

Guidance Document

G0056

Civil Engineering - Pump Drainage Systems

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IMPORTANT INFORMATION

This document must not form part of contractual terms and conditions between London Underground (LU) and Suppliers.

Neither LU nor Suppliers are bound to provide any of the items or services or follow any processes described in this document unless they are also required to provide them explicitly by other contractually binding documents.

The information within this document must not be used by LU or Suppliers to raise or moderate expectations of delivery by Suppliers or LU over and above contractual requirements.



1 Purpose

- 1.1 The purpose of this Guidance Document is to support *LU Category 1 Standard S1056 Civil Engineering – Pump Drainage Systems* and give guidance on established good practice solutions that meet the requirements of that standard.
- 1.2 This standard also covers hydraulic and structural design of internal and external building pump drainage systems (*foul, grey and surface water / clean water [non-potable]*). It should be noted that buried drainage assets are generally designated as *Civil Engineering* assets and non-buried drainage as *Premises* assets (*except pump drainage assets which are also generally designated as Civil Engineering assets*).
- 1.3 Guidance for gravity drainage systems is given in *LU Guidance Document G0052 A2 Civil Engineering – Gravity Drainage Systems*.

2 Scope

- 2.1 This Guidance Document applies to *new* and *rehabilitated* pump drainage system assets (*foul, grey and surface water / clean water [non-potable]*) owned by LU as part of the following drainage systems:
 - a) Track and off-track pump drainage systems (*surface water / clean water [non-potable]*).
 - b) Stations, depots and other operational buildings pump drainage systems (*foul and surface water / clean water [non-potable]*).
 - c) Other pump drainage systems (*foul and surface water / clean water [non-potable]*).
- 2.2 This Guidance Document provides guidance on the application of the *Standard* requirements for pump drainage system assets (*owned by LU*) during their life cycle through Design, Construction, Maintenance (*including Inspection and Assessment*) and Decommissioning.
- 2.3 This Guidance Document precisely mirrors the sub-section headings of LU Standard S1056 (*Civil Engineering – Pump Drainage Systems*) and Clause and sub-Clause numbering throughout. This arrangement facilitates easy reference when a user wishes to establish what further guidance is available for any given Clause in the Category 1 Standard; it also facilitates the future updating of the document.
- 2.4 The information contained in this Guidance Document is derived from a variety of sources including historical LU documents and other industry guidance regarded as good industry practice.

3 Guidance

3.1 Design

3.1.1 General

3.1.1.1 Required Duty

- 3.1.1.1.1 The *Required Duty* for pump drainage system assets is reproduced directly as a guidance note in the LU Standard S1056. It originates from the Asset Condition Assessment and Certification Foundation Documents for Pumps & Drainage which

can be found as an attachment to LU Category 1 Standard S1042 Asset Condition Reporting (ACR).

3.1.1.2 Pump drainage systems – general design principles

3.1.1.2.1 The Pump Failure Impact Time (PFIT) drives the designation of a pump site as either 'Critical', 'Priority' or 'Non-critical'. This *Criticality Designation* is recorded against the asset in the LU Asset Register. The criticality designation dictates the type of control panel provided for the pump site and a list of LU pump sites (*excl. JNP sites*) with their relevant criticality designations, correct at time of publication, is included as Attachment 7.1. JNP pumpsites will be added to the document by revision in due course.

All submersible pumpsets shall have integral water-filled cooling jackets where cooling of a pump is required. The designer is to check the site specific pump site characteristics and client design requirements in order to determine the need for pump cooling.

3.1.1.2.2 No further guidance

3.1.1.2.2.1 The *Standard* requires *Critical Pump Sites* to be equipped with a minimum of two pumps. In such cases and where practicable, each pumpset shall be capable of lifting the whole of the design outflow. The design outflow takes account of the attenuating impact of any pump site storage volume provided.

3.1.1.2.3 No further guidance

3.1.1.2.3.1 No further guidance.

3.1.1.2.4 No further guidance.

3.1.1.2.5 No further guidance.

3.1.1.2.6 This Standard sub-Clause is intended to apply to *Critical* and *Priority* pump sites only and its intent is for emergency pumping to be as non-disruptive an operation as possible. This is achieved by always providing a permanent emergency connection point (*as described in sub-Clause 3.1.1.2.6 a)*) to the primary delivery pressure pipeline at a convenient location outside the wet-well. This provision is in expectation of pump site failure usually not being the result of a failure of the primary delivery pipework (*but rather of the pumpset*) such that it may be utilised in an emergency assuming it is fit.

However, in the event of a failure of the primary delivery pressure pipeline, then employment of lay flat hoses may be required. In such cases, the designer is required to consider the practicalities of using them. Principally, the existence of a proximal and suitable point of discharge (*usually a gravity drainage system but could be another pump drainage system*). There may also be serious implications for the normal operation of stations (*and possibly depots*) in some instances, where the use of lay flat hoses could necessitate station closure. Such impacts are generally considered unacceptable and should be designed out. Hence the *Standard* requires designers to consider the merits of introducing a permanent secondary pressure pipeline as part of the initial build. This would effectively be a sort of drainage 'dry-riser' (*potentially but not necessarily of smaller diameter than the primary delivery pipework*), and ideally routed on a significantly different line from the primary delivery pressure pipeline (*to limit the disruption risks associated with any single damage event*) but typically to the same point of discharge. The merits of introducing this level of redundancy into the design need very careful consideration; discussion with the LU *Profession Head* (*Pumps & Drainage*) to establish the *Business'* view of risks/costs against perceived benefits will be necessary.

This sub-Clause also requires provision of two Lewden-type electrical sockets of different voltage ratings in order to facilitate the expeditious introduction of the

emergency pumping measures. In the event that pump site failure is the result of a general power supply failure, then no specific mitigation of that risk is intended by this sub-Clause. There are two main reasons for this, firstly that the designation of the pump site as either '*Critical*', '*Priority*' or '*Non-critical*' ensures that those sites having the highest risks associated with their failure are provided with *Dual Independent Power Supplies*; secondly that a general power supply failure will have wider impacts than just the pump site, so a temporary cessation of pumping will likely be only one of several impacts to be dealt with by the *Business*.

3.1.1.2.7 No further guidance.

3.1.1.2.8 LU operations may produce a number of different contaminants in drainage effluent. Such contaminants are not limited to immiscible fluids like hydrocarbons; they can include specific minerals like zinc, and others which can render effluent highly acidic.

TfL/LU subscribes to the principles of sustainability and as such, requires designers to first try to eliminate the production of problem substances through the use of environmentally friendly and ecologically sustainable alternative products and processes.

Where such elimination isn't possible and a problem substance is produced as a result of LU operations, then it should be treated on site wherever possible. This is also consistent with the sustainability agenda, which requires organisations to be responsible and deal with their own problems at source/on site, rather than export them to another party (*which can increase aggregate risk*).

Hydrocarbons are common pollutants in LU effluent but they can be effectively separated out (*for special disposal*) using *Oil Separators*. Where pump drainage systems are necessary to lift effluent into a separator, the design of them needs to be undertaken with care to ensure that the effluent isn't emulsified by the pumping process. Low-shear pumpsets are typically specified for this purpose but specialist advice should be sought in all cases.

The Environment Agency (EA) provides guidance on pollution control via their suite of Pollution Prevention Guideline (PPG) publications available as free downloads on their website.

Further information on pollution control is provided in the LU Category 1 Standard *S1052 Civil Engineering – Gravity Drainage Systems*.

3.1.1.2.9 No further guidance.

3.1.1.2.10 No further guidance.

3.1.1.2.11 Applications for allocation of space on operational property are not technically required for depots. However, in the case of pump drainage systems, designers should be aware that such applications are likely to be required by the *Profession Head (Pumps & Drainage)* to ensure that proposed assets are smoothly integrated into the depot environment. Designers are advised to check with the *Profession Head (Pumps & Drainage)* and the asset maintainer early on in the design process to establish whether such an application will be required.

3.1.1.3 Supervisory Control and Data Acquisition (SCADA)

3.1.1.3.1 No further guidance.

3.1.1.3.2 For the avoidance of doubt, this sub-Clause permits the designing-in of redundancy to pump sites via the provision of multiple pumps whose theoretical combined pumping rate exceeds the required maximum design outflow rate.



It is intended to make clear that whatever pumps are provided, will all be utilised under the control philosophy, by cycling the duty function through each pumpset in turn. This ensures that all pumpsets remain serviceable and any latent defects quickly become manifest.

The designer shall ensure that the design utilises one of the standard TfL software packages for pump site control.

3.1.1.3.3 No further guidance.

3.1.1.4 Chambers, sumps, tanks and interceptors

3.1.1.4.1 The requirement to provide RFID tags has been conceded against the Gravity Drainage Systems Standard (S1052) (*refer to Concession No. CR07394*). This is equally applicable to Pump Drainage Systems. Therefore, designers should note that LU is no longer pursuing an RFID roll-out strategy across *Pumps & Drainage* discipline assets and their installation is no longer required.

3.1.1.4.2 Waste tanks are used to collect and retain waste water prior to pumping to a higher level for discharge to a receiving sewer or other structure. The following guidance is provided in relation to the provision of waste tanks:

- a) Tanks will be manufactured from stainless steel or Phenolic resin based composites or other materials that are equally fire compliant, structurally sound, non-corrodible and durable.
- b) When calculating the size of waste tanks the following criteria should be taken into consideration:
 - I. The operating requirements of the level detection apparatus.
 - II. The dimensions of the room in which the tank is installed.
 - III. The space available for maintenance of the tank and associated pumps.
 - IV. The access arrangements for installation of the tank.
- c) Under normal operating conditions the storage volume between pump start and stop levels should be small enough to avoid septicity of the collected waste water. Pump stop level should be set as low as practicable.
- d) The minimum height between start and stop levels of the associated pumps should be designed such that the pump is operating correctly (*in accordance with the manufacturer's recommendations*).
- e) The overall size of tank will be determined by location and likely usage. In the absence of any other data 24 hours storage should be assumed.
- f) Tanks should be of watertight construction. Where for ease of installation, tanks are manufactured in sections, the parts should be joined with flanged gasketed joints. All screwed pipe connections to Phenolic resin composite tanks should have internal and external Nitrile rubber gaskets.
- g) Tanks should have profiled inverts shaped with self-cleansing gradients towards suction outlets.
- h) A bolted watertight access plate should normally be fitted to the top of a tank to allow for maintenance work.
- i) Inlet pipes to tanks should generally be fitted 150 mm above the highest pump start level.
- j) Outlet pipe inverts should be fitted flush with the lowest point in the tank. Ventilation pipes should be fitted to the top of tanks. Level controls should be located remote from the point of inlet so as to avoid possible problems with surface turbulence.

3.1.1.4.3 If a designer believes there are sound engineering reasons for not making permanent access provision in pump drainage system chambers, they should be discussed with the *Profession Head (Pumps & Drainage)* at the earliest opportunity in the design process.

3.1.1.4.4 No further guidance.



3.1.1.5 Pipework

3.1.1.5.1 No further guidance.

3.1.1.5.2 No further guidance.

3.1.1.6 Electrical

3.1.1.6.1 No further guidance.

3.1.1.6.2 No further guidance.

3.1.1.6.3 No further guidance.

3.1.1.7 Fire protection

3.1.1.7.1 Sub-surface Railway areas are effectively defined in *The Fire Precautions (Sub-surface Railway Stations)(England) Regulations 2009* as station premises where the public has access and where it includes an enclosed underground railway platform. The terminology supersedes use of the term 'Section 12' which was a reference to section 12 of the *Fire Precautions Act 1971* under which the preceding set of regulations had been issued. The current regulations are made under article 24 of the *Regulatory Reform (Fire Safety) Order 2005*.

The regulations do not explicitly include connected railway tunnels and shafts beyond platforms but LU fire safety measures naturally extend to those in appropriate ways.

3.1.1.8 Design life and product registration

3.1.1.8.1 Design Life of materials or products are normally verified via *British Board of Agrément* (BBA) certification. However, in the case of solid walled polyethylene (PE) pipes manufactured in accordance with the requirements of German Standards DIN 8074 & 8075, BBA certificates may not exist. This particular type of pipe is extensively used by LU and its Design Life is considered acceptable.

However, designers should note the following when specifying use of PE. It is vulnerable to chemical attack from Polycyclic Aromatic Hydrocarbons (PAH's), some solvents and some detergents. They tend to cause swelling of the product due to absorption into the surface of the material. This can lead to 'environmental stress cracking' (*shortening of the polymer chains leading to brittle fracture*).

Thermoplastics of many different types (*e.g. uPVC*) are used for pipe manufacturing and may also be vulnerable to chemical attack. Designers should therefore discuss particular applications with manufacturers if they are unsure as to suitability.

3.1.1.8.2 No further guidance.

3.1.1.9 Whole life asset management

3.1.1.9.1 No further guidance.

3.1.1.9.2 Notwithstanding the guidance provided in the *Standard* on this issue, designers are reminded that the demonstration of design solution optimality must be made on an objective basis. Therefore, the range of design solutions/options under consideration should be examined in an appropriately detailed costs/risks benefit analysis, with monetary values discounted back to present day using LU's applicable *Discount Rate*.

3.1.1.9.3 Designers should take care to ensure that any declared maintenance strategy/process associated with a particular asset or system, has been carefully conceived to minimise health and safety risks and financial costs. Any residual risks inherent to the design should be communicated to the contractor/installer in accordance with the *HSE CDM 2007 Approved Code of Practice*.

3.1.1.9.4 No further guidance.

3.1.1.10 Consents and approvals

3.1.1.10.1 Designers should check with the *Profession Head (Pumps & Drainage)* before seeking the approval of the *SuDS Approving Body (SAB)*.

TfL has requested an exemption from the (*Flood and Water Management Act 2010 (FWMA)*) requirement to seek *SuDS Approving Body* consent for all its railway entities' *construction works having drainage implications*. The effect of this potential exemption on the process of obtaining consent/approval for a new discharge to Public Sewers is not fully understood at the time of writing this guidance document.

However, if the exemption is granted, it will be on the basis that LU effectively self-mandates the use of SuDS wherever reasonably practicable, so the exemption would not constitute a right to avoid SuDS installation at the whim of the designer. Design decisions not to employ SuDS have to be well-reasoned and justified clearly in relevant assurance documentation. A standard civils CDS proforma exists within the LU Pathway (*formerly Project Management Framework*) which requires completion of a statement regarding use of SuDS. The requirements of that proforma should be augmented with the additional gravity & pump drainage systems information required by Clause 7.4 of this document. The CDS proforma can be found linked from the TfL Pathway Product Matrix on the LU Intranet.

LU owes a *Duty of Care* to third parties in addition to any specific statutory obligations they may have. Designers should ensure that any necessary Environmental Permits (*under the Environmental Permitting (England and Wales) Regulations 2010*) are obtained (*for discharges to Controlled Waters, etc.*), as well as ensuring that designs meet LU's more general *Duty of Care*. Early consultation with the EA regarding potential discharges to Controlled Waters (*whether direct or via drains owned by others*) is always advisable.

LU retains ownership of *Environmental Permits* acquired in relation to the railway and of existing prescribed rights to discharge. Advice shall be sought from the LU Safety, Quality and Environment (SQE) directorate regarding any *Environmental Permits* that may be required.

Historically, Sewerage Undertakers were not obligated to accept new connections that would convey groundwater to Public Sewers. Where they were willing to accept such connections, the discharges were normally treated as trade effluent, for which a charge was/is levied. The new FWMA now obligates Sewerage Undertakers to accept such connections where the system has received SuDS approving body consent - but it is not clear at the time of writing whether this would extend to entities enjoying exemptions from the FWMA consenting process.

Designers should consider whether discharges from drainage systems affected by the design may be sufficiently contaminated as to require disposal to foul sewer. Discussions with the local Sewerage Undertaker may be required and may result in a Trade Effluent Agreement under the appropriate Section of the Water Industry Act 1991.

3.1.1.11 Assurance

3.1.1.11.1 The Profession Head may delegate his authority as assurance signatory to formally accredited persons.

3.1.1.11.2 The relevant specific requirements for a *Pumps & Drainage Conceptual Design Statement (CDS)* are included as Attachment 7.4. These requirements are in addition to the general *Civil* and/or *Premises* discipline requirements set out in the standard Civils and Premises CDS Template (*available through the Pathway Product Matrix*).

At the time of writing this guidance document, no specific *Pumps & Drainage* CDS template exists. However, designers should check in the future as one is intended to be produced and will be available through the *Pathway* Product Matrix.

3.1.2 Clean Water (Non-potable) Pump Drainage Systems

(*Clean Water (Non-potable)* as defined in *LU Technical Specification T0002*.)

3.1.2.1 Location of drainage systems

3.1.2.1.1 It is TfL/LU's expectation that designers will rarely be able to produce an unequivocal *whole-life costing exercise* that demonstrates a pumping solution to be more cost beneficial than a gravity drainage solution. Therefore, early consultation with the *Profession Head (Pumps & Drainage)* should be undertaken to ensure support for such a proposal will be forthcoming.

3.1.2.1.2 Location of drainage system access points

3.1.2.1.2.1 Where drainage access chambers are positioned in locations covered by matting (e.g. *at station entrances*), a panel shall be cut into the matting to facilitate access to the drainage asset without recourse to removal of the whole mat. The panel shall be at least 150mm larger on all sides than the clear opening dimensions of the chamber it provides access to. The panel and the mat aperture shall be neatly trimmed using a proprietary product to ensure the finished detail is both tidy and safe.

3.1.2.2 Hydraulic design criteria

3.1.2.2.1 General

3.1.2.2.1.1 When considering the issue of *Designing for (Event) Exceedence*, designers should refer to the *S1052 Civil Engineering – Gravity Drainage Systems* and its supporting Guidance Document.

3.1.2.2.1.2 No further guidance.

3.1.2.2.1.3 No further guidance.

3.1.2.2.1.4 Clean water (*non-potable*) pump drainage systems situated in tunnels and shafts are required (*under the Standard*) to be designed as grey water pump drainage systems. This is because the clean effluent is often subsequently contaminated with grey water discharges from cleaner's sinks and other sources of solid waste (*such as grit and litter*) as a result of the incremental introduction of sanitary facilities and other drainage features over the years and their connection to the nearest available pump drainage systems.

3.1.2.2.2 Sump sizing and pump discharge rate determination

3.1.2.2.2.1 No further guidance

3.1.2.2.2.2 The correct representation of upstream and downstream hydraulic boundary conditions in a hydraulic model is a critical factor for the predictive accuracy of the model. This is the case whether an integrated hydraulic model of pump drainage system and contributing gravity drainage system is constructed or not.

If separate hydraulic models are created then correct representation of boundary conditions becomes not only critical but potentially also an iterative process. This illustrates why the integrated model option is preferred. However, if separate hydraulic models are constructed then the following guidance is offered in relation to boundary condition characterisation.

- a) In the case of a contributing gravity drainage system (*whether existing or proposed*), the downstream hydraulic boundary is represented by an appropriate



time-varying surcharge to the outfall (*a stage/time relationship*) which represents the estimated performance of the receiving pumping station in terms of wet-well surcharge level. Clearly though, the contributing gravity drainage system, will be a factor influencing the wet-well surcharge level, so care must be taken to ensure modelling congruence through iteration if necessary. It is advisable to be conservative in the case of separate models because under-design is more of a problem than over-design. Refer to LU Category 1 Standard S1052 for further instruction.

- b) In the case of the proposed (*receiving*) pump drainage system, this guidance note concerns the hydraulic modelling of the flow balancing component of the design, i.e. *not* the detailed hydraulic modelling of individual pump performance and pressure pipelines (*delivery/rising mains*). The flow balancing component of the design is still a *full hydrodynamic unsteady flow analysis* but it is focussed on determining the balance between time varying inflows and outflows - to determine the critical volume of effluent storage required, given a specified outflow rate (*i.e. pump rates of flow*). Within this hydraulic model the upstream hydraulic boundary is represented by inflow hydrograph(s), which are generated within the separate hydraulic model(s) for the contributing drainage system(s) (*whether gravity or pump*). The downstream hydraulic boundary is represented by the specified outflow rate (*typically a stage/discharge relationship*) which represents the proposed pump(s) hydraulic performance. This hydraulic modelling is usually an iterative process, as the designer attempts to find the optimum balance between competing design requirements, (*e.g. there may be a physical limit on how large a volume of effluent storage can be provided at a site and this may in turn drive up the required outflow rate, and/or there may be a limit on the allowable discharge rate*).

If time-varying hydraulic boundary data isn't available to the designer for any reason, then conservative steady-state conditions shall be assumed in the hydraulic design. However, this should be avoided if at all possible as it can lead to uneconomic pump drainage system design solutions.

3.1.2.2.2.3 No further guidance.

3.1.2.2.2.4 No further guidance.

3.1.2.2.2.5 No further guidance.

3.1.2.2.3 Pressure pipelines

3.1.2.2.3.1 Where a concession is sought to permit design mean flow velocities outside the permitted range, the proposals should nevertheless adhere to the following principles:

- a) Mean velocities less than 1.0m/s shall be justified in the context of the increased maintenance liability that may result from the increased risk of deposition of suspended solid material within the pipeline.
- b) Mean velocities greater than 2.0m/s shall nevertheless be subject to an absolute upper limit of 3.0m/s and shall be justified in the context of the increased system running costs associated with overcoming the increased system headlosses (*from higher flow velocities*).

In all such cases early consultation with the *Profession Head (Pumps & Drainage)* should take place to ensure approval is forthcoming.

3.1.2.2.3.2 The roughness values provided in the *Standard* are average values for pressure pipelines, but these values can increase by an order of magnitude for pipelines in poor condition. It is advised that where the velocity head is significant compared with the static head (say 25%); a precautionary approach is taken with regard to roughness value. The suggested roughness values should be increased to 2.0mm and 1.0mm respectively in such cases. This situation is common in long pressure pipelines.



3.1.2.2.3.3 The design of very long pressure pipelines (say >500m), and/or with undulating longitudinal profiles, needs to consider:

- a) Retention time and septicity (*in foul and grey water pipelines*). It may be necessary to use chemical dosing or reduce retention times by using a smaller diameter pipe or a smaller pump.
- b) Effect of hydraulic surge and cyclic loading on the fatigue life of the pipe material.

3.1.2.2.3.4 No further guidance.

3.1.2.2.3.5 No further guidance.

3.1.2.2.3.6 No further guidance.

3.1.2.2.4 *Electrical and telecommunication*

3.1.2.2.4.1 No further guidance.

3.1.2.2.4.2 No further guidance.

3.1.2.3 **Structural design criteria**

3.1.2.3.1 *General pipeline structural design*

3.1.2.3.1.1 No further guidance.

3.1.2.3.2 *Chamber structural design*

3.1.2.3.2.1 No further guidance.

3.1.2.3.2.2 No further guidance.

3.1.2.3.2.3 No further guidance.

3.1.2.3.2.4 No further guidance.

3.1.2.3.2.5 No further guidance.

3.1.2.4 **Sustainable Drainage Systems (SuDS)**

3.1.2.4.1 A statement pertaining to the use (*or otherwise*) of SuDS features is a requirement of the standard CDS template. Refer also to sub-Clause 3.1.1.10.1 of this guidance document.

3.1.3 **Grey Water Pump Drainage Systems**

(*Grey Water as defined in LU Technical Specification T0002.*)

3.1.3.1 **Location of drainage systems**

3.1.3.1.1 No further guidance.

3.1.3.1.2 No further guidance.

3.1.3.1.3 No further guidance.

3.1.3.1.4 No further guidance.

3.1.3.2 **Hydraulic design criteria**

3.1.3.2.1 No further guidance.



3.1.3.2.2 No further guidance.

3.1.3.2.3 No further guidance.

3.1.3.3 Structural design criteria

3.1.3.3.1 No further guidance.

3.1.3.3.2 No further guidance.

3.1.3.4 Sustainable Drainage Systems

3.1.3.4.1 No further guidance.

3.1.4 Foul Water Pump Drainage Systems

(Foul Water as defined in LU Technical Specification T0002.)

3.1.4.1 Location of drainage systems

3.1.4.1.1 No further guidance.

3.1.4.1.2 No further guidance.

3.1.4.1.3 No further guidance.

3.1.4.2 Hydraulic design criteria

3.1.4.2.1 No further guidance.

3.1.4.2.2 No further guidance.

3.1.4.2.3 No further guidance.

3.1.4.3 Structural design criteria

3.1.4.3.1 No further guidance.

3.1.4.3.2 No further guidance.

3.1.4.4 Sustainable Drainage Systems

3.1.4.4.1 No further guidance.

3.1.5 Flood Protection

3.1.5.1 Flood protection to TfL/LU assets and the fulfilment of their *Duty of Care* to third parties in this respect, are cornerstones of the TfL/LU commitment to sustainable development. At the time of writing, LU is embarked on a major review of flood risks to the network (*called the LU Comprehensive Review of Flood Risk (LUCRFR)*). A key output of that project will be the delivery into service of a GIS-based system for monitoring and managing flood risks, to ensure both safety and commercial risks are maintained ALARP.

All projects that deliver works which impact on flood risks (*from any and all sources*) will be required to provide certain information (*as described in documentation to be included in TfL Pathway (the TfL Project Management system)*) to the *Flood Risk Manager (not yet appointed)* and the *Profession Head (Pumps & Drainage)*, so that the GIS-based flood risk management tool can be kept up to date.

Refer also to *S1052 Civil Engineering – Gravity Drainage Systems* and its supporting guidance document.



3.2 Construction

3.2.1 General

3.2.1.1 Further advice on construction details is included in this document as Attachment 7.2.

In-trench drainage installations necessarily involve risks associated with excavation; particularly in the railway environment (*refer also to LU Category 1 Standard 1-021 Works near mains services and Structures*). Buried cabling of all kinds may be present - *power, signalling, telecommunications, etc.* Care must be taken to review available service record drawings at design stage and highlight the known risks on the drawings. At construction stage, various non-intrusive survey technologies are available to help identify buried assets prior to breaking ground. Excavation work should be undertaken carefully and follow recognised safe digging practice in accordance with Health and Safety Executive guidance document HSG47.

In addition to the need to protect existing buried assets against damage (*with the myriad adverse consequences for an operational railway if such damage were to occur*), there are the health and safety consequences of striking or encountering certain assets and materials. The risk of electrocution is ever present when working in the LU railway environment and stringent measures exist to eliminate or mitigate the risk. However, there are also more insidious threats to health, for example asbestos is often present in the railway environment. LU maintains an *Asbestos Register* and the TfL *Pathway* ensures that Project Managers refer to the register as part of the project risk assessment process.

3.2.1.2 No further guidance.

3.2.1.3 No further guidance.

3.3 Maintenance (including Inspection and Assessment)

3.3.1 General

3.3.1.1 No further guidance.

3.3.1.2 No further guidance.

3.3.1.3 No further guidance.

3.3.1.4 A list of pump sites (*excl. JNP sites*) with their relevant *Criticality Designations* (*Critical/Priority/Non-critical*), correct at time of publication, is included as Attachment 7.1. Refer also to sub-Clause 3.1.1.2.1 of this guidance document. The list also includes the pump sites' individual criticality scores (*listed as 'criticality code'*). It is these individual pump site scores/codes that are used by the *Fault Reporting Centre* (*or Network Operations Centre (NOC)*) to prioritise corrective actions in the event of simultaneous pump site failures.

The process for determination of criticality score/code is as follows:

1. The consequences of pump site failure are assessed and scored between 1 and 10 according to severity, in line with the following hierarchy (*ref. Table GD 3.2.1.4.1*).

Score	Consequence of Pump Site Failure
10	Victoria Back Pump House – Special category (semi-catastrophic consequences)
9	Stop traffic – multi line
8	Stop traffic – single line
7	Property damage – (whole station)