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Planning, design and installation of irrigation schemes

Part 4. Guide to water resources

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Committees responsible for this British Standard

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- Agricultural Engineers' Association
- British Agricultural and Garden Machinery Association Ltd.
- Health and Safety Executive
- Ministry of Agriculture, Fisheries and Food
- National Farmers' Union
- Silsoe College
- Silsoe Research Institute
- UK Irrigation Association
- National Rivers Authority
- Well Drillers' Association

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Foreword

This Part of BS 7562 has been prepared under the direction of the Agricultural Machinery and Implements Standards Policy Committee and contains recommendations on good practice in the planning, design and installation of irrigation schemes in the UK, together with information and guidance. It is intended for the use of engineers and farmers having some knowledge of the subject. It embodies the experience of engineers successfully engaged on the design and construction of irrigation schemes so that other reasonably qualified engineers may use it as a basis for the design of similar irrigation schemes.

This Part of BS 7562 contains information and represents good practice at the time it was written and inevitably, technical developments may render parts of it obsolescent in time. It is the responsibility of engineers concerned with the design and construction of schemes to remain conversant with developments which have taken place since publication.

This standard has been prepared in six Parts as follows.

Part 1. *Glossary of terms*

Part 2. *Acquisition of site data*

Part 3¹⁾. *Irrigation water requirements*

Part 4. *Guide to water resources*

Part 5¹⁾. *Distribution systems and irrigation equipment*

Part 6. *Guide for feasibility and implementation procedures*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

¹⁾ In preparation.

Guide

1 Scope

This Part of BS 7562 gives guidance and information on water resource requirements. It covers the Water Acts, surface and underground water resources and design of sourceworks, public supply and water quality.

Annex A lists some relevant further reading.

2 References

2.1 Normative references

This Part of BS 7562 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover. Subsequent amendment to, or revisions of, any of these publications apply to this Part of BS 7562 only when incorporated in it by updating or revision.

2.2 Informative references

This Part of BS 7562 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 7562 the definitions given in BS 7562 : Part 1 : 1992 apply.

4 Legislation

4.1 Common law water rights

4.1.1 General

In common law the occupier of any land is entitled to the riparian rights of any natural stream contiguous with that land. In England and Wales such rights relating to abstraction of water have been largely replaced by the Water Resources Act 1991[1]. Common law rights still exist in Scotland and Northern Ireland.

4.1.2 Underground water

Common law rights do not apply to underground water unless it can be shown that water is flowing in a defined underground channel.

4.2 Introduction to the Water Acts

4.2.1 Sources

Sources of water for spray irrigation are controlled by the National Rivers Authority (NRA).

4.2.2 Applicability of Water Acts

All acts referred to in this Part of BS 7562 apply to England and Wales only except the Spray Irrigation (Scotland) Act 1963[2].

4.2.3 Acts and associated regulations

The abstraction of water and impounding of watercourses are controlled by the Water Resources Act 1991, as influenced by, among others:

- a) The Reservoirs Act 1975[3];
- b) various local water authority acts and/or orders;
- c) The Wildlife and Countryside Act 1981[4];
- d) The Spray Irrigation (Definition) Order 1965[5];
- e) The Water Resources (Licences) Regulations 1965[6];
- f) The Water Resources (Miscellaneous Provisions) Regulations 1965[7];
- g) The Water Resources (Licences) (Amendments) Regulations 1965[8];
- h) The Water Resources (Succession to Licences) Regulations 1969[9];
- i) The Spray Irrigation (Scotland) Act 1963.

NOTE. *The Code of practice on Conservation, Access and Recreation*[10] provides further information on the abstraction of water and impounding of water courses.

4.3 Scotland

The Spray Irrigation (Scotland) Act 1963 empowers the river purification authorities to control the abstraction of water for spray irrigation. Abstraction requires to be licensed on specified watercourses.

4.4 Licences to abstract water

4.4.1 General

Subject to the exceptions in 4.4.6 no one may take water from any source unless they hold a licence from the NRA. They are allowed to abstract only within the conditions of that licence. Possession of an abstraction licence gives the holder a protected right to the specified amounts, but it does not guarantee that such amounts will always be available or that the water will always be of suitable quality.

4.4.2 Derogation

In deciding on the issue of a licence the National Rivers Authority has to, by law, ensure that it will not derogate any existing right to water except with the consent of the person entitled to such a right. Thus a licence gives a protected right both in the sense that no one else can subsequently take that water, and also in the sense of indemnifying the holder against any effect his abstraction might have on existing rights.

4.4.3 Protected right

Licensed abstraction is a protected right as is any abstraction from a surface watercourse used for domestic and agricultural purposes other than spray irrigation. Unlicensed abstraction from underground strata used for domestic purposes is also a protected right.

4.4.4 *Special conditions*

In areas where water is scarce, licences may be issued but only with conditions that require that abstraction ceases when flow or level falls below a given value. This may mean that water would not be available in some years, often the years when irrigation is most required.

4.4.5 *Content of abstraction licences*

Abstraction licences have to specify the following.

- a) The person to whom the licence is granted.
- b) Whether the licence is to remain in force until revoked, or whether it is to expire at a specified date.
- c) The quantity authorized for abstraction during a specified period or periods from the source of supply to which the licence relates.
- d) The way in which the water is to be measured or assessed.
- e) The means by which water may be abstracted.
- f) The land on which, and the purposes for which, the water is to be used.
- g) Any other provisions that the NRA considers appropriate.

4.4.6 *Exceptions to licensing*

The following categories are exempt from licensing.

- a) One-off abstraction of up to 5 m³ provided that it does not form part of a continuous operation whereby in total more than 5 m³ are abstracted.
- b) Similar abstractions of up to 20 m³, provided consent is obtained from the NRA.
- c) Abstraction of less than 20 m³ per day from an inland water for domestic or agricultural purposes other than spray irrigation.
- d) Abstraction of less than 20 m³ from underground strata for domestic purposes.
- e) Abstraction to test for the presence of water in underground strata or its quality or quantity provided that any such test is with the consent of the NRA under section 32(3) of the Water Resources Act 1991 and in accordance with any conditions imposed.

4.5 *Licences to impound or abstract from a watercourse*

Before carrying out any works which impound water or any further works which divert the flow of an inland water in connection with such impounding works the Water Resources Act 1991 requires that an appropriate licence is obtained from the NRA. The impounding works may only impound water to the extent authorized in the licence and should also allow for the release of any compensation flows specified. Any other conditions have also be complied with.

4.6 *Application for a licence to abstract or impound water*

4.6.1 *Pre-application consultation*

Consultation with NRA officials regarding the viability of any proposal is strongly advised to avoid incurring advertising cost unnecessarily.

4.6.2 *Eligibility to apply*

The applicant has to be the occupier or prospective occupier of the land contiguous to the abstraction point or have a right or prospective right of access to it.

4.6.3 *Application forms*

There are three types of application forms:

- a) for a licence to abstract from an inland water;
- b) for a licence to abstract from underground strata;
- c) for an impounding licence.

4.6.4 *Advertising*

Application for licences, renewals, or variations other than reductions in quantities have to be advertized according to a prescribed form of notice in the local press and the London Gazette. The NRA provides forms for this purpose.

The advertising procedure may be waived, at the discretion of the NRA in the case of applications for less than 20 m³ per day.

4.6.5 *Maps*

Applications should be accompanied by a map of a scale not less than 1:10 000 showing:

- a) in the case of abstraction, the land occupied by the applicant, the proposed point of abstraction and the land on which the water is to be used;
- b) in the case of impounding, the inland water and the proposed point of impounding.

4.6.6 *Consideration of application*

4.6.6.1 *General*

The NRA is permitted up to three months to deal with any application after receipt. This period can be extended by mutual agreement between the applicant and the NRA.

4.6.6.2 *Factors considered*

Apart from ensuring there is no derogation of protected rights the NRA has to take into account any formal objections received. Furthermore there is an obligation to consult with English Nature and others regarding any conservation sites.

Licences will only be granted if the character and flows of any affected watercourse can be safeguarded taking into account all existing uses.

4.7 Variation of conditions of licence

The variation of the conditions of any licence to abstract or impound water requires a formal application to the NRA. This necessitates advertising except for:

- a) transfer of ownership; or
- b) reductions in quantities, rates and periods of abstraction or the area of land to be irrigated.

The NRA should be consulted before proceeding with any formal application to vary a licence.

4.8 Land drainage consent

In addition to an abstraction licence any abstraction from surface watercourses may require a Land Drainage Consent from the NRA for any temporary or permanent installation on the river bank. This may impose restrictions and conditions on such works which may include provisions to allow for access to river banks for maintenance.

4.9 Measurement of abstractions

Abstractions are normally required to be measured using a flow meter. In appropriate cases it is possible to use flow gauging weirs or rated pump capacities to assess the quantity abstracted. Apart from any measurement requirements imposed as licence conditions, accurate measurement is strongly recommended in all cases in the interest of good irrigation management.

4.10 Charges

4.10.1 Charge for application

The NRA may make a charge for any application to abstract, impound or vary an existing licence.

4.10.2 Annual charges

Licensed abstractions are subject to an annual charge in accordance with the scheme operated by the NRA. The charges are dependant upon the total licensed quantity, period of abstraction, type of source and the use made of the water. They vary in different parts of the country.

No charge is levied for water from underground strata that is used for agricultural purposes other than spray irrigation, provided that the quantity does not exceed 20 m³ per day.

4.10.3 Abatement of charges

Charges are normally levied according to licensed entitlement whether or not water is actually abstracted. However, in the case of spray irrigation only, Section 127 of the Water Resources Act 1991 allows for an agreement to be entered into whereby reduced charges may be implemented in years when less than the full entitlement is taken.

5 Estimation of water availability

5.1 Introduction

An abstraction licence does not guarantee that the water is reliably available. The availability of water at any location varies greatly and the following components need to be considered:

- a) the water naturally available in the resource;
- b) any artificial augmentation, for example effluents or river augmentation works;
- c) existing protected rights, either for abstraction or for in-river needs.

5.2 Consultation with NRA

Most of the components listed in 5.1 cannot be properly assessed at the abstraction site. The NRA is responsible for these matters and should be consulted at the outset. It will usually advise on water availability, and may refuse applications for water from unreliable sources. However the decision on acceptable levels of risk is normally a matter for the applicant and his advisors.

5.3 Availability of surface water in summer

5.3.1 General

In most areas in England where irrigation is practised, river flows fall to very low levels in summer, and such flows which are predictable and can be relied upon are often already committed to existing abstractions. However surface water may be available from some major rivers or where flows are augmented by NRA river support works.

5.3.2 Cessation conditions

Abstractions of flows in summer are normally subject to a condition that abstraction has to cease when the flow or level is below that which is necessary to protect downstream rights. This restricts the amounts available for abstraction, which are likely to be at their lowest in dry conditions when irrigation is most needed. The NRA may advise on the possible frequency of restrictions, and hence on the likely reliability of the source.

5.3.3 Irrigation bans

Powers also exist under Section 57 of the Water Resources Act 1991 for the NRA to enforce partial or complete bans on irrigation in any area in the event of exceptional shortage of rain or other emergencies.

5.3.4 Stream flow measurements

On small streams some local flow gauging may be necessary to augment the broader scale resource assessment available from the NRA.

Standard methods of measuring flow and the flow ranges to which they are applicable are outlined in table 1. As flows vary from month to month and from year to year regular recordings are required to provide adequate data for available resources to be estimated.

Table 1. Method of measurement for source flow rate and typical flow ranges	
Method	Maximum flow for accurate measurement l/s
Stopwatch	
1 l container	0.25
5 l container	3.00
90° V notch weir	68
Rectangular weir	
0.6 m	170
1.0 m	290
1.3 m	380
1.6 m	470

5.4 Availability of surface water in winter

5.4.1 General

Winter flows are generally much higher than summer flows, and water is usually available to be stored on the site for subsequent summer use. Winter abstractions are usually also subject to cessation conditions which may restrict the ability to refill reservoirs in a dry winter. The NRA may advise on a probability basis as to the reliability of refilling a proposed storage reservoir. This reliability is not related to the volume which may be needed in the subsequent summer as summer rainfall is independent of the preceeding winter conditions.

5.4.2 Stream flow measurements

Local stream flow measurements may be recorded as detailed in 5.3.4.

5.5 Availability of groundwater

5.5.1 General

Water may be available either in shallow deposits such as gravels, or in underlying aquifers such as chalk, limestone or sandstone. The availability of groundwater at any location depends upon:

- the existence of a suitable aquifer;
- the overall natural recharge to the aquifer, and the extent to which it is already committed to existing abstractions and to spring flows and;
- the risk of local derogation to neighbouring abstractions.

5.5.2 Test pumping

It is almost always necessary to drill and test pump to evaluate the factors listed in 5.5.1 before any licence application can be determined. Prior consent for such tests has to be obtained from the NRA under Section 32 of the Water Resources Act 1991. The NRA should therefore be consulted at an early stage to enable the test to be carried out before any application is made.

Any consent to drill and test pump will specify:

- the dimensions of the borehole to be test pumped;
- the duration and rate of test pumping;
- the observations to be taken throughout the test within the surrounding area at existing or proposed boreholes and springs.

The procedures for test pumping wells and boreholes are described in BS 6316. In general the information derived from test pumping is used to evaluate:

- the reliable yield of the well or borehole;
- the design of the pump and the depth of installation;
- the impact of the proposed abstraction on existing groundwater users and surface flows.

5.5.3 Groundwater licence conditions

Following the evaluation of the test pumping results, the NRA may wish to modify the original licence application to safeguard the rights of existing groundwater users. This may be in the form of either a reduction in the quantities to be abstracted or conditions within the licence that may limit the duration of groundwater pumping. Such conditions may relate to an abstraction ceasing when specified groundwater levels or river levels are reached. If the NRA is unable to predict the exact effects of a groundwater abstraction, it may issue a time limited or temporary licence with conditions that require the licensee to collect water level data throughout the period of licence.

5.6 Safety

5.6.1 Safety of operators and public

All reservoirs or surface water supplies with an increased water level should be securely fenced to prevent unauthorized access. Gates or covers which can be either opened or removed should be lockable. Tanks, etc. will need to be fitted with suitable covers.

Pumps and other machinery or pipework which requires access for maintenance or operation should be designed to prevent injury to anybody carrying out the work. Means of access, machinery guarding and electrical risks should be considered.

Relevant warning signs will need to be displayed, e.g. access prohibited, risk of drowning, confined space.

Steps should be taken where appropriate to exclude rodents, e.g. pipes either feeding the reservoir or taking from the reservoir should be covered at the ends with rodent exclusion devices.

5.6.2 Priming and inspection

Special care should be taken when priming pumps and inspecting the suction pipework and inlet.

5.6.3 Sumps and inlets

Sumps and inlets should be fenced to eliminate the risk of either people or animals falling in the water. If access to the sump and inlet are required for maintenance, horizontal mesh on frames may be used instead, over the complete area. The mesh should be removable when required but should be lockable for safety reasons.

5.6.4 Livestock

Livestock should be prevented from entering or falling into the reservoir or deep water sources by the provision of secure fencing. Access points should be lockable.

5.7 Conservation and environmental effects

Consideration should be given to minimizing any environmental effects arising from the design and construction and operation of irrigation schemes including effects on habitats, biodiversity and natural beauty.

Attention should be given to procedures for dealing with incidents, accidents and potential emergency situations such that detrimental environmental effects are minimized.

6 Design aspects of surface flowing water sources

6.1 General

Flowing water sources range from small farm streams to large rivers. This clause deals with aspects of flowing water sources which need special attention to ensure that the proposed source will be suitable.

6.2 All sources

6.2.1 Flow rate variation

If the flow rate varies greatly during the period when normal abstraction would occur, the water source may not meet the flow rate required for the system. In this case, it may be advisable to either consider storage of the water or an alternative water source.

6.2.2 Floating debris

Floating debris in the form of logs, fallen branches or trunks, flotsam and jetsam may need to be removed.

6.2.3 Water level variation

The water level variation should be investigated accurately prior to specification and selection of the pumping equipment. If there is excessive water level variation, this may affect the selection of the type of pump that could be used.

6.2.4 Water velocity

High water velocity at the pump suction inlet may cause water turbulence which will encourage air in the pipe, and thus cavitation in the pump.

6.2.5 Position of pump offtake

The pump position should be selected such that the suction pipe is not at a point where siltation could occur.

6.2.6 Flood risk

The pump should be sited at a location where the flood risk is low. The use of a portable pump and fittings may be necessary.

6.2.7 Watercourse condition

The condition of the watercourse related to maintenance may affect the carrying capacity, e.g. weed growth.

6.2.8 Obstructions in watercourse

Obstructions in the watercourse, e.g. suction pipes, floating pumps and anchor cables may be hazards to wildlife and others.

6.2.9 Water level

Raising the water level may be required where there is not adequate depth of water above the suction inlet pipe. Any proposed raising of the water level is likely to need approval from the NRA.

6.2.10 Bank stability

The proposed pump site should be studied to be sure that it is stable and is able to support the pump and fittings and pumphouse without collapsing. Vibration that may be caused by pumping plant should be considered. Erosion may be aggravated by boats causing wash of the banks and thus eroding the bank.

6.3 Canals

6.3.1 Licence

Abstraction from canals and associated surface sources under the jurisdiction of British Waterways Board can only be authorized by NRA granting a licence to British Waterways Board. Individuals seeking abstraction from such sources have to apply to British Waterways Board who, if agreeable, apply to the NRA for such a licence.