



## **SABI Code of Practice for On-farm Irrigation Design**

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*This code was developed to provide guidelines for irrigators and those servicing irrigators on developing a new irrigation system or upgrading an existing one. It makes recommendations for:*

- *planning*
- *design*
- *installation and commissioning, and*
- *operation and maintenance of irrigationsystems.*

*The main aim of the guidelines is to encourage more efficient and cost-effective use of irrigation resources.*

### **Skills required**

The industry understands that standards and codes for the various activities and equipment used in irrigation systems are only useful if appropriately skilled people apply them. This code also outlines the skills required during the various phases of planning, designing, installing, commissioning, operating and maintaining an irrigation system. These skills are also required when an upgrade to an existing system is planned.

Vocational training in recent years has been based on achievement of competency standards. Competency standards for irrigation being prepared by SABI will detail the skills required within the irrigation industry in all aspects of irrigation management. Irrigators should also be aware of the industry certification programs run by SABI that certify irrigation designers. Certification programs for installers and managers are currently being developed.

### **How to use this code**

The code deals with a range of irrigation system types, and not all comments will be relevant to every application. When developing a new system or upgrading an existing system, the irrigator or industry operator can select the items needed for the particular situation from the checklist of processes and activities.

### **Why develop an irrigation code?**

As the largest user of water in South Africa, the irrigation industry understands that it has an obligation to manage water in a responsible manner and to recognise the rights of other users. Adopting a code of practice for irrigation is a way for members of the irrigation industry to demonstrate their responsible attitude towards land and water resources, and to show that their practice matches or exceeds accepted community values.

## **What is the code?**

This code is a written statement of the minimum desirable practices and actions to undertake when developing a new irrigation system or renovating an existing system. The code presents practices of an acceptable standard, given the current state of knowledge. This code applies only to the on-farm sector of the industry and does not cover off-farm irrigation water delivery systems.

## **Are these guidelines compulsory?**

This document (the code) is not a regulation. It recognises the right of irrigators to make their own business decisions, provided these decisions comply with legal requirements, regulations and industry standards. These decisions should also comply with principles of preserving natural resources.

On the other hand it is recommended that every irrigator take this code into account because it is likely that following these guidelines will result in more profitable irrigation enterprises.

## **PLANNING AN IRRIGATION SYSTEM**

The first step for the irrigator in developing a new irrigation system, or upgrading an existing system, is to prepare a comprehensive plan. A plan ensures that all issues are considered before money and resources are committed. The plan may also be required for the following purposes:

- to provide a detailed brief for the designer of the irrigation system
- as supporting documentation to justify purchase or transfer of water licences
- to demonstrate compliance with any regulatory requirements
- to support applications to banks or other sources of finance
- to support compliance with a Land and Water Management Plan (LWMP) or an Environmental Management System (EMS)
- to obtain local government planning permit
- to meet irrigation development guidelines imposed by statutory authorities

Enough detail should be included to provide accurate information to the system designer so that a water efficient and economically feasible design can be prepared that is suitable for the plants to be irrigated in the planned location. The plan should cover economic and financial, legal and regulatory, environmental, property, water, agronomic and human resource issues.

### **Contents of the plan**

This is a typical outline for an irrigation development plan. Risk analysis is needed on all these issues.

#### ***Economic and financial issues***

- a market analysis for the crop or crops to be grown
- a detailed business plan including a financial plan for the development with cash flow, risk analysis and funding arrangements.

#### ***Legal and regulatory issues***

- a list of local and State statutory requirements and clearances (for example restrictions on clearing vegetation, appropriate land title, or land use restrictions) and how the plan meets the requirements
- evidence that the proposed irrigated enterprise can be operated within all relevant laws
- evidence of compliance with local and state guidelines for the disposal of drainage water
- approvals process, and the time it requires
- land ownership rights.

#### ***Environmental issues***

- description of high conservation value areas and remnant native vegetation or rare and endangered species

- condition of natural watercourses that might be used for drainage discharge or as a source of water
- distance from towns or settlements that could be affected by the development
- assessment of the long-term sustainability of the development
- hydrogeological surveys, covering depth and quality of groundwater and subsoil permeability
- evidence of compliance with EMS, LWMPs, and strategies

### ***Property issues***

- location of the property
- property plan
- existing infrastructure, roads, lanes, drains, electricity and buildings

### ***Water supply and drainage issues***

- water ownership rights
- legal availability, physical access, annual allocation, reliability and permissible rate of extraction
- licence requirements
- capital and annual cost of water supply and drainage disposal
- source of water
- quality of supply
- supply storage requirements
- subsurface and surface drainage
- capacity of drainage disposal facilities
- quality of drainage water
- recycling and recirculating systems

### ***Agronomic issues***

- suitability of crop type for the land use, for example land capability, soil types, and local growing conditions
- crop water requirements at this location
- soil infiltration rates and system application rate
- crop rotations
- production system
- topography
- local climate including rainfall, evaporation, variability, occurrence of frosts and other climatic data

### ***Human resources***

- skill level of available workforce
- availability of labour and resources to operate the proposed system
- how design and contracting will be managed

### **Help from the irrigation service industries**

A range of skills is required for the successful development and commissioning of an irrigation system (see the table of skills on page 11). It is the responsibility of the irrigator to check that people they contract actually have the required skills.

The skills could be held by a number of different professionals, and the particular profession which has these skills may vary from place to place. For example, in one area an engineering practice that specialises in irrigation development may have within the practice many of the skills required. This does not mean that all engineering practices will retain the appropriate skills.

Irrigators who are planning and supervising development work need to know each of the skills required so that they can find a suitably qualified person. People working on an irrigation development should be able to demonstrate their competence to undertake the tasks in several ways including formal qualifications, previous track record and industry certification.

### **Who can help with economic and financial planning?**

Irrigators may need to source suitably qualified technical people to draw up comprehensive budgets for the crops to be grown and for the overall development. These people need demonstrated expertise in financial analysis and budgeting, including cash flow and funding requirements. These skills might be found in a number of organisations and in both the public and private sectors. Potential sources of this expertise include farm management consultants, accountants, government departments and consulting engineers amongst others.

### **Who can help with compliance issues for the development?**

Practitioners require the ability to collect all the relevant information and analyse possible effects on the irrigation development. Competency must be demonstrated in an ability to review each of the following areas:

#### ***Legal***

- all legal issues relating to the planned system
- local, State and national government regulations

#### ***Environmental***

- environmental factors that might be affected by the development, for example drainage disposal (surface and subsurface), salinity, EMS compliance, flora and fauna
- heritage and conservation values for the location

### **Who can help with resource planning?**

#### ***Surveyors***

People with surveying skills can check property boundaries and topographic details.

#### ***Hydrologists and hydrogeologists***

Government authorities, hydrologists, hydrogeologists and other natural resource planners can help research and measure water aspects such as:

- availability of water both underground and surface
- variability of water supply
- quality of water supply and its variability
- drainage management including disposal
- potential impact on underground water
- potential impact of floods

#### ***Agronomists***

- collect and analyse weather and climate information for the location
- undertake soil surveys detailing range and type of soil types present in the crop rootzones, including key data such as waterholding capacity, and physical and chemical characteristics
- estimate leaching fraction and check soil profile can manage this, including rainfall
- relate the crop requirements including nutrient, water, pest and weed management to the local conditions in the short and long term.

## **DESIGNING AN IRRIGATION SYSTEM**

The basis of an efficient and cost-effective irrigation system is the design. *Therefore it is recommended to make use of a SABI accredited Irrigation Designer.*

The designer will use the following information to determine the capacity of the system:

- maximum crop water demand

- waterholding capacity of the soil
- maximum available annual and extractive water supply, whether from a stream, a storage, a supply channel or a bore
- leaching fraction required
- frost protection requirements

The design and choice of irrigation system will take into account constraints including:

- topography of property
- human resources to operate the system efficiently and correctly
- environment of the farm such as the proximity to towns and presence of native vegetation and habitat
- water supply characteristics: quality, quantity, frequency and security
- occupational health and safety issues
- legal and regulatory requirements of the irrigation system including storm water retention system, capacity and management
- expansion strategy
- system flexibility
- automation
- money required to build, operate and maintain the system selected and cost comparison with other systems

### **What the design contains:**

The designer should specify the following information:

- physical layout: supply, application, drainage, and stormwater control infrastructure and reuse structures
- specification of components and their installation
- operating schedule of the system and any constraints
- degree of automation
- energy requirements and energy source
- fertigation and filtration requirements
- system application rate and uniformity of application
- estimated life of the system (according to manufacturer's specifications)
- detailed costings of components and labour required to install, operate and maintain the system
- methodology to monitor the system and its environment
- potential for staged development and order of construction
- commissioning procedures

### **Designer's skills**

Designing an irrigation system requires a high level of skill and a professional approach. Working from the information gathered during the planning phase, the irrigation designer must be able to:

- understand and work within the constraints of the business plan
- understand and use all surveys including soil, hydrogeology and topographic surveys
- understand a range of technical issues, including hydraulics, soils, agronomy, hydrology, hydrogeology and engineering
- design the irrigation system so that it delivers the correct amount of water to the plants at the required times
- communicate and work closely with the client

Irrigation designers demonstrate their competence through successful practical experience, formal qualifications and/or industry certification.

## **INSTALLATION AND COMMISSIONING**

The next task is to ensure that the system is installed and operates in the way in which it has been designed. This requires close cooperation between the property manager, designer and the contractors installing the system. It is in the best interests of all parties to ensure an appropriate contract is prepared.

### **Preparing the contract**

The basis of the contract to install and commission the system is an agreed schedule for the installation that specifies the costs, time frame (including seasonal factors), payment schedule, deliveries of product, responsibilities, construction management and reasons for possible variations, and a termination process. In the contract it is important to specify whether the contractor is contracted to the designer or to the owner.

The contract should also specify the party responsible for compliance with all relevant legal requirements. Before the contractor starts installing works, the property manager should provide all relevant property information to ensure timely and efficient completion of the installation. This information should include an accurate plan of the existing farm infrastructure detailing the location of services such as electricity and telephone. The contractor is responsible for disease and pest control and ensuring the correct sterilisation of all equipment when moving from property to property.

### **Checks during installation**

During installation the property manager or other responsible person should perform an on-going audit to ensure all design specifications and regulations are met. The following checks should be made regularly throughout construction:

- whether all products meet appropriate product standards;
- whether all construction complies with all regulations, including engineering design specifications, and environmental and occupational health and safety requirements;
- whether appropriate disease prevention measures are being taken.

### **After installation and commissioning**

Following the completion of the installation the contractor should provide a complete record of work that includes:

- a commissioning report
- an accurate plan of the system as built, showing 'as installed' variations from the original design
- written operating instructions and manuals
- a maintenance schedule for the proper maintenance of all structures and equipment.

Where appropriate the installing contractor and/or the designer should operate the system for an agreed commissioning period to ensure that the system operates to specification. This period should ideally be covered by a warranty. The warranty may extend beyond the commissioning period. If necessary, the contractor should arrange for training of key staff to ensure correct operation of all equipment.

### **Contractor's skills**

It is the owner's/irrigator's responsibility to ensure that the contractor can demonstrate the skills required to build and install the system specified. Contractors are required to install and commission most irrigation systems, except those where minor upgrades or very simple systems are being installed. In instances where the operator of the system also installs the system, skills in the same general categories are required. The skill level must be appropriate for the scale of system being installed. A contractor typically needs business and technical skills.

### ***Business and financial management***

- manage finances and cash of the contracting business
- manage licensing requirements of staff (such as heavy vehicle licences)

- comply with all occupational health and safety requirements
- meet all legal obligations associated with maintaining the contracting business
- identify all legal issues associated with irrigation system developments such as water storage and drainage
- communication and liaison skills
- project management skills including task prioritisation within time frames and staff management

*Keep planning on a broad front. Identify any factors which might slow or halt progress. Return and reassess previous assumptions and alter as necessary.*

### **Technical skills**

- ability to interpret plans
- understanding and familiarity with product installation requirements
- knowledge of all skills required for installing the designed system. These skills include knowledge of pipe joining and material handling, and of electrical, hydraulic, mechanical, earthmoving, construction and concreting skills
- ability to identify and deal with any environmental impacts during system installation

The specific knowledge and skills needed will differ for each system.

### **Management, operation and maintenance**

The installed system is the key to cost-effective lifelong water application. A system that has been designed and built as a water-efficient system must be operated correctly if it is to demonstrate its efficiency. Correct operation and maintenance of an irrigation system requires an understanding and application of basic irrigation principles:

- Regular service of parts and equipment as per the schedule
- Regular maintenance checks of all physical parts of the system from the water source to the drainage and reuse sections
- Schedule of maintenance
- Correctly trained staff to operate the system
- Objective information on which to base irrigation schedules
- Detailed instructions for the correct operation of the system
- Working life of system components
- Redevelopment/upgrading plan

The operator should monitor the system to ensure it operates to specifications.

### **Documentation**

#### ***Operation manual***

The system operation manual should specify:

- the correct way to operate all equipment and installations
- scheduling methods and crop water requirements
- how the system should work and its optimal operating range
- protocols for operating the system safely
- how the system handles natural extreme events such as floods and storms
- how the system's operation will be monitored
- how environmental impacts such as drainage will be monitored
- emergency procedures

## **OPERATION AND MAINTENANCE**

### ***Maintenance manual***

A system maintenance manual should include:

- a service manual and parts book
- a schedule of maintenance and replacement that specifies the frequency of inspection

and service for all elements of the system. Maintenance records as well as financial records of costs to operate and maintain the system should be kept.

### **Operator's skills**

Once the system has been commissioned and handed over by the installer, the responsibility for ongoing operation and maintenance lies with the manager of the system. Staff should be able to demonstrate the following skills:

- knowledge of basic soil plant water relationships
- basic knowledge of hydraulics and system components
- ability to read plans, manuals and technical specifications
- ability to apply objective scheduling methods
- ability to plan irrigation, schedule and order water (peak and off-peak)
- understand application rates and how many hours to water
- ability to monitor and understand water quality and impurities such as snails
- ability to test pressure/flow rates in system (valves/emitters)
- ability to monitor pump performance, including alignment and efficiency
- basic knowledge of pipe repairs
- understand how to operate the system safely within OH&S regulations
- ability to read water meter, rain gauge, tensiometers, and compare to benchmarks
- keep records/monitor/check list
- calibrate fertigation equipment
- determine the potential for off-site and groundwater impacts from operation and drainage
- understand operational risks

### **Summary of important issues when planning irrigation:**

Economic & business planning  
Environmental issues  
Legal issues  
Property boundaries/ topography  
Water availability  
Water quality  
Weather information  
Soil surveys  
Plant water requirements  
Nutrient, pest, weed  
management  
Selection of system  
Design system  
Drainage, storages and earthworks  
Manage installation and construction  
Interpret plans  
Product knowledge  
Knowledge of irrigation principles  
Audit, monitor system  
Maintenance

## **SKILLS BY OCCUPATION**

**The following professionals can help with irrigation system planning, development, installation and operation.**

*Engineer*

*Agronomist*

*Accountant*

*Economist*

*Surveyor*

*Contractor*

*Irrigation designer*

*Solicitor*

*Environmental scientist*

*Hydrologist*

*Hydrogeologist*