering
New rolling stock operated by any train operating company, including LU				
Before operation of new rolling stock listed in [1], which is to be operated as a train on LU infrastructure can commence.	IMA*	CTC	WA**	
Widening the operational area of approved rolling stock operated by any train operating company, including LU				
When it becomes necessary to widen the operational area of rolling stock listed in [1] approved to operate as a train on LU infrastructure, before operation can commence.	IMA*	CTC	WA**	
Modification to existing passenger rolling stock operated by LU				
Temporary and permanent modifications to existing passenger rolling stock which is to be operated on LU infrastructure where modifications affect the factors listed in [2].	IMA*	CTC	WA	
Temporary and permanent modifications to existing passenger rolling stock which is to be operated on LU infrastructure where modifications affect the factors listed in [5].		CTC	IMA***	
Existing passenger rolling stock with special repairs (e.g. crash or fracture repairs which leave the vehicle in a non-standard but serviceable condition).		CTC		
Any vehicle that has not been operational on LU infrastructure for a period of 6 months or more.		CTC		
Modifications to existing BCV and SSR passenger rolling stock which do not change the factors listed in [2, 5].		C		
Modifications to existing JNP passenger rolling stock which do not change the factors listed in [2, 5].				C
Modification to existing rolling stock operated by any train operating company, excluding LU				
Temporary or permanent modifications to existing rolling stock which is to be operated as a train on LU infrastructure, where modifications do not change the factors listed in [2].	LU approval not required			
When changes affect the factors listed in [2], before operation can commence.		CTC		
Engineering rolling stock and on-track plant operated in a possession, specified area or engineer's current area				
Before operation of all engineering rolling stock and on-track plant listed in [3, 4] which are to be operated on LU infrastructure only in a possession, specified area or engineer's current area.		CTC		

[1] = Applies to passenger trains, engineering trains and infrastructure maintenance support trains.

[2] = Changes that affect the following:
Rolling stock traction and braking performance,
Interaction between rolling stock manual/automatic control systems and signalling systems (affecting operating performance)
LU Rule Book and its associated publications,
Working timetable,
Safety of track staff (worsen only),
Rolling stock safety (worsen only).

[3] = Applies to new or existing vehicles whether or not they conform to the definition of a train

[4] = Applies to engineering trains, passenger trains being used for engineering purposes or test purposes, on-track plant which is included in the formation of a train and on-track plant which is not included in the formation of a train

[5] = Changes that affect the following:
Rolling stock reliability (worsen only),
Rolling stock availability (worsen only),
Cab environment (interior and exterior),
Saloon environment (interior and exterior),
Accessibility (worsen only),
LU operational staff (duties and training).

3.22 Principles of Assurance

3.22.1 The assurance regime shall be based on the appropriate intrusion necessary to fulfil the assurance needs of the next higher level in the assurance chain.

3.22.2 Assurance shall be a continuous, involving and evolving process.

3.22.3 The level of assurance shall be risk based.

3.22.4 All requirements shall be clearly and unambiguously defined.

3.22.5 Assurance requirements shall be imposed down the assurance chain and the provision of assurance shall be provided up the assurance chain.

3.22.6 Assurance requirements placed on a provider of assurance shall be non-prescriptive.

3.22.7 Providers of assurance may exceed the specified requirements but this shall not place any additional obligations on other providers of assurance.

3.22.8 Each level in the assurance chain shall normally seek assurance only from the level immediately below.

3.22.9 Assurance shall be accreditation and evidence based.

3.22.10 Acceptance and approval processes do not absolve the provider of assurance from their responsibility to provide such assurance.

3.22.11 Assurance activities shall be integrated through a central point at each level in the assurance chain within an agreed framework.

3.22.12 Each level in the assurance chain shall have processes accredited by the receiver of assurance for demonstrating and recording the competence of all recognised persons involved in the assurance process.

3.22.13 The purpose and process for audits shall be understood by all concerned.

3.22.14 Processes for the management of non-compliance to requirements shall be established.

3.22.15 There shall be a clearly defined and effective mechanism for the clearance of corrective actions.

4 Responsibilities

4.1 All responsibilities are outlined in Section 3.

5 Supporting information

5.1 Examples of changes, projects, activities and contracts for services in scope

5.1.1 Examples of changes, projects or contracts for service to which this standard applies include:

a) organisational and management changes, including change that may impact upon a contractual relationship with LU or required contract / project deliverables;
b) changes to methods of operation;
c) changes to inspection and maintenance arrangements;
d) introduction of new or altered assets or equipment;
e) maintenance or inspection programmes;
f) location specific planned maintenance, repair or replacement of assets or equipment which, when carried out, has a significant effect on passenger flows or loadings;
g) planned service level changes;
h) the introduction of new, or modification of, existing Rolling Stock or on track plant and equipment (including Road-Rail vehicles and track trolleys);
i) new formations of permanent / semi-permanent coupled Rolling Stock;
j) changes that may impact on LU customer facing requirements (e.g. heritage standards);
k) Temporary operational and health and safety procedures to be introduced, where there are no existing operational rules in the LU Rule Book, which cover the intended method of operation or working.

5.1.2 The following activities (when carried out in accordance with LU's Standards) would not normally require an Assurance Plan/PEP:

a) responses to incidents, failures etc, such as short term deviations from normal operation or reactive maintenance activity;
b) location specific maintenance, repair and like-for-like replacement of equipment and components, carried out under an assured maintenance plan, unless it has a significant effect on passenger flows or loadings.

6 References

6.1 References

6.1.1 Statutory documents

Document no.	Title
-	Railway and other Guided Transport Systems (Safety) Regulations

6.1.2 Industry codes of practice

Document no.	Title
-	Engineering Safety Management "Yellow Book" - RSSB

6.1.3 LU company documents

Document no.	Title
-	LU Project Management Manual
5-539	Verification of Assurance

6.2 Abbreviations

The following abbreviations are created:

a) within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
b) from published sources that are clearly identified.

Abbreviation	Definition	Source
ALARP	As Low As Reasonably Practicable	a
CAP	Change Assurance Plan	a
DRACCT	Directors Risk and Assurance Change Control Team	a
ERU	Emergency Response Unit	a
LU	London Underground	a
OAN	Operational Assurance Notification	a
PEP	Project Execution Plan	a
PFI	Private Finance Initiative	a
PPP	Public Private Partnership	a
SABRE	Site Access Booking for Railway Engineering System	a
SID	Station Area Identification	a
VAP	Verification Activity Plan	a

6.3 Definitions

The following topic specific definitions are created:

a) within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
b) from published sources that are clearly identified.

Term	Definition	Source
Access Reservation Agency	A division of LUL which shall be responsible for recording Access Requests on SABRE and administrating the procedure set out in the Access Code;	a
Accredited	Descriptive of an organisation or individual empowered to provide assurance within specified boundaries	a
Assurance	The extent that defined requirements have been complied with and that controlled processes have been followed in achieving the deliverables.	A
Assurance Plan	A plan outlining a supplier's assurance milestones; and defining the supplier's proposals for providing evidence of assurance to LU at each assurance milestone, by way of tests, demonstrations or otherwise.	A
Checker	A person not necessarily in a different design team but who is independent of the Preparer, who checks the work of the Preparer, in respect of vital signalling or signalling control systems;	a

Term	Definition	Source
Design group	Part of a design organisation, under the dedicated direction of a competent person and comprising a number of design teams;	a
Design organisation	A department of, or an organisation comprising a number of design groups owned, controlled or appointed by a supplier or an outside party, for the purpose of carrying out the original engineering design of projects including new or altered work;	a
Design review	Documented, comprehensive and systematic examination of a design to evaluate its applicability and adequacy and its capability to identify problems, if any, and propose the development of solutions;	a
Design team	Part of a design group, comprising one of more persons working on the engineering design of projects including new or altered assets;	a
Fault Reporting Centre or FRC(1)	means a staffed telephone answering service provided by an Infraco which receives information on Asset faults as reported by LUL Staff, assigns a fault reference number to each reported fault, identifies and mobilises the required resource to fix the fault within the Standard Clearance Time or (if prescribed by LUL) the Special Clearance Time, feeds back progress on fault repair to LUL, and maintains a complete database of all fault measurement information to enable contract payments and management of assets and determines the allocation of Under 48 Hour Access Requests in accordance with the Access Code	a
Fire Precautions	Those measures, be they physical assets or management procedures that contribute to the control of fire risk in the relevant premises.	A
Function	The purpose or action for which a person or thing is particularly fitted or employed.	A
Good time	Sufficient time has been allowed for: • the provision of the required information • the time required for review by the recipient and the provision of any response • taking account of any such response • the recipient to take any action required of them to control risk	a
Independent design organisation	A design organisation , which is a separate legal entity from that which carried out the original engineering design, appointed by the supplier for the purpose of checking the original design.	A
Inspection and Maintenance	Preventative activities, including strategic planning arrangements for Maintenance and inspection, Remedial activities, including strategic planning where appropriate, Regimes required by Statute or LU requirements. The undertaking of preventative or corrective action, or both, including repairs, to ensure that the Condition of the asset continues to meet the Required Duty over the service life of the asset.	A
Landlord Manager (2)	The appointed representative (or authorised delegate) of LUL who acts as custodian of a particular asset on behalf of the company. This may be, for stations, the Group Station Manager or for infrastructure (train path or permanent way), or Train Operating Manager	a

Term	Definition	Source
Line Clear area	All LU track, and the first 600 mm from each platform edge in the subsurface sections and the tube sections, except: • non-electrified track • track within depots or sidings where traction current is normally on at all times • the platform side of stations at stations fitted with platform edge doors when fully closed.	A
Line Safe area	All LU track, and the first 600 mm from each platform edge not included in the Line Clear area except: • non-electrified track • track within depots or sidings where traction current is normally on at all times.	A
LU reputation	Maintenance of corporate identity and brand, promotion of accessibility and inclusion, management of design, protection of heritage.	A
New assets	Assets which are new in design or purpose which are not contemplated or accounted for under the Third Schedule of the PPP Contracts;	a
Operational railway	An area which is • within the LU boundary fence alongside the track in the open section • between the tunnel walls alongside the track in tunnel sections • within a - station - signal box - Signalling or Service Control Centre - regulating room - Line Control Office - control and command centre - substation - power control room - depot or stabling sidings.	A
Preparer	A person in a design group who prepares the engineering design of vital signalling or signalling control systems;	a
Principles Approver	A person not necessarily in a different design team but who is independent of the Checker and the Preparer, who checks and approves the work of the Checker and the Preparer, in respect of vital signalling or signalling control systems;	a
Project	A unique set of co-ordinated activities, with definite starting and finishing points, undertaken by an individual or organisation to meet specific objectives within defined schedule, cost and performance parameters	a
Project Manager	The person nominated for the activity or work to manage, co-ordinate, and bring it to a satisfactory completion.	A
Provider of assurance	An entity on whom fixed and/or variable requirements are set and against which there is a requirement to provide assurance.	A
Receiver of assurance	An entity with the right to receive assurance by virtue of the fixed and variable requirements it sets and its place in the assurance chain.	A
Residual Risk	Risk remaining following the implementation of identified controls.	A
Rolling Stock	Trains, carriages, cabs, coaches, locomotives, self-propelled mechanical plant and other vehicles which can operate alone or together on track together with all powered and unpowered track trolleys;	a

Term	Definition	Source
Signalling Control system	A signalling system which provides the facilities for the operational control, information and manual or automatic routing of trains;	a
Station Layout Plan	A plan which sets out details of the Station structure, including Ticket Hall, Routeways, lifts, escalators, platforms and Staff Accommodation and other rooms, as identified in Appendix 12 (Station Plans) to Schedule 2.1 of the PPP Contracts;	a
Station Preparation Time		
Supplier (1)	Supplier to London Underground, the primary organisation or individual that is selected to deliver a product, service or facility to London Underground and contracting directly to London Underground. This includes Consultants, Contractors, Infracos and PFI Contractors and excludes organisations or individuals selected by and contracting directly to them.	A
Surveillance	Activities including audit, monitoring/inspection, investigation, data capture/trend analysis, and document review	a
Third Party (3)	Descriptive of an organisation other than LU or a supplier	a
Train	As defined in the 1993 Railways Act	b
Verification	Monitoring activity to ensure that outcomes comply with requirements	a

6.4 Person accountable for the document

Person accountable for the document
Ian Gaskin – Head of TfL Management Systems

All clauses are owned by HSQE General Manager – Systems and Standards, with the exception of the following:

Paragraph number	Technical content manager
3.4.1	CPD Head of Engineering
3.4.2	CPD Head of Engineering
3.4.3 (d) and (e)	CPD Head of Engineering
3.4.5 (c) and (d)	CPD Head of Engineering
3.4.6(a)	CPD Head of Engineering
3.4.5 (e) and (f) to (k)	CPD Head of Engineering
3.4.6 (f) to (i)	CPD Head of Engineering
3.4.7 (e)	COO Head of Operational Support
3.4.7 (f) to (k)	CPD Head of Engineering
3.4.8	CPD Head of Engineering
3.6	CPD Head of Engineering
3.7	CPD Professional Head of Rolling Stock and COO Head of Operational Support
3.8	CPD Professional Head of Signalling
3.9	COO Head of Operational Support (except clause 3.9.1)
3.9.1	CPD Professional Head of Rolling Stock
3.10	COO Head of Operational Support

Paragraph number	Technical content manager
3.11	COO Head of Operational Support
3.15.4	CPD Professional Head of Permanent Way
3.15.1 (a)-(m)	CPD Head of Engineering
3.15.1(n)	Head of Strategy & Asset Management
3.15(p)-(s)	CPD Head of Engineering
3.15.2	CPD Professional Head of Civil Engineering
3.15.3	CPD Professional Head of Civil Engineering
3.16	CPD Head of Engineering
3.17	CPD Head of Engineering
3.18	CPD Head of Engineering
3.19	CPD Head of Engineering
3.20	CPD Head of Engineering
3.21	CPD Professional Head of Rolling Stock

6.5 Document history

Issue no	Date	Changes	Author
1-538 A1	February 2008	Replacement of the following: E1008 2-05102-251 1-476 2-05107-701 2-05107-704 1-412 1-201 clauses 3.1.1, 3.1.2, 3.2.1.3-4, 3.2.2.1-3, 3.3.1-3.3.3.2, 3.4.1-3, 3.5.2 1-196 clauses 3.2.3.1-3.2.3.2.7 1-193 clauses 3.1.1-4, 3.7, 3.8	C Behan
1-538 A2	November 2008	Approved for issue	J Collis
1-538 A3	May 2009	Approved for issue	C Behan
1-538 A4	June 2009	Further typographical errors corrected following PSC consultation	C Behan
1-538 A5	September 2010	Amendments to increase visibility of safety verification arrangements, reflect Metronet incorporation into LU and the introduction of PMF.	C Behan
1-538 A6	February 2011	New clause 3.1.8 added (LU-WN-00985); New clause 3.2.9 added and subsequent clauses renumbered (LU-WN-00985); Clause 3.2.11 deleted (LU-WN-00985); Clause 3.10.1 amended (LU-WN-00985); Clause 3.14.2 amended (DRACCT 00140); Clause 3.21 new row added to table and footnotes changed (DRACCT 00140).	L Holland R Billett
S1538 A7	January 2012	Clarification of approval process on clause 3.21 to avoid double handling as per DRACCT No. 01058.	R Billett

Issue no	Date	Changes	Author
S1538 A8	May 2012	Clause 3.9.1 New requirement to consider impact of infrastructure changes on the permitted running routes for passenger trains and engineer's vehicles (DRACCT 01169) Clause 3.9.2 thru' 3.9.11 renumbered due to new clause 3.9.1 Clause 3.14.2 clarified to apply to rolling stock and generic title for operational approval (LU-Q-01129) Clause 3.21 – second column heading amended to generic title for operational approval in line with revised clause 3.14.2 (LU-Q-01129)	G Neil
S1538 A9	June 2014	Updated to incorporate the Operational Assurance process, in accordance with the Access Transformation and approved CAP (DRACCT ref 01820). Also written notices LU-WN-01213 and LU-WN-01262 incorporated during this update.	Dale Smith
S1538 A10	March 2015	Minor formatting correction to reinstate the clause number 3.2.4 for the paragraph. This number was deleted in error when updating from A8 to A9 occurred.	Dan Eyob (following query raised to Ian Gaskin)

Schedule 4

Form of Order

Orders are agreed and entered into by the Company and the Supplier by way of purchase orders pursuant to, and strictly subject to the terms of this Agreement for the performance of the Service.

Schedule 5
Contract Variation Procedure

1 The cost of any Variation Order shall be agreed between the parties taking account of the reasons why the Variation Order was required.

2 The Company may propose a variation by completing Part A of the Variation Proposal and supplying three (3) copies of it to the Supplier. Within five (5) Working Days of receipt, or such other time as may be agreed by the Company, the Supplier shall complete Part B of the Variation Proposal and shall supply two (2) copies of the Variation Proposal to the Company. The Company shall be entitled, at any time within thirty (30) days of receipt, to instruct and authorise the Supplier to proceed with the variation on the terms so set out by each party by completing and signing Part C of one copy of the Variation Proposal (which, following such signature, will be referred to as a "**Variation Order**") and supplying such Variation Order to the Supplier. The relevant part(s) of the Agreement and the relevant Contract shall thereupon be varied accordingly.

3 The Supplier may propose a variation, after requesting the issue by the Company of a Variation Proposal variation number, by completing Parts A and B of a Variation Proposal and supplying two (2) copies of it to the Company. The Company shall be entitled, at any time within thirty (30) days of receipt, to instruct the Supplier to proceed with the variation on the terms so set out by the Supplier by completing and signing Part C of one copy of the Variation Proposal (which, following such signature, will be referred to as a "**Variation Order**") and supplying such Variation Order to the Supplier. The relevant part(s) of the Agreement and the relevant Contract shall thereupon be varied accordingly.

4 The Supplier may indicate in a Variation Proposal that the price is an estimated price but, if it does so, it shall supply a firm price to the Company in writing at least seven (7) days before the expiry of the time within which the Company is entitled to instruct the Supplier to proceed with the variation.

5 The price indicated by the Supplier must be the full price and shall cover all costs associated with the variation. If appropriate a range of prices may be shown corresponding to the quantity of Goods to be supplied.

6 In an emergency, both parties shall use their reasonable endeavours to expedite the actions permitted or required under the Agreement and each Contract Variation Procedure.

7 The Company will not accept any retrospective claims for additional work caused by a variation which has not been approved by the Company in accordance with the Agreement and each Contract Variation Procedure before the commencement of such additional work.

8 All authorised additional work resulting from any Variation Proposal shall be priced in accordance with any applicable rates set out in Schedule 2.

9 The Supplier shall at all times act reasonably and shall price each Variation Proposal at the least possible additional cost to the Company that it is reasonably and economically practicable for the Supplier to offer and which has the least possible impact on the terms of the Agreement and the relevant Contract, including, but not limited to the Specification.

10 Strict adherence to the procedure described in this Schedule 5 shall be a condition precedent to any addition to the price for the Goods. If the Supplier does not adhere to each paragraph in this Schedule 5 then the Supplier shall not be entitled to any addition to the price notwithstanding that the Supplier may have supplied additional or varied Goods.

Appendix 1

Form of Variation Proposal/Variation Order

To:	From:

Contract Reference Number:
Order Number
Variation Number:
Variation Title:

PART A (TO BE COMPLETED BY THE ORIGINATOR OF THE VARIATION ORDER)	
Description of change:	
Reason for changes and impact (if any) on Contract:	
Variation Proposal Authorised by:	**Proposal Date:**

PART B (TO BE COMPLETED BY THE SUPPLIER)	
Price Breakdown Note: If a further breakdown is needed please append details as a separate sheet.	
Expected Order Delivery Date:	
Supplier's Representative: **Print Name:** ..... **Signature:** ..... **Date:**	
Completed document to be returned to the Company's Representative	

PART C (TO BE COMPLETED BY THE COMPANY'S REPRESENTATIVE)
Comment on Parts A and B:
Variation Authorisation **Company's Representative:** **Print Name:** ..... **Signature:** ..... **Date:** .....

Schedule 6

QUENSH

Contract Menu

Contract No: TFL 01366

Contract Name Walkway and Drainage Panels

Client: Transport for London

Supplier: Lionweld Kennedy Flooring Ltd

Principal Contractor: **Yes** ☐ **No** ✓

Guidance

The menu is a tool which is used by the Client to identify conditions that apply to specific contracts and communicate these conditions to the Supplier.

How to complete the menu

1. The Client evaluates the scope of work and enters 'Y' or 'N' in the 'Identified by the Client' column of the menu against each condition selected as applicable or not applicable to the Contract. In the 'Other documents / comments' column the Client can make references to other documents which are supplementary information which is available although not contained within the QUENSH manual but should be considered by the Supplier when they review the conditions. Copies of any additional documents identified in the menu shall be made available to the Supplier. All documents referenced in the Menu shall be current issue, unless otherwise advised. This column can also be used to communicate information (comments) to the Supplier which may be of use to the Supplier when reviewing the conditions.
2. The Client fills in 'Client menu (Invitation to Tender)' section on the last page of the menu and issues the menu as part of the ITT.

   (1) The Supplier receives the ITT, evaluates the scope of work and, as a requirement of the tendering process, inserts 'Y' or 'N' in the 'Identified by the Supplier' column of the menu against each condition selected as being applicable. These selections may be different from those identified by the Client. Where the Supplier's selection differs from the Client's selection, a clear explanation of the reason for these differences shall be given by the Supplier. A reference to these explanations shall be put in the 'Reference to explanation' column on the menu.

   (2) The Supplier representative signs and dates the 'Supplier menu (Tender)' on the last page of the menu and submits it with the tender, for consideration by the Client.

   (3) Differences in the Client and Supplier menu selections will be discussed and resolved with the Client at subsequent tender review meetings. The agreed final version of the menu selections shall form a mandatory part of the Contract and shall be complied with by all Suppliers and their sub-contractors.

   (4) The menu shall be subject to project version and document control.

Queries on the menu

Any queries in relation to the Contract QUENSH Conditions selected on the menu are to be referred to the Client representative, see contact details/address on last page of the menu.

Contract menu

Requirements in QUENSH

Applicable requirements identified by Client				Identified by Supplier	
Section	Topic	Other documents / Comments	Y / N	Agreed? Y / N	Reference to explanation
4	Agreement of the applicable QUENSH contract conditions				
5	Supplier's selection of sub-contractors		Y	Y	
6	Identification of Safety Critical Activities		N	Y	
7	Works Environmental Management		N	Y	
8	Emergency Plan		N	Y	
9	Method Statements		N	Y	
10	Health, Safety and Environment File		N	Y	
11	Pre-start health, safety and environment meeting		N	Y	
12	Supplier's site induction		N	Y	
13	Site Person in Charge		N	Y	
14	**Staff requirements**				
14.1	**Behaviours**				
14.1.1	Alcohol and drugs		N	Y	
14.1.2	Control of hours worked		N	Y	
14.2	**Knowledge**				
14.2.1	English language		N	Y	
14.2.2	Access Card and Worksite Briefing		N	Y	
14.2.3	Visitors to sites		N	Y	
14.3	**General competence**				
14.3.1	Evidencing competence of safety critical staff		N	Y	
14.3.2	Identification of safety critical staff		N	Y	
14.3.3	Competent external safety critical personnel		N	Y	
14.3.4	Training		N	Y	
14.3.5	Asset specific competence		Y	Y	
14.4	Medical requirements		N	Y	

Applicable requirements identified by Client				Identified by Supplier	
Section	Topic	Other documents / Comments	Y / N	Agreed? Y / N	Reference to explanation
14.5	Identification of Suppliers staff		N	Y	
14.6	Clothing		N	Y	
15	**Permits and licences**				
15.1	LU specific permits and licences		N	Y	
15.2	Permits, licences and certificates for Supplier's staff		N	Y	
16	**The Principles of Access**				
16.1	Introduction		N	Y	
16.2	Access to Stations		N	Y	
16.3	Access to Track		N	Y	
16.4	Access to depots		N	Y	
17	**Applying for Planned Access**		**N**		
17.1	Introduction		N	Y	
18	Applying for Generic Access		N	Y	
18.1	Constraints that apply to Generic Access		N	Y	
19	Access for fault repair		N	Y	
20	Operational Assurance		N	Y	
21	**Closures and possessions**		**N**	**Y**	
21.1	Requirements for closures		N	Y	
21.2	Requirements for possessions		N	Y	
22	**Controls at point of access**		**N**	**Y**	
22.1	Publication of works		N	Y	
22.2	Checks at point of access		N	Y	
22.3	Signing-on with the Station Supervisor - The Station Visitors Record Sheet and Person in Charge Evacuation Register (PICER)		N	Y	
22.4	**Track specific requirements**		**N**	**Y**	
22.4.1	Protection Master		N	Y	
22.4.2	Possessions (Possession Master, Technical Officer, Cable Lineman, Signal Operator, etc.)		N	Y	
23	Removal of supplier's personnel from LU Premises		N	Y	
24	Incidents		N	Y	

Applicable requirements identified by Client				Identified by Supplier	
Section	**Topic**	**Other documents / Comments**	**Y / N**	**Agreed? Y / N**	**Reference to explanation**
25	Notification of regulatory concern or action		Y	Y	
26	Confidential Incident Reporting and Analysis System (CIRAS)		N	Y	
27	**Monitoring**			**Y**	
27.1	LU inspections		Y	Y	
27.2	Monitoring the supply chain		Y	Y	
27.3	Health, safety and environmental audits, inspection and tours by the Supplier's personnel		N	Y	
27.4	Work location inspection and audit		Y	Y	
27.5	Timescales for rectifying non-compliances		Y	Y	
28	Radio transmitters and transceivers		N	Y	
29	Mobile phones		N	Y	
30	Knives		N	Y	
31	Site health, safety and environment committee		N	Y	
32	Site housekeeping and security		N	Y	
33	Accidental damage, obstruction or interference with assets		N	Y	
34	Delivery of materials		Y	Y	
35	**Conveyance of loads**		**N**		
35.1	Conveyance of loads on lifts and escalators		N	Y	
35.2	Conveyance of hazardous materials and substances		N	Y	
36	Asbestos (non asbestos removal projects)		N	Y	
37	Working in or near lifts and escalators		N	Y	
38	Work on or adjacent to utilities and High Voltage cables (buried services)		N	Y	
39	Working on or about the track		N	Y	
40	Access to electrical sub-stations, working equipment, relay and other secure rooms		N	Y	
41	Entering areas with gaseous fire suppression systems		N	Y	
42	**Fire prevention**		**N**		
42.1	General requirements		N	Y	
42.2	Temporary fire points		N	Y	

Applicable requirements identified by Client				Identified by Supplier	
Section	Topic	Other documents / Comments	Y / N	Agreed? Y / N	Reference to explanation
42.3	Timber		N	Y	
42.4	Composites		N	Y	
42.5	Sheeting materials		N	Y	
42.6	**Gas cylinders**		**N**		
42.6.1	Use of gas cylinders in below ground locations		N	Y	
42.6.2	Storage of gas cylinders (above ground)		N	Y	
42.7	**Flammable and highly flammable materials**		**N**		
42.7.1	Use of flammable and highly flammable materials below ground		N	Y	
42.7.2	Storage of flammable and highly flammable materials below ground		N	Y	
43	**Hot work and fire hazards**		**N**		
43.1	Hot work		N	Y	
43.2	Reasonable notice of works		N	Y	
43.3	**Precautions**		**N**		
43.3.1	Buildings, assets etc.		N	Y	
43.3.2	Gas cylinders		N	Y	
43.3.3	Gas detection		N	Y	
44	**Storage**		**N**		
44.1	General requirements for storage		N	Y	
44.2	Trackside storage		N	Y	
44.3	Hazardous materials and substances		N	Y	
44.4	Allocation of space on operational property		N	Y	
45	Plant and equipment		N	Y	
46	Clearance approvals		N	Y	
47	Access equipment		N	Y	
48	Temporary works		N	Y	
49	Temporary fences and hoardings		N	Y	
50	**Temporary lighting and power supplies**		**N**		
50.1	General requirements		N	Y	
50.2	Lighting in tunnels and shafts		N	Y	
51	Screening of lights and positioning		N	Y	

Applicable requirements identified by Client				Identified by Supplier	
Section	Topic	Other documents / Comments	Y / N	Agreed? Y / N	Reference to explanation
52	**Environmental requirements**		**N**		
52.1	General environmental requirements		N	Y	
52.2	Environmental nuisance		N	Y	
52.3	Water		N	Y	
52.4	Waste management		N	Y	
52.5	Noise and vibration		N	Y	
52.6	Archaeology, historical interest and listed buildings		N	Y	
52.7	Wildlife and Habitats		N	Y	
52.8	Resource Use		N	Y	
52.9	Pest control		N	Y	
52.10	Land and water pollution prevention		N	Y	
53	**Quality requirements**		**Y**		
53.1	Records		Y	Y	
53.2	Retention period		Y	Y	
53.3	Availability of records for inspection		Y	Y	
53.4	Statistical process control, audit and inspection procedures		Y	Y	
53.5	General quality requirements		Y	Y	
53.6	Quality Plan		N	Y	
53.7	Testing and inspection		Y	Y	
53.8	Certification of conformity		Y	Y	
53.9	Quarantine		Y	Y	
53.10	Traceability		Y	Y	
53.11	Maintenance and servicing		N	Y	
53.12	Design		Y	Y	
53.13	Computer aided design		Y	Y	
53.14	Asset commissioning and handover		N	Y	

Other requirements / comments

As a current supplier of Drainage and Walkway panels we are familiar with the requirements and Contract QUENSH Conditions of document S1552.

Although the contract is a supply only we have approached the requirements of the QUENSH menu based on any potential visit to the TFL sites to support your installation teams in terms of training, handling or cutting the product, which has been done on the existing contract.

To ensure TFL have the confidence and competence of our QUENSH resource we have attached the CV's of our 2 managers who are responsible for this element of the project. These are listed in Appendix 1. We have also included (in Appendix 1) a training Matrix of the empolyees involved in the manufacturing process.

If Lionweld Kennedy are successful in securing this project the following documents can be issued if required

1. Health & Safety Plan
2. Environmental Management Plan
3. Quality pack

Client/Supplier approval

Client Menu (Invitation to Tender)

Prepared by: Andrea Smith Signature: _____

Approved by (the Client's representative): Andrea Smith Signature: _____

Title: Snior Project MAnager

Address: 172 Buckingham Palace Road, London SW1 9TN

Phone No: _____

Email: _____

Revision of this menu: A

Supplier Menu (Tender)

Approved by (the Supplier's): _____ Signature: _____

Title: _____

Address: _____

Phone No: _____

Email: _____

Revision of this menu: _____

Contract Menu (Final Approval of Menu)

Evidence shall be recorded of any amendments to the Client's menu which were agreed in establishing the Contract Menu.

Client's representative approval: _____ Signature: _____

Supplier's representative acceptance: _____ Signature: _____

Schedule 7
Deed of Novation

THIS DEED is made day of 201[ ]

BETWEEN:

LONDON UNDERGROUND LIMITED a company registered in England and Wales under number 01900907 and having its registered office at 55 Broadway, London SW1H 0BD (the "**Company**"); and

[ ] a company registered in [England and Wales] under number [ ] and having its registered office at [ ] (the "**Supplier**"); and

[ ] a company registered in [England and Wales] under number [ ] and having its registered office at [ ] (the "**New Company**").

WHEREAS:

(A) The Company has a framework agreement dated [ ] and referenced [insert contract number] with the Supplier pursuant to which contracts may be entered into for the provision of [describe in brief the scope of supply] (together the "**Contract**").

(B) The Company wishes to transfer [part of] its benefit and burden under the Contract to the New Company.

(C) The Supplier and the New Company have agreed to such transfer upon the terms and conditions of this Deed.

IT IS AGREED AS FOLLOWS:

1. In this Deed:

1.1 "**Transfer Date**" means [ ].

2. With effect from the Transfer Date:

2.1 the New Company undertakes to perform the obligations of the Company under the Contract and be bound by its terms in every way as if the New Company is and had been named at all times as a party to the Contract in lieu of the Company;

2.2 the Supplier releases and discharges the Company from all demands and claims whatsoever in respect of the Contract and accepts the liability of the New Company in relation to the Contract in lieu of the liability of the Company and agrees to be bound by the terms of the Contract in

every way as if the New Company were and had been a party to the Contract at all times in lieu of the Company;

2.3 for the avoidance of doubt, it is hereby expressly agreed that:

2.3.1 any and all rights, claims, counter-claims, demands and other remedies of the Supplier against the Company accrued under or in connection with the Contract prior to the date hereof shall be exercisable and enforceable by the Supplier against the New Company; and

2.3.2 any and all rights, claims, counter-claims, demands and other remedies of the Company against the Supplier accrued under or in connection with the Contract prior to the date hereof shall be exercisable by the New Company against the Supplier.

2.4 the Company transfers its rights and obligations under the Contract to the New Company.

3. A person who is not a party to this Deed may not enforce any of its terms by virtue of the Contracts (Rights of Third Parties) Act 1999.

Executed as a deed by the parties and delivered on the date of this Deed

Executed as a deed by affixing the Common Seal of)

London Underground Limited)

in the presence of:-)

……..

[Authorised Signatory]

Executed as a Deed by [SUPPLIER])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

Executed as a Deed by [NEW COMPANY])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

Schedule 8

Form of Parent Company Guarantee and Performance Bond

THIS GUARANTEE is made the day of 201

BETWEEN:

(1) [ ] a company registered in England and Wales under number [ ] and having its registered office at [ ] (the "**Guarantor**");

(2) [ ] a company registered in England and Wales under number [ ] and having its registered office at 55 Broadway, London SW1H 0BD (the "**Company**" which expression shall include its successors in title and assigns); and

(3) [ ] a company registered in England and Wales under number [ ]and having its registered office at [ ] (the "**Supplier**").

WHEREAS:

(A) This Guarantee is supplemental to a framework agreement pursuant to which contracts may be made (together the "**Contract**") for the carrying out of [ ] at [ ] made between (1) the Company and (2) the Supplier.

(B) The Guarantor has agreed to guarantee to the Company the due and punctual performance of the Contract by the Supplier in the manner hereinafter appearing.

(C) The Supplier is a party to this Guarantee in order to confirm its request that the Guarantor provide this Guarantee on the terms set out herein.

NOW IT IS HEREBY AGREED as follows:

1. The Guarantor unconditionally guarantees to the Company the proper and punctual performance and observance by the Supplier of all its obligations, warranties, duties, undertakings and responsibilities under the Contract and shall forthwith make good any default thereunder on the part of the Supplier and the Guarantor shall pay or be responsible for the payment by the Supplier to the Company of all sums of money, liabilities, awards, losses, damages, costs, charges and expenses that may be or become due and payable under or arising out of the Contract in accordance with its terms or otherwise by reason or in consequence of any such default on the part of the Supplier.

2. This Guarantee shall be a continuing guarantee and indemnity and accordingly shall remain in full force and effect until all obligations, warranties, duties and undertakings now or hereafter to be carried out or performed or observed by the Supplier under or arising out of the Contract have been duly and completely performed and observed in full.

3. The Guarantee is in addition to and not in substitution for any other security or warranty which the Company may at any time hold for the performance of any obligations, warranties, duties and

undertakings under the Contract and may be enforced by the Company without first taking any proceedings or exhausting any right or remedy against the Supplier or any other person or taking any action to enforce any other security, bond or guarantee.

4. The Guarantor shall be under no greater obligation or greater liability under this Guarantee than it would have been under the Contract if it had been named as the Supplier in the Contract.

5. The obligations and liabilities hereunder shall remain in full force and effect and shall not be affected, lessened, impaired or discharged by:

   (a) any alteration or variation to the terms of the Contract;

   (b) any alteration in the extent or nature or sequence or method or timing or scope of the works, services or supplies to be carried out under the Contract;

   (c) any extension of time being given to the Supplier or any other indulgence or concession to the Supplier or any forbearance, forgiveness or any other thing done, omitted or neglected to be done under the Contract;

   (d) any other bond, security or guarantee now or hereafter held for all or any part of the obligations of the Supplier under the Contract;

   (e) the release, modification, exchange or waiver of any such bond, security or guarantee;

   (f) any amalgamation or reconstruction or dissolution including liquidation of the Supplier;

   (g) the making of a winding up order, the appointment of a provisional liquidator, the passing of a resolution for winding up, liquidation, administration, receivership or insolvency of the Supplier;

   (h) any legal limitation, disability or incapacity relating to the Supplier (whether or not known to you);

   (i) any invalidity in, irregularity affecting or unenforceability of the obligations of the Supplier under the Contract;

   (j) the termination of the Contract; or

   (k) anything the Company or the Supplier may do or omit or neglect to do including, but without limitation, the assertion of or failure or delay to assert any right or remedy of the Company or the pursuit of any right or remedy by the Company.

6. Until all amounts which may be or become payable and all liabilities, obligations, warranties, duties and undertakings in respect of the Supplier's obligations have been irrevocably paid, performed or discharged in full, the Guarantor shall not, after a claim has been made or by virtue of any payment, performance or discharge by it under this Guarantee:

   (a) be subrogated to any rights, security or moneys held, received or receivable by the Company or be entitled to any right of contribution or indemnity in respect of any payment made or moneys received on account of the Guarantor's liability under this Guarantee;

(b) claim, rank, prove or vote as a creditor of the Supplier or its estate in competition with the Company unless the Company so directs; or

(c) receive, claim or have the benefit of any payment distribution or security from or on account of the Supplier, or exercise any right of set-off against the Supplier unless the Company so directs.

7. This Guarantee is irrevocable.

8. The benefit of this Guarantee may be assigned by the Company at any time to any assignee of the benefit of the whole of the Contract. No further or other assignments shall be permitted.

9. The Guarantor:

(a) gives the guarantee contained in this Guarantee as principal obligor and not merely as surety;

(b) agrees to indemnify the Company on written demand against any loss or liability suffered by it if any provision set out in the Contract guaranteed by the Guarantor becomes unenforceable, invalid or illegal, and

(c) waives any right it may have of first requiring the Company to proceed against, or enforce any other rights or security or claim payment from, any person before claiming from the Guarantor under this Guarantee.

10. Until all amounts which may be or become payable in respect of the Supplier's obligations have been irrevocably paid in full by the Guarantor, the Company may:

(a) refrain from applying or enforcing any other moneys, security or rights held or received by the Company in respect of those amounts, or apply and enforce the same in such manner and order as it sees fit (whether against those amounts or otherwise) and the Guarantor shall not be entitled to the benefit of the same; and

(b) hold in a suspense account any moneys received from the Supplier on account of these Supplier's obligations or on account of the Guarantor's liability under this Guarantee.

11. The Company is entitled to make any number of demands under this Guarantee.

12. The invalidity, illegality or unenforceability in whole of or in part of any provisions of this Guarantee shall not affect the validity, legality and enforceability of the remaining part or provisions of this Guarantee.

13. This Guarantee may be executed in any number of counterparts each of which shall be an original and all of such counterparts taken together shall be deemed to constitute one and the same instrument.

14. No person other than TfL (as such term is defined in the Contract) and its subsidiaries (as defined in section 1159 of the Companies Act 2006) shall have any right to claim or remedy under or pursuant to this Guarantee and the provisions of the Contracts (Rights of Third Parties) Act 1999 are hereby excluded.

15. This Guarantee, executed and delivered as a deed, shall be governed by and interpreted according to the laws of England and the Courts of England shall have exclusive jurisdiction save that the Company shall have the right to bring proceedings in the courts of any other jurisdiction in which any of the Guarantor's assets may be situated.

16. [*For non-UK resident Guarantors only:*

For the purposes of this Guarantee the Guarantor hereby appoints ..... of ..... [to be a London address] to accept service of process on its behalf, and service on the said ..... at the said address shall be deemed to be good service on the Guarantor; and the Guarantor hereby irrevocably agrees not to revoke or terminate such appointment).]

Executed as a deed by the parties and delivered on the date of this Guarantee

Executed as a Deed by [GUARANTOR])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

Executed as a deed by affixing the Common Seal of)

[COMPANY])

in the presence of:-)

……..

[Authorised Signatory]

Executed as a Deed by [SUPPLIER])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

FORM OF ON DEMAND PERFORMANCE BOND WITH ANNEX 1

BOND

(Letterhead of Guarantor)

To: [Company name] (its successors in title and assigns)

Contract Bond No. [●]

1. Whereas our clients [●] (the "**Supplier**") have entered into a contract with you dated [●] (the "**Contract**") in respect of [●], we [●] (the "**Guarantor**", which term shall include our successors in title and assigns) hereby irrevocably undertake as a primary obligation upon first demand in writing made by you upon us from time to time or at any time to pay to you on each occasion the sum demanded by you within five (5) banking days upon service of your demand.

PROVIDED THAT:

2. This Bond shall come into force on the date hereof.

3. Any demand hereunder shall be substantially in the form of Annex to this Bond, and as between you and us the facts set out in that demand shall be: (a) deemed to be true and (b) accepted by us as conclusive evidence for the purposes of this Bond that the amount claimed in the demand is due and payable to you hereunder, it being our intention that the event upon which payment must be made hereunder is the service of your demand without any rights on our part to raise any objections, irrespective of the validity or the effectiveness of the Contract and the obligations arising thereunder and irrespective of the underlying facts or their significance under the Contract.

4. All sums payable under this Bond shall be paid in pounds sterling to such bank account as may be specified in your demand in immediately available funds, free of any restriction or condition and free and clear of and without any deduction or withholding whether for or on account of tax, by way of set-off, or otherwise, except to the extent required by law.

5. For the purpose of this paragraph 5, the expression "Expiry Date" means [●]. Our liability hereunder shall be limited as follows:

   (a) we shall have no liability in respect of any demand received after the Expiry Date; and

   (b) in respect of a demand or demands received on or before the Expiry Date, our liability shall not exceed the aggregate sum of £[●].

6. Our obligations hereunder shall remain in full force and effect and shall not in any way be affected, reduced or discharged by:

   (a) any alteration to the terms of the Contract made by agreement between you and the Supplier; and/or

(b) any defence, counterclaim, set-off or other deduction available to the Supplier under the Contract; and/or

(c) any alteration in the extent or nature or sequence or method or timing of the works/services to be carried out under the Contract; and/or

(d) any time being given to the Supplier or any other indulgence or concession to the Supplier or any forbearance, forgiveness or any other thing done, omitted or neglected to be done under the Contract; and/or

(e) any other bond, security or guarantee now or hereafter held by you for all or any part of the obligations of the Supplier under the Contract; and/or

(f) the release or waiver of any such other bond, security or guarantee; and/or

(g) any amalgamation or reconstruction or dissolution including liquidation or change in control or constitution of the Supplier; and/or

(h) the termination of the Contract; and/or

(i) any other event which might operate to discharge a guarantor at law or in equity.

7. Terms defined in the Contract and not otherwise defined herein shall have the same meaning in this Bond unless inconsistent with the context.

8. This Bond shall be governed by, and interpreted according to, the laws of England and the Courts of England shall have exclusive jurisdiction in relation to any claim, dispute or difference concerning this Bond and any matter arising from it save that you shall have the right to bring proceedings in the Courts of any other jurisdiction in which any of our assets may be situated.

9. This Bond may be assigned or transferred without our prior consent to any member of the TfL Group. Any other assignment or transfer of this Bond by either party shall require the consent of the other party, such consent not to be unreasonably withheld or delayed.

10. This bond may not be amended, varied or supplemented in any manner whatsoever without your prior written consent, other than in accordance with its express terms.

11. Each of the provisions of this bond is severable and distinct from the others, and if at any time any such provision is or becomes ineffective, inoperable, invalid or unenforceable it shall be severed and deemed to be deleted from this bond, and in such event the remaining provisions of this bond shall continue to have full force and effect.

12. All bank charges and other fees payable in relation to or in connection with this bond are for the account of the Manufacturer and you shall have no liability or responsibility therefor.

13. Except to the extent it is inconsistent with the express terms of this bond, this bond is subject to the ICC Uniform Rules for Demand Guarantees, 2010 revision, ICC Publication No. 758.

Executed as a deed by the parties and delivered on the date of this Bond.

Executed as a Deed by [GUARANTOR])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

Executed as a deed by affixing the Common Seal of)

[COMPANY])

in the presence of:-)

……..

[Authorised Signatory]

ANNEX 1

Form of Demand from the Company to the Guarantor

Dear Sirs

[Contract Title]

Contract No: [●] (the "Contract")

We refer to the Bond given by you to us dated [●].

An event has occurred of the type described in Clause [●] of the Contract.

We hereby demand payment from you of the sum of £[●] under the Bond. Please make payment by CHAPS made payable to [Company name / bank account details].

Yours faithfully

.....

[Company name]

55 Broadway

London

SW1H 0BD

Schedule 9
Form of Collateral Warranty

THIS AGREEMENT is made the day of 20[ ]
BETWEEN : -

(1) **London Underground Limited** registered in England and Wales under number: 01900907 and having its registered office at 55 Broadway, London SW1H 0BD (the "**Company**");

(2) [ ] a company registered in England and Wales under number: [……]and having its registered office at [.....] (the "**Sub-Contractor**"); and

(3) [ ] a company registered in England and Wales under number: [……]and having its registered office at [.....] (the "**Supplier**").

WHEREAS :-

(A) The Company has entered into a framework agreement, pursuant to which contracts may be made, with the Supplier (together the "**Main Contract**") pursuant to which the Supplier is to undertake and complete the following supply: [ ] (the "**Supply**").

(B) The Sub-Contractor has submitted a tender to the Supplier for the carrying out and completion of certain parts (the "**Sub-Contract Supply**") of the Supply referred to above as more particularly described in the tender.

NOW IN CONSIDERATION of the payment of £1 (one pound) by the Company to the Sub-Contractor (receipt of which the Sub-Contractor hereby acknowledges) IT IS HEREBY AGREED as follows:

1. The Sub-Contractor warrants to the Company that:

   (a) the Sub-Contract Supply have been and will be carried out with the skill and care to be expected of appropriately qualified and experienced professional contractors with experience in carrying out works or services of a similar type, nature and complexity to the Sub-Contract Supply;

   (b) reasonable skill and care has been and will continue to be exercised in connection with:

(i) the design of any goods, works or services to the extent that the Sub-Contractor has or will be responsible for such design;

(ii) the selection of all goods and materials comprised in the Sub-Contract Supply (in so far as such goods and materials have been or will be selected by the Sub-Contractor);

(iii) the satisfaction of any performance specification or requirement in so far as the same are included or referred to in the contract between the Supplier and the Sub-Contractor in relation to the Sub-Contract Supply (the "**Sub-Contract**");

(iv) the execution and completion of the Sub-Contract Supply;

(v) the Sub-Contract Supply will, on completion of the Main Contract, comply with all Applicable Laws and Standards (as such capitalised terms are defined in the Main Contract);

(c) the Sub-Contract Supply will be reasonably fit for the purposes for which they are intended (awareness of which purposes the Sub-Contractor hereby acknowledges) and in particular but without limitation will be so fit for the period and with a rate of deterioration reasonably to be expected of high quality, reliable, well designed and engineered goods, materials and construction; and

(d) it has the right to grant to the Company all licences (including without limitation all rights to sub-licence) of all intellectual property rights as contemplated in this Agreement.

For the purposes of construing the warranties in this Clause 1 references to the Sub-Contract Supply shall include any part of the Sub-Contract Supply. Each warranty shall be construed as a separate warranty and shall not be limited by reference to, or reference from, the terms of any other warranty or any other term of the Sub-Contract.

2. The Sub-Contractor shall, save in so far as he is delayed by any event in respect of which the Supplier is granted an extension of time under the Main Contract for completion of the Supply:

(a) Execute and complete the Sub-Contract Supply in accordance with the provisions of the Sub-Contract; and

(b) ensure that the Supplier shall not become entitled to any extension of time for completion of the Supply or to claim any additional payment under the Main Contract due to any failure or delay by the Sub-Contractor.

3. The Sub-Contractor shall from time to time supply the Company and the Supplier with such information as either may reasonably require.

4. To the extent that the intellectual property rights in any and all Documents have not already vested in the Company or the Supplier, the Sub-Contractor hereby grants to the Company an irrevocable, non-exclusive, non-terminable, royalty-free licence to copy and make full use of any and all Documents and all amendments and additions to them and any works, designs or inventions of the Sub-Contractor incorporated or referred to in them for the following purposes:

(a) understanding the Supply;

(b) operating, maintaining, repairing, modifying, altering, enhancing, re-figuring, correcting, replacing, re-procuring and re-tendering the Supply;

(c) extending, interfacing with, integrating with, connecting into and adjusting the Supply;

(d) enabling the Company to carry out the operation, maintenance repair, renewal and enhancement of the Underground Network (as such capitalised terms are defined in the Main Contract);

(e) executing and completing the Supply; and

(f) enabling the Company to perform its functions and duties as Infrastructure Manager and Operator of the Underground Network (as such capitalised terms are defined in the Main Contract)

provided always that the Supplier shall not be liable for the consequences of any use of the Documents as aforesaid for any other purpose. Such licence shall carry the right to grant sub-licences and shall be transferable to third parties without the prior consent of the Sub-Contractor.

For the purposes of this Clause, the term "**Documents**" shall mean documents, items of information, data, reports, drawings, specifications, plans, software, designs, inventions and any other materials provided by or on behalf of the Sub-Contractor in connection with the Sub-Contract (whether in existence or to be made).

5. The Sub-Contractor agrees:

(a) on request at any time to give the Company or any persons authorised by the Company access to the material referred to in Clause 4 and at the Company's expense to provide copies of any such material; and

(b) at the Sub-Contractor's expense to provide the Company with a set of all such material on completion of the Sub-Contract Supply.

6. The parties hereby agree that:

(a) this Agreement shall be personal to the Sub-Contractor;

(b) the Company may assign the benefit of this Agreement to any third party;

(c) the rights and remedies contained in this Agreement are cumulative and shall not exclude any other right or remedy available to either party in law or equity.

7. The Sub-Contractor warrants and undertakes to the Company that he has maintained and will continue to maintain all insurances required to be maintained pursuant to the terms of the Sub-Contract and that, insofar as he is responsible for the design of the Sub-Contract Supply, he has professional indemnity insurance with a limit of indemnity of not less than two million pounds (£2,000,000) in respect of each and every claim which may be made against the Sub-Contractor in respect of the Sub-Contract Supply. The Sub-Contractor shall maintain such professional indemnity insurance for a period of 12 years from completion of the Supply provided such insurance remains available at commercially reasonable rates and shall notify the Company forthwith if such insurance ceases to be so available. When deciding whether such insurances are available at commercially reasonable rates, no account shall be taken of any increase in the premium or imposition of terms which arise as a result of the Sub-Contractor's insurance claims record.

8. If any dispute of any kind whatsoever arises between the parties in connection with this Agreement or the Sub-Contract Supply which raises issues which are in opinion of the Company the same as or substantially the same as issues raised in a related dispute (the "**Related Dispute**") between the Company and the Supplier and such Related Dispute has already been referred to a conciliator or arbitrator appointed under the provisions to that effect contained in the Main Contract, then the Sub-Contractor hereby agrees that the Company may at his discretion by giving notice in writing to the Sub-Contractor refer the dispute arising out of this Agreement or the Sub-Contract Supply to the adjudicator, conciliator, arbitrator or other party (the "**Appointed Party**") appointed to determine the Related Dispute. In this event the

Appointed Party shall have power to give such directions for the determination of the dispute and the Related Dispute as he may think fit and to make such awards as may be necessary in the same way as if the procedure of the High Court as to joining one or more defendants or joint co-defendants or third parties was available to the parties and to him.

9. (a) Neither the Sub-Contractor nor the Supplier shall exercise or seek to exercise any right which may be or become available to it to terminate or treat as terminated the Sub-Contract or discontinue or suspend the performance of any of its duties or obligations thereunder or treat the Sub-Contract as determined without first giving to the Supplier or the Sub-Contractor (as applicable) not less than 35 days prior written notice of its intention to do so, with a copy to the Company, specifying the Sub-Contractor's or Supplier's grounds for terminating or treating as terminated the Sub-Contract or discontinuing or suspending its performance thereof or treating the Sub-Contract as determined.

(b) If the Main Contract is terminated for any reason, within 35 days of such termination the Company may give written notice to the Sub-Contractor and to the Supplier (a "**Step-in Notice**") that the Company or its appointee shall henceforth become the Supplier under the Sub-Contract in accordance with the terms of sub-clause (c) below.

(c) With effect from the date of the service of any Step-in Notice:

(i) the Company or its appointee shall be substituted in the Sub-Contract as the Supplier thereunder in place of the Supplier and references in the Sub-Contract to the Supplier shall be construed as references to the Company or its appointee;

(ii) the Sub-Contractor shall be bound to continue with the performance of its duties and obligations under the Sub-Contract and any exercise or purported exercise by the Sub-Contractor prior to the date of the Step-in Notice of any right to terminate or treat as terminated the Sub-Contract or to discontinue or suspend the performance of any of its duties or obligations thereunder or to treat the Sub-Contract as automatically determined shall be of no effect;

(iii) the Company shall become bound by the terms and conditions of the Sub-Contract in respect of all obligations and duties of the Supplier thereunder which fall to be performed after the date of the Step-in Notice and shall promptly thereafter make payment of any amounts properly due to the Sub-Contractor as at the date of the Step-in Notice and still outstanding; and

(iv) the Supplier shall be released from further performance of the duties and obligations of the Supplier under the Sub-Contract after the date of the Step-in Notice, but without prejudice to any rights and remedies of:

(1) the Sub-Contractor against the Supplier in respect of any matter or thing done or omitted to be done by the Supplier on or before the date of the Step-in Notice; and

(2) the Supplier against the Sub-Contractor in respect of any matter or thing done or omitted to be done by the Sub-Contractor on or before the date of the Step-in Notice.

(d) Notwithstanding anything contained in this Agreement and notwithstanding any payments which may be made by the Company to the Sub-Contractor, the Company shall not be under any obligation to the Sub-Contractor and the Sub-Contractor shall not be under any obligation to the Company unless the Company shall have served a Step-in Notice pursuant to Clause 9(b) above.

10. The Sub-Contractor's liabilities, duties and obligations hereunder shall be no greater and of no longer duration than the liabilities, duties and obligations which the Sub-Contractor owes to the Supplier under the Sub-Contract.

11. The Sub-Contractor further undertakes to indemnify the Company from and against the consequences of any breach by the Sub-Contractor of any of the warranties, covenants and undertakings contained in this Agreement.

12. The rights and benefits conferred upon the Company by this Agreement are in addition to any other rights and remedies that the Company may have against the Sub-Contractor including, without prejudice to the generality of the foregoing, any remedies in negligence.

13. Nothing contained in this Agreement shall in any way limit the obligations of the Supplier to the Company arising under the Main Contract or otherwise undertaken by the Supplier to the Company in relation to the Sub-Contract Supply.

14. No amendment to this Agreement shall be valid unless it is in writing and signed by all parties.

15. Any person who is not a party to this Agreement may not enforce any of its terms under the Contracts (Rights of Third Parties) Act 1999.

16. This Agreement shall be governed by and construed in accordance with English law and shall be subject to the exclusive jurisdiction of the Courts of England and Wales.

Executed as deed by the parties and delivered on the date of this Agreement.

Executed as a deed by affixing the Common Seal of)

London Underground Limited)

in the presence of:-)

……..

[Authorised Signatory]

Executed as a Deed by [SUB-CONTRACTOR])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

Executed as a Deed by [SUPPLIER])

acting by) …….

) Authorised Signatory

and) .....

) Authorised Signatory

Schedule 10

Not Used

Schedule 11

Not used

EXECUTION PAGE:

This Agreement has been signed by for and on behalf of the parties on the day and year written above.

Signed by

for and on behalf of
)……..

London Underground Limited) [Name and position of authorised signatory]

Signed by

for and on behalf of
)……..

[SUPPLIER]) [Name and position of authorised signatory]