LDCA

LAND DRAINAGE ▪ SPORTS TURF ▪ WATER MANAGEMENT

GUIDELINES FOR SPORTSTURF DRAINAGE INSTALLATION

FootballFoundation

football's biggest supporter

SPORT ENGLAND

Land Drainage Contractors Association

NAC Stoneleigh Park, Stoneleigh, Kenilworth, Warwickshire CV8 2LG

Tel: 01327 263264 Fax: 01327 263265 Email: secretary@ldca.org Website: www.ldca.org

LDCA GUIDELINES FOR SPORTSTURF DRAINAGE INSTALLATION

Acknowledgements

The Land Drainage Contractors Association gratefully acknowledges the assistance received from many organisation, members and individuals in producing these Guidelines.

The work and effort of the LDCA Technical Committee (R E Hughes, R Longdin J K Hoare, R Donald, N Wyatt and S Pask) is also warmly acknowledged.

February 2005

LDCA GUIDELINES FOR SPORTSTURF DRAINAGE INSTALLATION

INTRODUCTION

Whatever the sporting activity, efficient drainage is an essential element in maintaining a good playing surface.

Loss of use due to waterlogging or turf damage can result in a backlog of games, dissatisfied sportsmen, lost fixtures and even serious financial losses.

An efficient drainage scheme will eliminate waterlogging, reduce compaction, allow easier maintenance and more flexible management of valuable resources. Improved drainage will result in improved soil structure, fewer weeds, better sward and more economical use of fertilisers.

The Land Drainage Contractors Association (LDCA) recognises the need to promote and maintain high standards in sportsground drainage. Professional design and expert installation are regarded as equally important factors in successful drainage scheme.

The main content of these Guidelines relates to general sportsturf areas such as winter game pitches and playing fields. The more specialised requirements of certain areas such as golf greens and cricket square are not covered in detail.

The Guidelines are mainly concerned with pipe and slit drainage systems and exclude completely constructed surfaces such as sand carpets.

These guidelines have been compiled by the LDCA to assist all those involved in specifying, designing, installing and maintaining drainage works for sports use.

It should be emphasised that these Guidelines are a guide to good practice for the installation of drainage schemes and are not intended as a design guide for which professional advice should be sought.

APPROVED CONTRACTORS

Only fully experienced and well equipped contractors and consultants should be employed in the design and installation of drainage schemes for sportsgrounds. The LDCA recognises that well trained operators, using modern purpose built machinery to install quality materials to a high standard, are essential.

Members of the LDCA's Sportsturf Drainage Section undertake to supply and use materials to the recommended standards and to maintain the standards of workmanship contained in these guidelines.

CONTENTS

1.0 DESIGN

The design of individual drainage schemes depends on the underlying soils, the site location, the sporting activity, the degree of usage, and finance available.

Drainage schemes should be suitable for machine installation. Pipe junctions should be kept to a minimum and lateral drain runs maximised for economic installation. Where possible, main drains should be located outside the playing areas.

General guidance on design is given below. For specific and more detailed approaches professional advice should be sought.

1.1 Drainage Response

The intensity and capacity of a drainage scheme should be matched to the underlying soil types, the rainfall, the sporting activity and the degree of usage. Drain spacings, pipe sizes, and the nature and extent of any secondary treatment will vary, depending on the rate at which water is to be removed from the playing surface.

Drainage design rate will vary widely according to individual circumstances.

References for more detailed study of drainage response include Sports Turf Drainage – a Review by Caroline Ward, Journal of Sports Turf Res Inst Vol 59; and Regional Variation of Design Rates for Slit Drainage in Great Britain by Dr S W Baker, Journal of Sports Turf Res Inst Vol 58. MAFF ADAS Reference Book 345 The Design of Field Drainage Pipe Systems.

Full consultation should take place with the user, owner or manager of any proposed or existing facility before deciding upon the intensity of drainage scheme design.

Equations for calculating drain spacing invariably require a value for the hydraulic conductivity of the soil. Measurement of such values can be difficult and unreliable when undertaken in situ. Tests carried out on disturbed soil in a laboratory cannot always be regarded as representative of the soil. The selection of drain spacing is often, therefore, based on experience and soil type as well as the use of the surface.

1.2 Site Investigations

Topographical and soil surveys should be undertaken before design. These should be adequate to permit accurate assessment of drainage needs and problems. Sufficient data should be collected to allow a full drainage design to be compiled.

The location and condition of any existing land drains should be determined. Where possible, these may be incorporated into the new design. Care is recommended in assessing flows from existing drains, in particular main drains which may carry water from elsewhere.

Designs should take account of and avoid if possible any buried pipes, cables or other services. The need to work beneath overhead cables should be eliminated if feasible.

1.3 Importance of Outfalls

Before undertaking any detailed design or construction, the existence of a suitable outfall for drainage water should be located. This may be an existing land drain, ditch, stream, river or municipal drain. Permission from the relevant authority should be sought where necessary.

Where a suitable outfall is not available, pumping or soakaway solutions may be considered.

Soakaways are not recommended but where used, construction should be such as to be capable of dealing with surface runoff as well as drain flows.

1.4 Depth of Drains

Designers should be fully aware of the differences encountered where drains are laid through topsoil on existing pitches, and where installation takes place before topsoil placement.

The basis of any depth should be clearly stated. It is recommended that finished depths, from the playing surface, should be specified.

The depth of subsurface drains will depend on their function as well as soil type. Where drains alone are used, the soil type is an important consideration. Where sand/gravel slitting or other secondary treatment is used subsurface drains act mainly as carriers and the soil type has less importance.

In free draining soils, deeper drains may allow wider drain spacings. In heavy clays with poor filtration drains should be shallower and closer together. Where a relatively impermeable subsoil is present drains should be placed in that layer. Special care is recommended when springs are present.

The minimum depth of cover on any subsurface drain should be 450mm to be sufficient for drainage purposes and to protect the pipe from damage due to surface traffic or operations such as deep spiking.

1.5 Pipe Sizes

All pipe diameters should be sufficient to carry design flows at the gradients specified.

A recognised method of calculating pipe sizes should be used. Formulae, charts supplied by pipe manufacturers are acceptable.

When deciding pipe sizes, consideration of water entering the drainage area from another source should always be made.

Where culvert sizes are laid down by a Water Authority or other statutory body, the requirements should be determined and complied with.

1.6 Use of Permeable Backfill

The use of permeable backfill over subsurface drains is essential in all sportsfield applications. The function of the backfill is to provide a free draining connection between the upper soil layers and the drains. The material used should be suitably sized permeable backfill.
Design should ensure that the permeable backfill extends sufficiently near to the surface to intercept any secondary treatment and to ensure adequate water entry into the drains.
Secondary treatments, other than for maintenance should not be specified unless an adequate drainage system with permeable backfill is already in place.

The design depth from the surface to the permeable backfill may vary but should be at least a minimum depth of 100mm from the playing surface. Care should be taken to ensure that injury does not occur due to gravel or stone backfill material extending to the surface.

The choice of material for topping up permeable (gravel) backfill is extremely important. Advice on the most suitable material should be sought and contractors must take care to ensure that materials used conform to the guidelines given later in this document under Sand Backfill.

1.7 Silt Traps / Inspection Chambers

It is recommended that all drainage schemes incorporate provision for inspection and for silt collection and removal. Where possible, proprietary items should be used. The position and location of any inspection chamber should allow safe, convenient access and where possible be off the playing area.

On some soils, it may be necessary to design the layout to facilitate removal of silt and other deposits.

1.8 Drainage Plans

Drainage layouts, design proposals and any finished plans should be prepared using a clearly defined set of symbols such as those shown in Appendix A.

Such plans should clearly show the location of the drain runs, spacing, levels and other relevant information necessary for the correct installation.

The direction, depth, spacing and nature of any secondary treatment, such as slitting or banding, (sand banding or grooving,) should also be clearly shown.

1.9 British Standards

Where possible, designers should refer to British Standards and recognised Codes of Practice.

Where a British Standard is quoted, it should be the current edition in force at the time of the works.

2.0 MATERIALS

All materials used in the installation of sports drainage schemes must be of high standard. Where possible, only British Standard quality materials should be used.

The cost of replacing defective items and the consequent disruption to the playing area is prohibitive. Every effort should be made, therefore, to ensure that only materials suitable for the function are installed.

All materials delivered to the site should be inspected before use. Where a British Standard applies, storage and supply should comply with the Standard.

2.1 Flexible Corrugated Plastic Pipes

Plastic, corrugated drainage tubing, up to 300mm diameter, and pipe connectors should conform to BS4962 (1989). It is recommended that only pipes bearing the BS Kite Mark be installed.

Where filter wrapped pipes are specified, the filter wrapping must be undamaged and firmly fastened
to the pipes. All pipes and connectors should also conform to BS 4962 (1989).

2.2 Rigid Twin Walled Plastic Piping

Rigid twin walled plastic pipe, for which there is no British Standard, should be shown to be suitable for the specific purpose.

2.3 Pipe Junctions and Connectors

Purpose-made junctions and connectors should always be used when joining pipes. Appendix B shows a range of suitable junctions and connectors.

Connectors for in-line joining of plastic pipes should be of the positive joint type and comply with BS 4962 (1989).

2.4 Headwalls and Outfall Pipes

All drainage outfalls into open channels should incorporate suitable headwalls.

Construction materials should be strong and from resistant. Where possible, it is recommended that proprietary items are specified.

Outfall pipes into ditches or other open channels should also be rigid, frost resistant and fitted with a vermin grid.

Typical headwall and outfall constructions are shown in Appendix C.

2.5 Inspection / Junction Chambers

Chambers to facilitate pipe junctions and inspection, such as those shown in Appendix D, should be shown to be suitable for their function and able to withstand surface loads.

2.6 Silt Traps / Inlet Chambers / Gullies

Where silt traps or inlet chambers are provided, designs should be similar to those shown in Appendix E. It is recommended that a grating be always specified with inlet chambers.
Proprietary items are recommended provided they can be shown to be suitable for their function.

2.7 Permeable Backfill Materials

Selection of permeable backfill materials is of utmost importance. All backfill material placed over drains or in secondary treatments, should be clean, durable and free from dust, lime, and chemical or other pollutants.

2.8 Granular Backfill The backfill material placed over drains should be clean, washed aggregate, shingle or other suitable stone. Good quality artificial material, such a Lytag, may be used in certain applications.
Recycled material may be utilised provided it conforms to the specification below.

The material should have a narrow particle size range. The recommended limits for drains in grass pitches topped with sand are 5mm – 10mm.

2.9 Sand Backfill

It is imperative that the sand or sand/soil mix used is of the correct particle size to prevent migration into the granular backfill. Where this is not the case a blinding layer should be used to prevent any such migration. For example a fine sand or sand/soil mix used over 5 – 10mm granular backfill is likely to require a blinding layer of 50mm depth.
For fuller details of sand type selection and use see Appendix F.

Note should be taken by designers and contractors of what sand is available locally and if in doubt advice should be sought on its suitability.

2.10 Concrete and General Building Materials

Materials used for the construction of inspection chambers and headwalls should conform to the relevant British Standard as follows:

Concrete	BS 5328 (1981, 85)
Additives	BS 5075 (1982)
Blocks	BS 6073 (1981, 82, 84)
Bricks	BS 3921 (1974)

3.0 WORKMANSHIP

It is important that all those involved in the drainage of sportsturf are properly trained, equipped and fully experienced. The standards of workmanship should received constant attention, and supervision by responsible staff is essential.

Contractors should be familiar with all Health and Safety issues with regard to their employees and the general public. Where applicable work should be carried out in accordance with current CDM regulations. As a minimum the client should expect appropriate Method Statements and Risk Assessments prior to work commencing.

The installation of primary and secondary drainage systems involves the use of specialist plant and machinery fit for its purpose. All wheeled equipment should use low ground pressure tyres.

Where required all traffic of plant should be confined to approved routes within the site. (No heavy plant or earth moving equipment should be allowed on the site after the placement of topsoil.)

All reasonable precautions should be taken to prevent damage to existing sports surfaces. Where possible, public roads, pavements, verges and other areas should be kept clean and undamaged. Tarmacadam surfaces giving access to the site should be protected to prevent damage.

3.1 Underground Services

Private and publicly owned services should be located and marked before work commences.

Location using approved plans and/or detection equipment must be supported by hand digging to determine the exact positions.

It is recommended that written enquiries be made to all utility companies and interested parties as to the nature and location of such services.

Location of British Gas and British Pipeline Agency Ltd services should take place only in the presence of their official staff.

Any services affected by the drainage or other works, should be temporarily supported or protected in accordance with advice given by the relevant authorities.

In the event of any accidental damage to any buried services, the relevant authority should be immediately notified.

Contractors should have a written Health and Safety Policy including recommendations for working in the vicinity of underground services. Contractors should carry adequate Employees and Public Liability Insurance.

3.2 Soil Conditions

Work should not take place unless surface and subsurface soil conditions are suitable to minimise compaction, rutting and other soil or turf damage. High water table, puddles, wet topsoil etc can impair the efficiency of drainage installed in such conditions.

When draining through existing turf or sward, every care should be taken to prevent contamination of the surface with soil, stone or granular backfill.

3.3 Trench Digging

Drain trenches should be installed at the required depth and gradient.

Trench bottoms should be smooth and shaped so as to securely bed the pipes. The bottom width of the trench should conform as nearly as possible to the outside diameter of the pipe.

The minimum depth of cover over any subsurface drain should be at least 450mm and be sufficient to protect the drain from damage due to surface traffic, secondary operations and maintenance procedures.

Where drains alone are used, depths must be adequate to give efficient drainage of the area, to intercept any interflow of water in the topsoil layers and to pick up any springs.

When secondary treatments, such as sand slitting, are carried out over subsurface drains, the crown of the pipe should be at least 100mm beneath the depth of the secondary treatment.

Drains should only be laid at shallow finished depth where physical conditions dictate or at the express wish of the client or his agent. It may be necessary to protect very shallow pipes from the surface traffic.

(Where main drains are not backfilled with permeable fill, the excavated soil is to be replaced over the drain. Backfilling should ensure the topsoil is replaced correctly.)

Trenching in wet conditions should be avoided or smearing of the trench bottom and sides can result.

3.4 Removal and Disposal of Trench Spoil

Excavated soil should be removed to a tip on the site or removed from the site as

required. Trench spoil may be used to create a landscape feature as infill or it may be removed from site. Details of use of any spoil should be clearly defined in advance.

Side elevators should be fitted to all trenching machines working through existing turf and the trench spoil should be conveyed to suitable trailers for removal. Elevators and conveyors should be used and constructed so as to avoid contamination or damage to the playing surface.

3.5 Drain Laying

Drainage pipes should be laid on a firm, smooth bed shaped to support the pipes.

No loose material should be allowed to fall beneath the pipes.

Corrugated plastic pipe should be laid in straight lines, free from kinks, stretching or local undulations.
Well-fitting, tensile stress-resistant connectors should be used to join the pipes.
All drain lines should be plugged at the upper end to prevent ingress of soil or burrowing animals.

3.6 Grade Control

A recognised system of grade control should be employed when installing subsurface drains. It is essential that laser grade control systems be used particularly on flat surfaces.

A suitable outfall for drainage water must be provided. Pipes should be installed with adequate depth of cover, from the outfall, to an even specified grade without backfalls or local undulations.

Where laser grade control devices are employed, the siting of the laser transmitter must be correct and the direction of operation set to give true grades.

Competent, trained staff should be employed to lay all subsurface drains.

A person with a knowledge of surveying should be on hand at all times to direct operations.

Where laser grade control systems are used, a person knowledgeable on laser safety should also be in attendance. Warning signs should be displayed when working in public places.

Failure to take adequate precautions in respect of Class 3B lasers can be in contravention of the Health & Safety at Work Act 1974 and can result in permanent eye damage.

3.7 Drain Connections

Purpose-made, rigid junctions, such as those shown in Appendix B, should be used when connecting laterals to mains. The lateral must never be allowed to extend into the flow of the main drain as this could impede water flow.

Existing drains should be connected into the new system when required. This may be done use a well-fitting adapter piece or with generous amounts of permeable backfill.

When existing drains are known to be active and to carry water, a positive connector

is always recommended. Care must be taken to ensure that the new system has sufficient capacity to deal with the additional flow.

3.8 Air Temperature Limitations

Pipe laying and granular or stone backfilling over uPVC pipes should not take place when the air temperature is below 0degC.

Careful handling of all uPVC pipe is essential at low temperatures and the manufacturers' advice should be sought if work must proceed in sub-zero temperatures.
Polypropylene and polyethylene corrugated pipes may be laid in sub-zero temperatures down to a minimum of –10degC.

In extremely high temperatures care must be taken to avoid stretching or collapse of all plastic drain tubing.

3.9 Unperforated Pipes

Where there is a danger of tree root ingress, unperforated plastic pipes or pipes with sealed joints should be used.

Where leakage from a drain could cause soil erosion and poor bedding, scouring or pipe displacement, unperforated pipe should also be employed.

3.10 Backfilling with Permeable Fill

Suitable permeable backfill is to be placed over the drains to the required depth.

Any loose soil or other material on the pipe should be removed and soil should not be permitted to mix with the fill material. Aggregate or sand hoppers are recommended so as to regulate the depth(s) of the backfill and to minimise spillage and prevent soil ingress.

The backfill must be placed in such a manner as to avoid damage to, or displacement of, the pipes.
Backfilling over subsurface drains should normally extend to within 100mm to 150mm of the surface or so as to intercept the topsoil layer. The final 100mm of backfill should be a suitable sand, rootzone, soil or turf, depending on the application. Where slitting, banding or other secondary treatment is specified, the permeable backfill over the subsurface drains must interconnect with that treatment.

Catchwater or French drains, such as those beside all-weather surfaces, should have permeable backfill to the surface. In some cases, the final 50mm may be sand. Care should be taken when backfilling to keep the stone backfill free of soil.

Note: SETTLEMENT OF TRENCH LINES DUE TO SOIL SHRINKAGE
The summer of 2003 is recorded as one of the driest periods for many decades. This exceptional weather resulted in a phenomenon associated with soils of high plasticity and expansion related to moisture content. Shrinkage of such soils due to soil and ground moisture deficit - has resulted in subsidence of buildings, cracking of roads, and in respect of trenching, settlement of trench lines.

Settlement or cracking within trench lines in agricultural environments is not generally a problem and, indeed, is considered beneficial to the restructuring of consolidated or compacted soils. However, the leisure and amenity sector has suffered to varying

degrees, in some extreme cases sports turf facilities have been rendered no longer fit for use due to the hazard caused by cracking or settled trench lines.

A sports turf facility equipped with a drainage scheme will typically have a network of mains and lateral pipe work spaced at between 3 and 10 metre centres. The pipes are installed within excavated trenches and are backfilled with aggregate. Tri-axial shrinkage of the clay soils leads to increased trench widths allowing the backfill materials to settle causing depressions on the surface.

In addition to primary piped systems, secondary slit systems are often installed, offering improved surface drainage characteristics through either excavated or injected gravel or sand slits. Clay soil shrinkage promotes natural cracking of the soils; these cracks will take the line of least structural resistance - specifically trench or slit lines. The clay soils of the British Isles retain soil moisture with great tenacity. Water will only be drained from a soil once field capacity has been achieved; the drainage scheme will remove surplus soil water.

The dry summer / autumn of 2003 resulted in the lowest recorded annual rainfall in the UK since 1964 according to the Meteorological Office data. This allowed the drying of soil profiles to unprecedented depths with very low soil moisture content at depths exceeding 600mm.

The resultant soil shrinkage and cracking has generated settlement of trench and slit lines on both newly installed and, more surprisingly, existing established schemes which have been installed for a number of years.

Once settlement has occurred, remediation measures are limited to topping up. On intensive schemes, general sand or root zone top dressing may be an option but deep settlement will require specific application to individual trench lines by means of specialist equipment.

3.11 Inspection Chambers

Inspection chambers in a variety of designs and materials are acceptable. Appendix D shows typical proprietary units and designs.

Proprietary units should be laid on a firm base and have covers strong enough to stand the surface loads.

All inlet and outlet pipes should be of a rigid constriction and positioned at the correct levels. Pointing and sealing around all units and pipes is recommended to ensure adequate waterproofing.

3.12 Outfalls

A suitably constructed outfall should be provided where a drain discharges into an open channel. The invert should be positioned at least 150mm above the normal water level.

The final 1.5m of drain should be rigid and any projecting portion must be frost resistant. It is recommended that a vermin grid be fitted over the outfall.

All headwall constructions should include slope protection and splash plates, a suitable anchorage must also be provided. Appendix C shows a range of suitable headwalls and drainage outfalls. Where possible, proprietary items are recommended provided they are shown to be suitable for their purpose.

3.13 Surface Runoff Drains

All inlets for water entry into a pipe from an open channel, ditch, pond or other surface flow, should be provided with a silt trap and a trash grating.

Typical designs are shown in Appendix E. Glass reinforced concrete, plastic and pre-cast concrete designs may be used. All materials should be frost resistant.

All units should be strong and securely located. In all cases, care should be taken to ensure the correct depths and relative positions of inlets and outlets. The minimum height of the pipe above the base of any unit should be 300mm, to allow for silt accumulation.

4.0 SECONDARY DRAINAGE TREATMENTS

A secondary treatment is regarded here as any treatment placed over a primary piped drainage system so as to improve the drainage response.

In this document slit trench drainage refers to narrow trenches from which the soil has been removed, usually 50mm wide and 200-300mm deep, partly backfilled with gravel and topped with sand – see Appendix G.

Gravel band drainage refers to bands of gravel, or sand, installed using a trenchless method – i.e. a solid vibrating tine slicing through the soil with the permeable fill being placed simultaneously.

These techniques along with sand placement/grooving, subsoiling and mole ploughing, increase surface infiltration and improve drainage of the surface and upper layers.

Secondary drainage treatments should only take place over a properly designed and correctly installed primary piped drainage scheme.

4.1 Slit Trench Drainage

Slit trench drainage consists of an intensive system of narrow trenches backfilled with permeable materials running approximately at right angles to the drainage.
They may be spaced as closely as 500mm apart but spacings of 1 – 2 metres are more common. Their purpose is to move excess soil water speedily to the piped system.

Specialised trenching machines should be used to cut and backfill the slits. The machines should be fitted with spoil conveyors to load transport leaving the sward clean and uncontaminated.

The trenches or slits are normally filled with a suitable coarse sand or with suitable 5-10mm washed gravel topped with sand.

The correct depth(s) of permeable backfill must be maintained at all times and specialist hoppers should be free-running and frequently inspected for blockages.

Spacing of slits, length of run between underdrains, and the depth of the slits depends on the soil type, the sporting activity and the intended intensity of use. Also the close spacing gives a very rapid drainage response where the piped drains are spaced 5-7m apart; less so where the piped drains are 10m apart. Annual sand top dressings at the

rate of 150 tonnes per hectare should be stipulated for the following 2 – 3 years to further enhance this system.

For types of permeable backfill and selection see Appendix F.

Note: Settlement of the backfill often occurs. Usually it is due to shrinkage of the clay fraction of the soil as a result of the drier soil regime. It can be severe in periods of prolonged drought in the early years. Subsequent maintenance may be required.

4.2 Gravel Band Drainage

Gravel band drainage consists of an intensive matrix of sand or gravel bands running at right angles to the underdrainage. The bands are usually 20mm wide, spaced a maximum 500mm apart, up to 250mm deep and backfilled with 2-4 mm gravel or more often with one of the manufactured products; e.g. Lytag. The installation work is undertaken when soil moisture levels are medium to high to prevent heave.
As with slit trench drainage, in the early years soil shrinkage can cause some settlement of the permeable fill in the bands in very dry weather. However, the bands being narrow and more closely spaced, the settlement is usually far less pronounced. Where action needs to be taken an overall sand dressing worked in with a mat usually suffices.

5.0 MAINTENANCE

5.1 Sand Top Dressing

Following drainage operations primary or secondary, a suitable sand top dressing is recommended. Care should be taken to spread the sand evenly over the surface of the rate of 120 – 150 tonnes/ha.

Application as specified in Appendix F should be by means of specialist LGP equipment to prevent damage or compaction and the sand should be worked into the turf to prevent smothering.

5.2 Decompaction

Maintenance of surface infiltration on wet clay soils is extremely difficult. Surface compaction and smear due to intensive use in wet weather significantly reduces infiltration and causes waterlogging.

Various types of machines are available to introduce hollow or solid tines into the surface, breaking up compaction in the surface and topsoil layers. When hollow tines are used the soil cores may have to be removed from the surface.

Optimum soil moisture content will allow the machine to achieve maximum soil penetration and movement. If too wet smearing will occur, if too dry, poor penetration and tearing of the turf by the tines will occur. The depth and spacings should comply with the machinery manufacturer's recommendations. The treatment should form part of a regular maintenance schedule.

The treatment may be combined with a top dressing. Spiking should take place at regular intervals and sand should be applied as evenly as possible and worked into the tine holes using a drag brush or other suitable means.

6.0 INFORMATION SOURCES

There exists a wide range of publications including magazines and other literature on sports fields. In addition there are many official bodies concerned with the regulation of sport and the surfaces upon which sports are played.
The LDCA will be pleased to give details of the types of bodies listed below.

Authoritative Bodies:

Sports Governing Bodies:

Other Useful Bodies:

APPENDIX A

DRAINAGE PLANS
STANDARD SYMBOLS AND COLOURS

Plans for underdrainage and ditching should conform to the following symbols and colours. Deviations from standard must be clearly shown on the key or legend.
Where necessary, the plan must include the depth and spacing of Moling or Subsoiling ditch dimensions, fencing specifications, culvert sizes or other relevant information.

PLASTIC PIPES

DIAMETER MM	COLOUR
60 MMØ	RED
80 MMØ	PURPLE
100,110,125 MMØ	GREEN*
160,170 MMØ	BLUE*
200,225 MMØ	YELLOW*
OVER 225 MMØ	BLACK

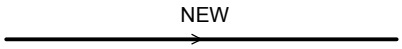
* INDICATE DIAMETER

OPEN DITCH

BROWN

PIPE DRAINS

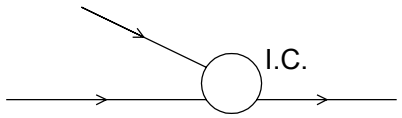
NEW



PIPE DRAINS

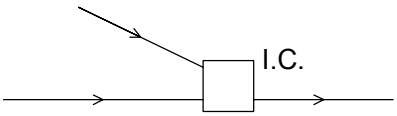
EXISTING

INSPECTION CHAMBERS
(IN OUTLET PIPE COLOUR)

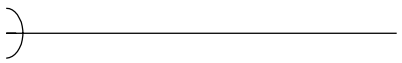


OR

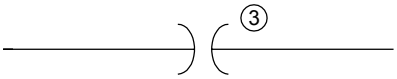
INSPECTION CHAMBERS
(IN OUTLET PIPE COLOUR)



PIPE INLET CHAMBERS



CULVERTS



(INCLUDE REFERENCE N°)

PLAN SCALES:UNDERDRAINAGE Not Less Than 1:2500
DITCHING Not Less Than 1:10560

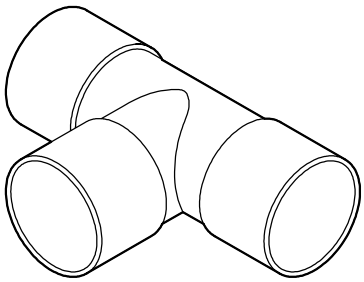
Plans should also include where relevant, the following information:

O.S. National Grid N°
O.S. Edition
Map Scale
Parish Name
Field Number
Certification of True Record
Date
Surveyors Name
Scheme Reference
North Point

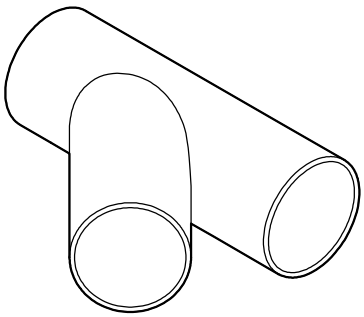
NOTE: Ordinance Survey Maps are subject to Copyright. Details of copying charges can be obtained from local offices.

APPENDIX B

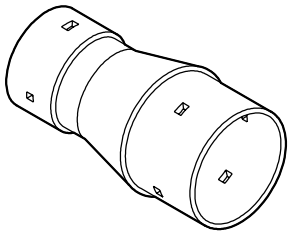
TYPICAL PIPE JUNCTIONS AND CONNECTIONS



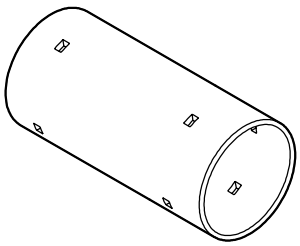
TEE PIECE



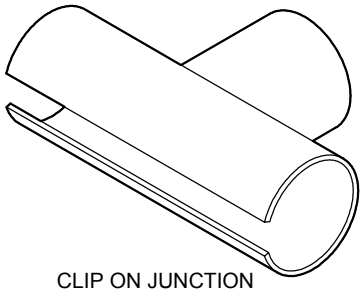
Y JUNCTION



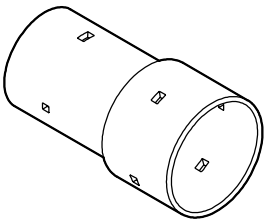
REDUCING COUPLING



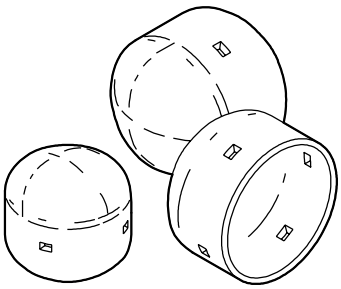
STRAIGHT COUPLING



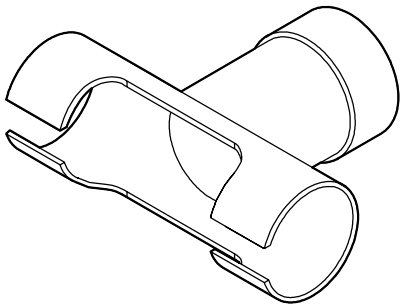
CLIP ON JUNCTION



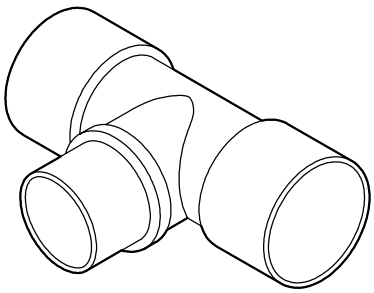
REDUCING COUPLING



END CAPS

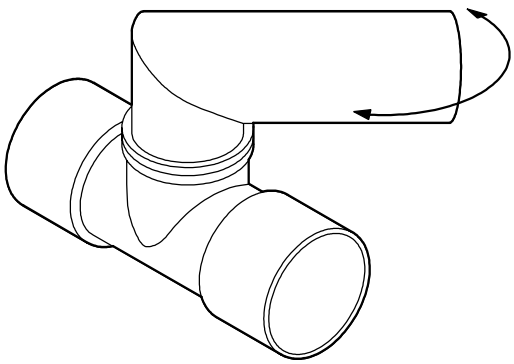


LATERAL JUNCTION (FIXED)



TEE REDUCING COUPLING

The junctions and Connections shown here are schematic and represent acceptable types. Junctions not shown may also be suitable and slight variations in design are acceptable.
Any junctions must be well fitting and, if applicable, comply with BS requirements.



LATERAL JUNCTION (VARIABLE)

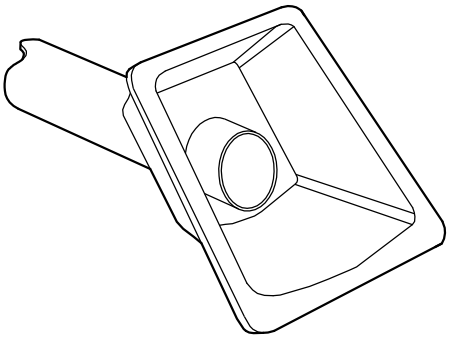
LDCA
LAND DRAINAGE ■ SPORTS TURF ■ WATER MANAGEMENT

APPENDIX C

TYPICAL UNDERDRAINAGE HEADWALLS AND OUTFALLS

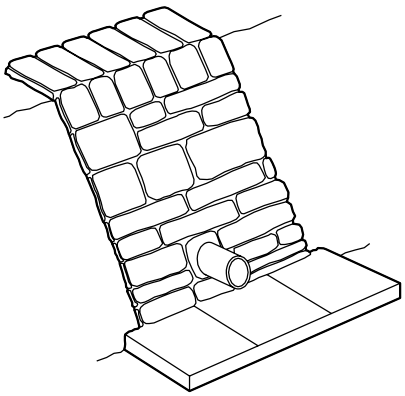
Outfalls may be constructed in a variety of materials. GRC Outfalls must have a rope, mesh or other method of anchoring the outfall in the ditch bank. Outfalls with precast holes or blank headwalls cut to suit pipe diameter are permissible.

GLASS REINFORCED CEMENT (GRC)



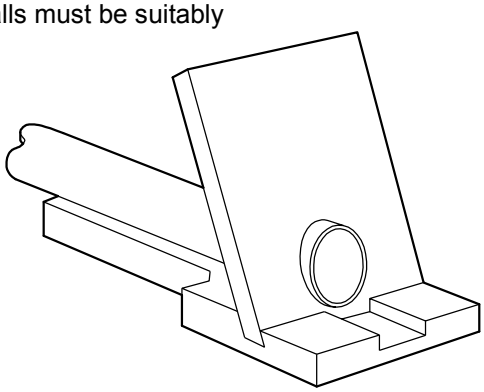
BRICK OR BLOCK BUILT

Durable, frost resistant concrete blocks. Bricks or natural stone may be used. Concrete foundations to be used where required.



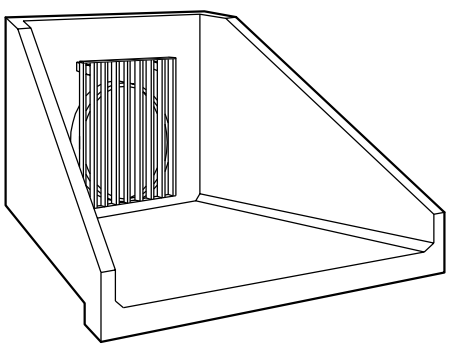
PRECAST CONCRETE

Precast headwalls must be suitably anchored



PRECAST CONCRETE HEADWALL

With wing walls



GENERAL NOTES:

(i) All outfall pipes to be at least 1.5m long and frost resistant.
(ii) Vermin gates to be fitted to all pipes.
(iii) Other types of headwall meeting these standards are acceptable.

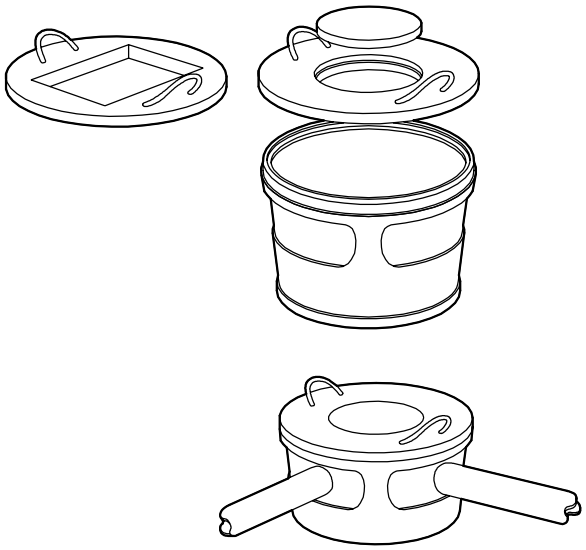
NOTE: The Outfall units illustrated are typical and are included as a guide only, the inclusion or omission of any proprietary item does not indicate the LDCA's approval or otherwise.

APPENDIX D

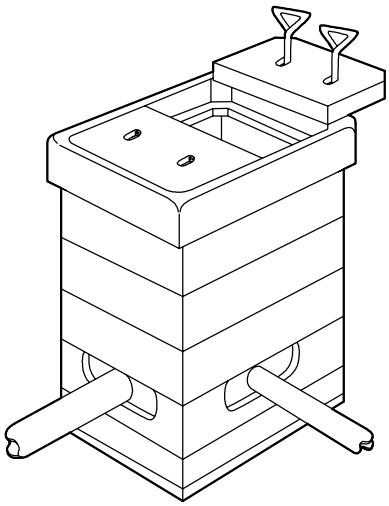
TYPICAL INSPECTION CHAMBERS

Inspection chambers are permitted in a variety of design and materials. Adequate strength must be ensured and attention is drawn to the NOTE on recommended dimensions. GRC units can only be used with very light loadings. The inclusion or omission of proprietary items does not indicate the LDCA's approval or otherwise, illustrations are for guide purposes only.

GLASS REINFORCED CEMENT (GRC)



PRECAST CONCRETE



Minimum Cross Sectional Area of Chamber 0.25m² up to 1000mm deep
Minimum Cross Sectional Area of Chamber 0.5m² up to 1800mm deep
Minimum Cross Sectional Area of Chamber 1.0m² over 1800mm deep

NOTES: Inspection Chambers must be capable of withstanding loads applied from backfill and surface traffic.
The following minimum dimensions are recommended for built in situ chambers.

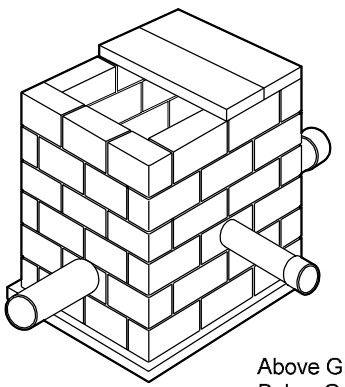
Floor Slab / Base	- 100mm (in Situ)
Walls	- 50mm (Surface)
Covers	-50mm (Surface)
	-65mm (below Ground)

Covers must be capable of manhandling and be fitted with handles or lifting rings.

BUILT IN SITU

(Square Construction)

Removable reinforced concrete slabs, preferably prestressed, provided with suitable lifting equipment.



Above Ground Covers 50mm Thick
Below Ground Covers 65mm Thick

ALL PROPRIETARY ITEMS MUST EITHER CONFORM TO MAFF STANDARDS OR BE INDIVIDUALLY APPROVED FOR USE

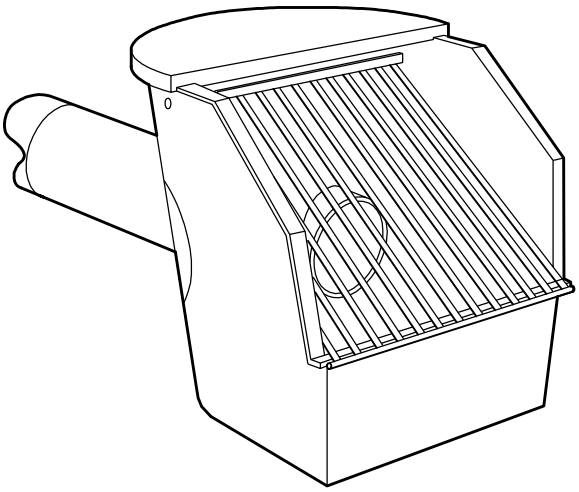
LDCA
LAND DRAINAGE ■ SPORTS TURF ■ WATER MANAGEMENT

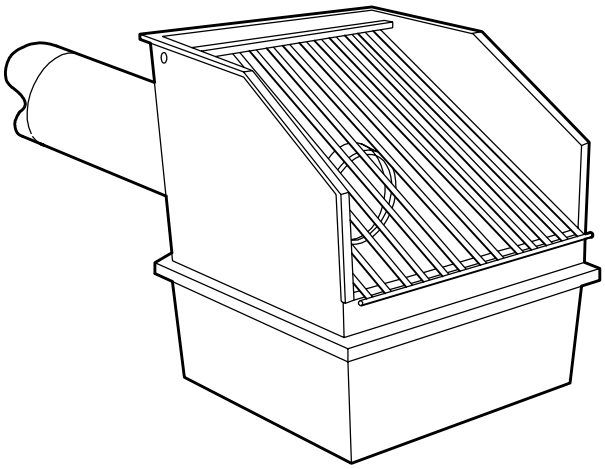
APPENDIX E

TYPICAL DRAIN INLETS AND SILT TRAPS

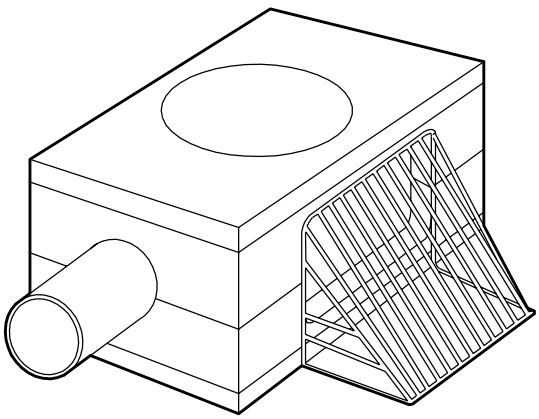
The following typical types of drain inlet may be used, the inclusion or omission of proprietary items does not indicate the IDCA's approval or otherwise.

GLASS REINFORCED CEMENT (GRC)





PRECAST CONCRETE



NOTES:

(i) All Units must be securely located and strong enough for their purpose.

(ii) Holes to accept Inlet Pipe must be carefully cut in GRC Units.

(iii) Prefabricated Concrete Units must be selected to suit pipe size.

(iv) All Blocks, Bricks or stone must be strong and frost resistant.

(v) Minimum height of pipe above base must be 300mm.

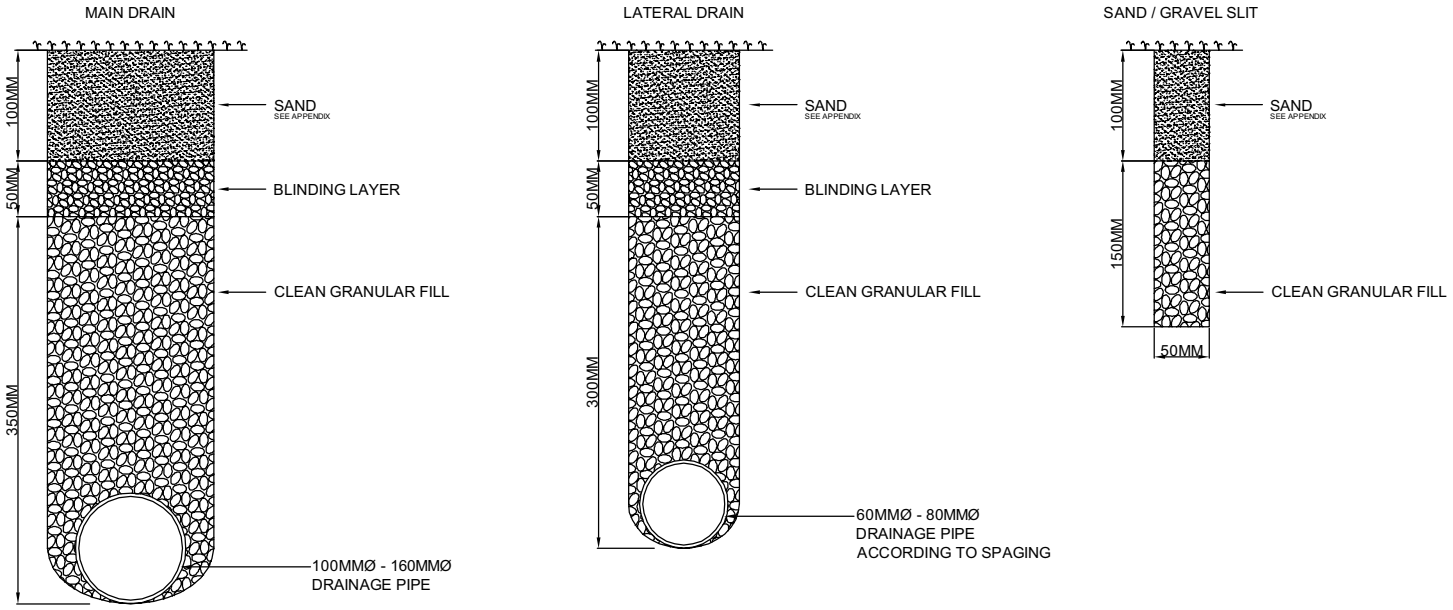
APPENDIX F

SAND TYPE SELECTION AND USE

PURPOSE \ SAND TYPE	VERY FINE SAND	FINE SAND SAND	MEDIUM SAND	COARSE SAND	VERY COARSE SAND
MM	0.050	0.125	0.250	0.500	1.00 2.00
ALL-SAND CONSTRUCTIONS FOR WINTER GAMES		▨	▨		
AMELIORATION FOR WINTER GAMES		▨	▨		
DRESSING FOR WINTER GAMES PITCHES		▨	▨	▨	
SOIL AMELIORATION FOR FINE TURF		▨	▨	▨	
TOP DRESSING OF FINE TURF			▨	▨	
SLIT DRAINS			▨	▨	▨
BLINDING LAYERS			▨	▨	▨
BUNKER SANDS			▨	▨	

APPENDIX G

DIAGRAMATIC ILLUSTRATION OF TYPICAL DRAIN INSTALLATIONS



Blinding layer may not be required between gravel and sand layers if the particle sizes of Aggregate & Sand are compatible.

LDCA
LAND DRAINAGE ■ SPORTS TURF ■ WATER MANAGEMENT