

WATER:

WATER CONSERVATION AND WATER DEMAND MANAGEMENT

**Core Notes for the Second Lecture of Module 3 of the Course
“Environmental Engineering – Sustainable Development in Coastal Areas”**

The material for this Lecture also includes:

- Synopsis
- Case Study
- Newspaper articles
- Self-test
- Sources of Reference

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1 Perspective on South Africa's Water Resource Situation

South Africa is a water scarce country. Our average rainfall is about 450 mm per year. This is much less than the world average of about 860 mm per year. Our rainfall differs greatly from year to year. The country is also prone to droughts. Furthermore, the country's rivers are small when compared to the rivers of other countries. The Orange River carries only about 10% of the water in the Zambezi River. All South Africa's rivers together have less than half the water of that in the Zambezi River. We also share many of our larger rivers, such as the Orange /Senqu and Limpopo, with other countries which also use the water from these rivers.

The National Water Act, (Act 36 of 1998) provides for progressive development of National Water Resource Strategy (NWRS) that provides the framework for the protection, use, development, conservation, management and control of the water resource of the country as a whole. Further, the NWRS provides the framework within which water will be managed at catchment or regional level, within defined water management areas.

Table 1 shows water resource situation for the base year 2000 in the nineteen defined water management areas. Already it can be seen that water resources in most water management areas are already in a situation of water stress. This is characterised by inter basin transfers from water rich catchments in order to meet the growing water requirements in centres having high demands such as Gauteng, Cape Town and their surrounding areas which are located far from exploitable resources.

In addition, a high-level analysis study undertaken by DWAF in 2000, showed that 10 of 19 water management areas in the country were facing a water deficit. In other words, in these catchments people are using so much water that either the ecosystem have been placed under severe stress or other users cannot rely on getting their fair share. DWAF is thus obliged to take action to bring water use in these catchments back within sustainable availability levels, that is, to balance the demand for water with supply. The main tools for doing so include increased water use efficiency, removal of infestations of invasive alien vegetation (which, like afforestation, also reduce runoff), the development of additional infrastructure such as dams and inter basin transfer systems to store water and bring it from areas of surplus to areas experiencing shortages, promotion of water trading and the reallocation of water use by compulsory licensing. Moreover, DWAF will have to deal with localised areas of water stress in otherwise well resourced water management areas.

Table 1 Water resource situation in 19 water management areas

Water management area		MAR MCM	Ecological reserve	Reliable local	Transfers in	Transfers out	Local requirement	Balance
1	Limpopo	986	156	281	18	0	322	-23
2	Luvuvhu/Letaba	1185	224	310	0	13	333	-36
3	Crocodile West and Marico	855	164	716	519	10	1184	41
4	Olifants	2040	460	609	172	8	967	-194
5	Inkomati	3539	1008	897	0	311	844	-258
6	Usutu to Mhlatuze	4780	1192	1110	40	114	717	319
7	Thukela	3799	859	737	0	506	334	-103
8	Upper Vaal	2423	299	1130	1311	1379	1045	17
9	Middle Vaal	888	109	50	829	502	369	8
10	Lower Vaal	181	49	126	548	0	643	31
11	Mvoti to Umzimkulu	4798	1160	523	34	0	798	-241
12	Mzimvubu to Keiskamma	7241	1122	854	0	0	374	480
13	Upper Orange	6981	1349	4447	2	3149	968	332
14	Lower Orange	502	69	-962	2035	54	1028	-9
15	Fish to Tsitsikamma	2154	243	418	575	0	898	95
16	Gouritz	1679	325	275	0	1	337	-63
17	Olifants/Doring	1108	156	335	3	0	373	-35
18	Breede	2472	384	866	1	196	633	38
19	Berg	1429	217	505	194	0	704	-5
Total for Country		49040	49040	9545	13227	0	170	12871

In figure 1, Turton`s model provides a succinct illustration of the historical and current level of water development which shows a pressing need for demand sided solutions as opposed to supply sided solutions. Table 1 read in conjunction with Fig 1, shows how initial phases of water abundance and scarcity required water resource development and building of infrastructure such as dams as an integral part of supply side solutions in order to meet the demands where they occur. However, this has since been transcended by an overall transition to the current phase of water deficit that dictates that demand side solutions must now be given priority as opposed to supply side solutions, which have become obsolete.

Table 2 Water Use requirements by water use sectors (NWRS, 2004)

Sector	Water requirements (Million cubic metres)	Percentage
Irrigation	7 920	62
Urban	2 897	23
Rural	574	4
Mining and industrial	755	6
Power generation	297	2
Afforestation	428	3
Total	12 871	100

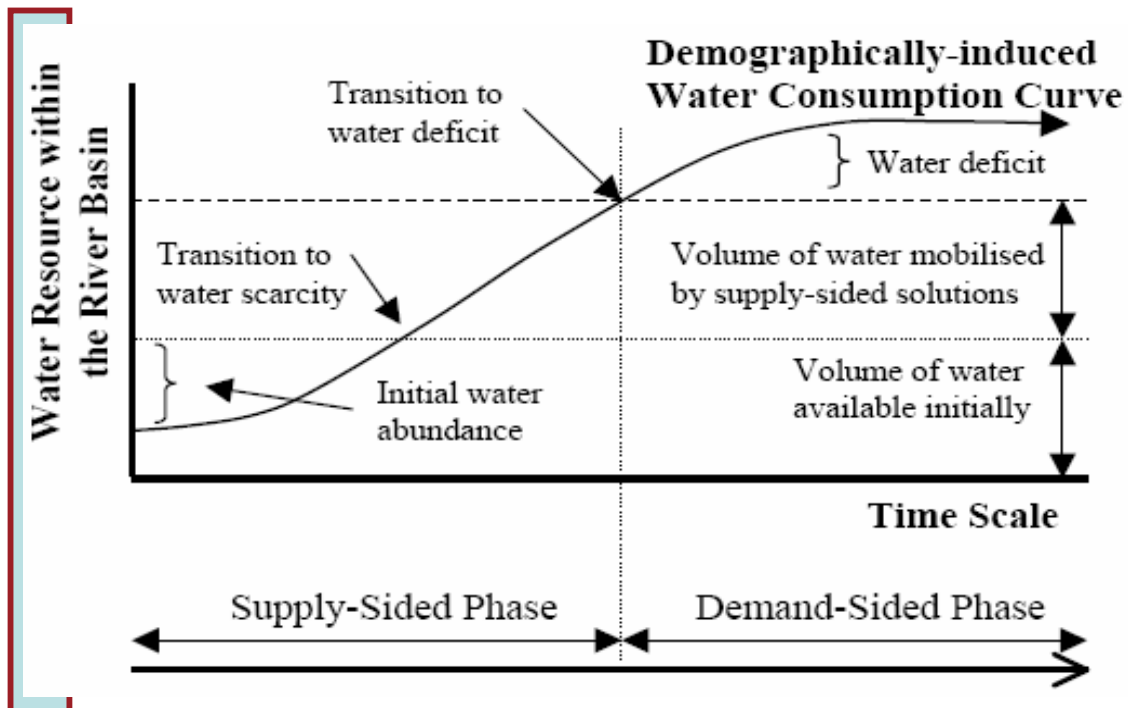


Figure 1 Turton's Model: Transition from Supply-side Phase to Demand-side Phase of a River Basin

2 Transition from supply side to demand side

Therefore in the light of aforementioned water resource situation and provision of the National Water Policy and National Water Act, 1998 (Act 37 of 1998), new approaches to water management will be needed. This will have to focus on the way in which water is used (efficiency, effectiveness and demand management) in which each water use sector dispenses with the policy of simply predicting, planning and supplying its water needs. It thus requires the efficient use of water through water conservation and water demand management measures and practices to become a way of life for all water use sectors. The underlying principles objectives of the National Water Act, 1998 provides the fundamental basis on which water resource is used and managed in South Africa. These are:

- Equity
- Efficiency
- Sustainability

Furthermore, National Water Act, 1998 (Act 38 of 1998) defines conservation in relation to a water resource means the efficient use and saving of water, achieved through measures such as water saving devices, water efficient processes water demand management and water rationing.

3 Demand side solution through water conservation and water demand management

The National Water Policy requires that a formal policy be developed for water conservation and use in each main use sector, such as agriculture, industry and mining.

This will include regulations for water conservation in each use sector to ensure their long-term water security. Specific institutional arrangements will be made to promote more efficient water use. The conservation and water demand management function of the national Department will be strengthening and greater priority must give to this area.

Thus, National Water Policy has provided a framework within which water conservation and water demand management can be implemented. The adoption of Integrated Water Resource Management approach will ensure that the its three components (institutional roles, enabling environment and management instruments) are catered for.

3.1 Definition of Water Conservation and Water Demand Management

Water Demand Management (WDM) is defined as the adaptation of and implementation of a strategy or a programme by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following

objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply, services and acceptability.

WDM should therefore not be regarded as the objective but rather as a strategy to meet a number of objectives. It should in fact be considered as broader strategy that requires the development and implementation of systems and measures associated with managing the overall use of water. The scope of WDM includes both distribution management and consumer/ end user demand management.

Water conservation (WC) is defined as the minimization of loss or waste, the care and protection of water resources and the efficient and effective use of water.

WC is the overall concept that requires the effective management and protection of water resources. WC should be considered as both objectives and strategy for water use institutions and consumers.

The three principles of equity, efficiency and sustainability come together in the field of water resources management to achieve integrated water resource management. As enshrined in the National Water Act, 1997 integrated water resource management is intended to enable us to meet the needs of our people for water, jobs and economic growth in a manner that also allows us to protect and, where necessary, rehabilitate our aquatic ecosystems. Above all, integrated water resource management will make it possible for us to use our precious water to assist in addressing the overwhelming need to eradicate poverty and remove inequity in South Africa.

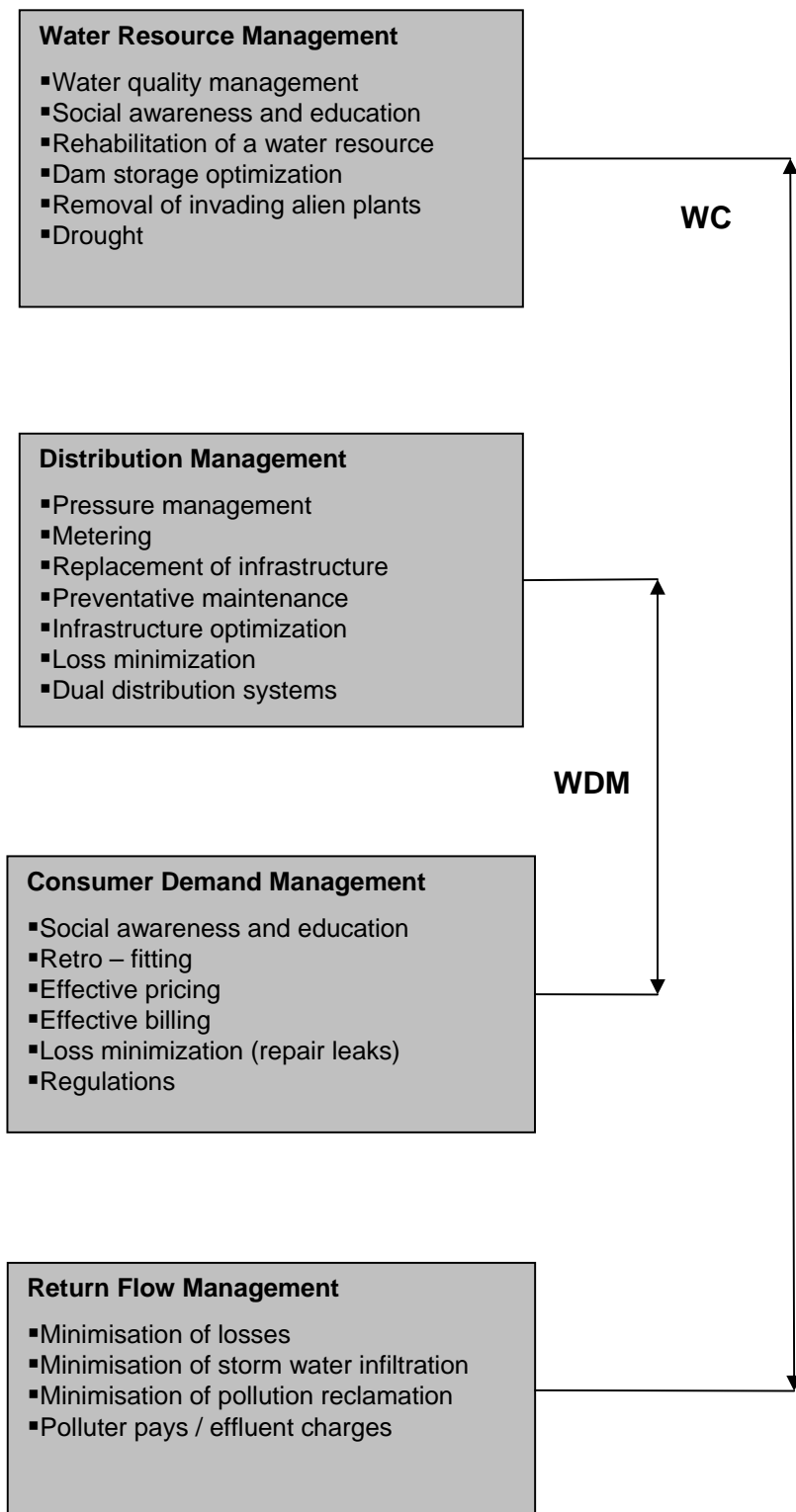


Figure 2 Typical Water Conservation and Water Demand Management activities throughout the water supply chain

4 FRAMEWORK FOR ACTION: SETTING UP A WATER CONSERVATION PROGRAMME

The basis for any water conservation programme is to change not what you are doing but how you are doing it as well as the technology or equipment you are using to do it. In many cases much can be achieved through low-technology measures that seek simple ways reduce water consumption and to prevent unnecessary wastage. For the programme to be successful, commitment is required at a very high level as has been observed in successful programmes and projects in other sectors previously.

A proposed phased approach would encompass the following:

- i. Review of current water use practices including any existing WC/WDM initiatives or projects;
- ii. Identification and appointment of a champion to drive a WC/WDM programme
- iii. Establishment of suitable fora for awareness, education and dissemination of WC/WDM matters and of relevant information;
- iv. Identify opportunities for WC/WDM projects and studies or use existing initiatives and ensure application of appropriate WC/WDM principles;
- v. Development of a Water Efficiency Management Plan (WEMP) utilising guiding principles from DWAF documents and other appropriate literature;
- vi. Development of generic guidelines or guiding principles for effective water efficiency management; and
- vii. Implementation and monitoring for continuous improvement.

In developing the above, appropriate targets for achievement and time frames need to be set. Budgets need to be agreed upon and suitable people be identified for the various functions and their responsibilities be allocated. A project management committee (PMC) needs to be set up to co-ordinate all activities and provide guidance. This PMC should comprise members from all affected parties and should be able to co-opt any other person it may require on an ad-hoc basis for specific advice or guidance. PMC should preferably meet at suitable intervals monthly initially to get projects off the ground and thereafter at least every two months.

Below are some measures that can be incorporated into the programme. In order to determine the most suitable interventions and applications of WC/WDM measures at an individual base level, it will first be necessary to ascertain the individual conditions and requirements of that base. In this regard a questionnaire will be developed for this purpose with possible site visits in some case for clarity and verification.

4.1 Basic or Fundamental Measures

Metering of premises - An accurate and reliable water meter is an important step in any water conservation programme. Without proper measurement of water consumption, a water conservation programme is difficult to implement and evaluate

successfully. It may be cost-effective to work in conjunction with the water service provider to ensure the water meter is in good working order. This may require the testing and calibrating of the water meter and may mean having the meter repaired or replaced.

Water accounting and reconciliation of water use bill - An accurate and reliable water meter allows for early detection and monitoring of unaccounted water. It makes it easier to reconcile the water bill as well as to spot unusual surges in water usage that may indicate a water leak. By undertaking a continuous analysis of monthly water consumption, unusual trends or unexplained surges that may indicate other problems could be determined. Actual readings on the meter should be compared to readings given on the account.

Water use audits and surveys - . By monitoring water use over time and conducting water use audits a trend can be established which would allow a prediction of expected water use, taking into account the various activities over a 24-hour period. Minimum night flow analysis is a measurement of water use during the time of least activity or when the use of water would be at its minimum such as the period between 00h00 and 02h00. If the percentage of water use during this time is more than perhaps 10% of peak time use, this could indicate small, undetected, usually underground leaks.

Gardening and landscaping - Landscape planning and renovation coupled with irrigation management can result in significant water savings. Without impacting on the desirable appearance and aesthetic value of a landscape, water savings can be effected through an informed selection of plants that require less water to thrive. The design of irrigation systems in respect of time, duration, radius, overlap of coverage and pressure of the system can have a profound effect on water savings. Taking prevailing weather conditions into account is also important. A more efficient system for plants and shrubs is drip-irrigation while borehole water use, when available, can reduce reliance on potable water.

Reuse and recycling - Basic re-use and recycling means any situation where a volume of water is used more than once. Very often water is discharged into the sewer system after only one use. Analysing all the various sectors where water is used it may be possible to identify areas where the output water of one use can become the input water of another use. It is important that where water is reused it is only for application where lower quality than potable water is feasible. If applicable, wastewater from one process can be used for a low-grade purpose such as pre-washing.

Awareness and education - Apart from technical interventions there are also the social and softer methods of achieving water conservation. An important indicator of the success of a water conservation programme is the impact and endorsement that it enjoys from stakeholders. When clients, staff and management embrace water conservation principles and become committed to its cause, this will enable implementation and the achievement of the desired efficiency levels.

4.2 Other short-term measures as an extension of guidelines given above

- Encourage all members to use water sparingly

- Incentivise all members to propose water saving measures
- Determine average / typical water consumption per member for domestic activities
- Determine average / typical water consumption per unit of work / production for operations / non-domestic activities
- Place bricks (wrapped in plastic) in toilet cisterns
- Turn off trip-tray urinals (where they exist) during quiet times
- Cut down on number of flushes when cleaning toilets
- Selected signage to request / remind members of their obligation to save water
- Excessive grassy or green lawn patch could indicate leaking pipes
- Revise cleaning procedures in kitchens and messes to eliminate taps running unnecessarily
- Any tanks and containers that are filled with water could be installed with a float valve that cuts the water supply to prevent overflowing and wastage
- Do not defrost or clean food under running water
- Ensure dishwashers always run at full capacity
- Ensure washing machines run at full capacity
- Adhere to maintenance programmes on equipment to ensure efficient operation
- Avoid using hoses to clean paved areas or outside walls
- Avoid using hoses to wash vehicles
- Do not irrigate or water gardens between 10h00 - 16h00
- Utilise sleeping quarters efficiently and if low occupancy occurs, re-allocate members and zone-off unoccupied areas or cut off water supplies to those areas
- Shut down air conditioning in vacant rooms and unused conference halls
- Avoid filling swimming pools to the brim
- Cover swimming pools when not in use to minimise evaporation

4.3 Advanced and Longer Term Measures

Sub metering and zonal division of premises - Ideally each zone or business unit of an establishment should be metered. Measurement of water usage in zones can be used to determine which the high usage zones are and then further analysis can be used to determine if each zones usage is justifiable. A water use system profile can thus be developed. Although this may seem an expensive step to install additional meters, this should be weighed up against the possible savings that can result in the early detection of water losses or the cost of continuous water wastage.

Pressure management - Small leaks on small pipes and fittings, which cannot always be seen, is normally present in all pipe systems and is very difficult to eliminate completely. They may require analyses such as minimum midnight flow to detect. They usually occur underground and are not cost effective to repair immediately or individually unlike large leaks (burst leakage). Such small leaks are very sensitive to pressure compared to the larger leaks, thus a programme of pressure management whereby the water pressure is adjusted during periods of low and high water use can reduce such small leaks and also reduce the frequency of

bursts. If properly managed, water can be saved without any negative impact on water users.

Reuse and recycling - Water recycling implies the beneficial use of reclaimed water and involves treating wastewater where it can be used again for purposes that do not require potable quality. If garbage disposals are used, water can be routed from another process into the disposal thereby eliminating the use of clean purified water, which is not required for this purpose. Under various conditions water can be re-used for landscaping and irrigation. There is technology available to reuse water for commercial cooling, air conditioning, flushing of toilets and urinals, decorative fountains, laundering and the washing of pavements.

Replacement and retrofitting - Various fixtures and appliances, some less simple than others, are available to increase water efficiency. In particular there are tap aerators that reduce water flow but still give an impression of a strong flow. In general any flow of water from a basin tap above 10 litres a minute can be considered as wasteful. Alternatively if new taps are to be installed, ones that use less than 10 litres per minute should be used. Similarly low flow shower heads that also use less than 10 litres per minute can be used. The principle with showerheads and aerators is that water is mixed with air and this coupled with fitting design, gives the sensation of a higher volume spray with less water. Regarding toilets there are now newer ones that use as little as 6 litres per flush as opposed to 15 litres with older models. Toilets with dual / half flushes to eliminate solids are also available. In general any water use appliance that needs replacement, should take place with ones that are water efficient. Examples are dishwashers, washing machines and ice-making machines.

Integrated utilisation and management - The co-ordinate development of a comprehensive water management plan taking into account all the different purposes that water is used for and analysing the requirements for each use is necessary to ensure that an establishment becomes water efficient. The plan has to include technical, social and environmental aspects with each one being subject to budgetary constraints. The most advanced method can involve considerable capital outlay to install a fully integrated system whereby water for a specific process is used for further processes before being disposed of or being recycled and reworked into the system in a continuous loop with minimal losses and outflows. It is not always feasible to become water efficient overnight thus the need to embark on a phased approach over a number of years having specific targets and objectives in mind.

4.4 Other medium to longer term measures

- Consider rainwater harvesting as an alternate water source (for swimming pools or irrigation)
- Install trigger guns on all hoses
- Install single lever control mixing taps
- Install quarter-turn taps
- Install tap flow restrictors
- Convert to push button or infrared urinals
- Certain waste water can be treated and reused for irrigation or in cooling towers
- Switch to drought resistant plants in the garden