Chapter 3

Saving Water: Step by Step

3.1 Developing a Sustainable Water Management Plan

To save water an organisation requires a plan. A successful water management plan (WMP) needs to incorporate *technical approaches and a systems approach*. This is the key to achieving ***sustainable*** water conservation within a facility.

A plan works best when it places *sustainable water management* in the context of an organisation's overall approach to social and environmental responsibility. Without a systems approach, gains achieved through technical improvements are lost when management finds other priorities, or when a champion is promoted or leaves the organisation. It is only when costs increase again that another campaign is launched and old ground is revisited as illustrated in Figure 3.1. To avoid this 'roller coaster' cycle, management must ensure that there is a *continuous improvement strategy*.

A successful WMP

- is part of a well-formulated water policy that aligns with the goals of the corporate plan and regulatory requirements (**leadership**)
- identifies and assigns responsibility to a person (**accountability**)
- sets targets for water use efficiency and minimises pollution to reduce the overall environmental footprint (**plans**)
- integrates water efficiency into the operations of the organisation
- addresses behavioural changes among employees
- drives the development of water usage reporting systems and processes for collection of data
- specifies the costs and benefits to the company of sustainable water management and
- drives changes in how the organisation interacts with contractors and suppliers.

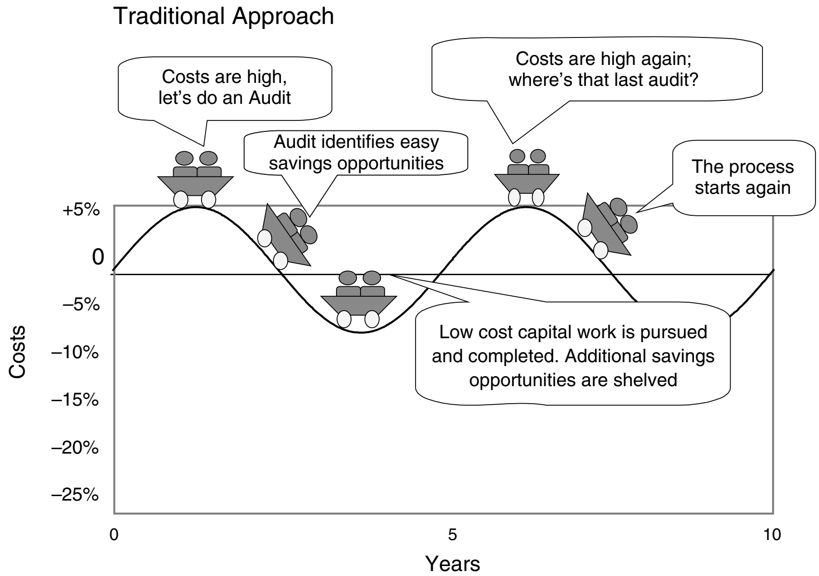

Figure 3.1 Traditional approach to water management

Courtesy of Energetics Pty Ltd.

The benefits of having a well-formulated WMP are as follows:

- Alignment with corporate strategy
  Water conservation can be brought into alignment with corporate strategy by showing the linkage between water conservation, environmental performance and business improvement. Once this linkage is clearly shown it will provide a platform for the organisation to allocate sufficient resources to carry out the WMP. The alignment with corporate strategy will then lead to systems being embedded to realise long-term sustainable savings in water and other associated resource input costs while improving environmental performance of the organisation. Figure 3.2 shows this relationship.
  For example, the steel industry is a highly competitive industry. To be competitive in the global market a steel manufacturer needs to operate in the lowest cost quartile. When this is the corporate strategy, then reducing all input costs including water needs to be a high priority for the company.
- Cost savings
  A reduction in water consumption will reduce both water usage costs and discharge costs as well as reduce other associated costs such as natural gas costs, electricity and chemical treatment costs. Improved

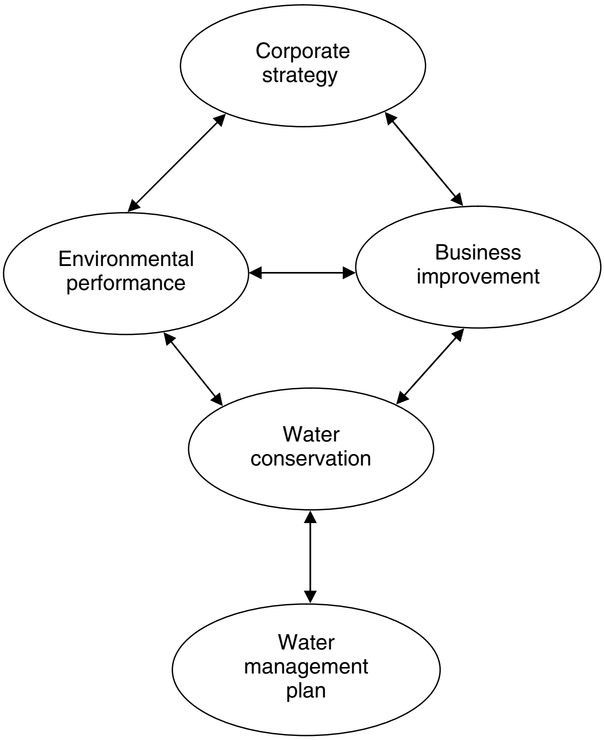

Figure 3.2 WMP alignment with corporate strategy

water efficiency in a manufacturing plant can also provide productivity and product quality improvements.

- Reduced organisational water footprint
  A water management plan will result in making significant reductions in water usage if an organisational perspective is maintained. All inputs and outputs need to be analysed.

Case Study: BlueScope Steel

BlueScope Steel Port Kembla Steel Works is Australia's largest steel manufacturing facility. It consumes 35 000 m^3/day (9.25 US Mgal/day) of freshwater and 850 000 m^3/day (224.5 US Mgal/day) of saltwater. Over a ten year period BlueScope Steel has improved water use efficiency per ton of steel from 5.5 m^3/T to 2.69 m^3/T making it one of the world's most water efficient steel makers [1].

- Good public relations
  A successful water conservation programme can be promoted internally to the organisation. This will increase uptake by senior management to allocate funds for capital- intensive water conservation initiatives. By publicising the achievements externally, the organisation will come to be regarded as an environmentally committed good corporate citizen.
- Brings about behavioural changes through involvement of employees, contractors and suppliers
  A successful WMP involves all employees, relevant contractors and suppliers. Therefore a WMP should contain sufficient initiatives such as workshops and seminars to increase employee awareness as well as to get their participation in identifying the improvement opportunities. This ultimately leads to positive cultural and behavioural change within the organisation. Employees can be motivated through financial and non-financial incentives. Contractors may be evaluated using additional performance criteria, which will align their activities with the organisation's water conservation efforts.
  For example, cooling tower water treatment contracts are typically awarded based on lowest cost, technical competence and on-site availability. Minimising water usage is rarely a requirement. A new contract could explicitly state the need to ensure that cooling tower water usage is minimised whilst maintaining the other criteria. This in turn reduces the chemicals required to treat the water and results in a cost saving.
- Reassessment of redundant process steps
  Often these initiatives lead to reassessment and review of processes. Often processes are carried out through force of habit and rarely questioned whether they are valid or not. A WMP will lead to reassessment of the process steps and help to identify redundant steps.
- A reference document for obtaining subsidies
  Many governments and municipal authorities provide funding to implement water conservation within the business community. A well-developed WMP can be an excellent document to cite when applying for funds from these agencies as it shows the organisation's commitment and structured approach to water conservation.
- Linked to senior management performance
  The WMP is a transparent document to allocate responsibilities and water usage reduction targets to departments and senior managers. The achievement of WMP targets can be linked to senior management remuneration packages. Often whilst the corporate strategy may have water conservation as a key driver for the organisation, middle managers may not be fully committed to achieving those drivers. By linking senior management remuneration to achieving those targets, the organisation is ensuring that the goals will be achieved.

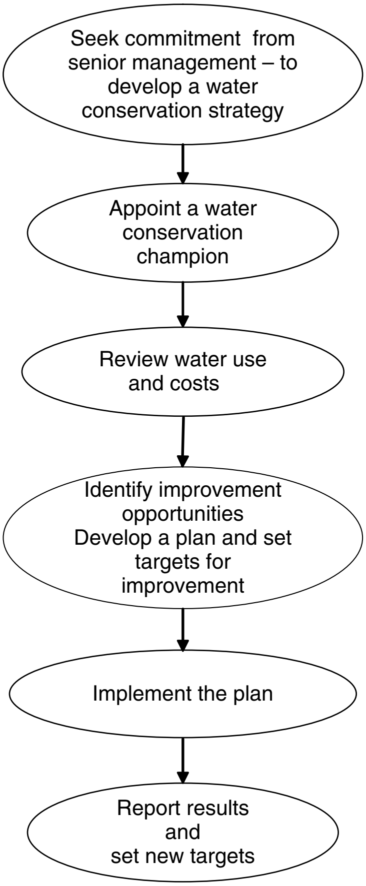

Figure 3.3 A step-by-step guide to developing a water management plan

Figure 3.3 gives a step-by-step guide to establishing a successful Water Management Plan.

3.2 Step 1: Seek Senior Management Commitment

Senior management commitment and leadership is fundamental to the success of a sustainable water conservation programme. Therefore, management needs to do the following:

- Develop a water conservation policy that includes clear water reduction targets, not just cost savings. The policy can be developed in terms of reducing overall consumption compared to a base year or by reducing it to below an industry benchmark. If there is lack of knowledge on how to set clear targets, then this could be done after the saving potential has been identified.

An example of a water conservation policy

This organisation is committed to reducing its water consumption. By 2010 we will reduce our potable water consumption from 4 m^3/ton to 2.0 m^3/ton. This will increase efficiency, cut costs and enable us to be globally competitive whilst making a positive contribution towards the environment.

- Appoint a company-wide water conservation manager.
- Allocate sufficient resources.
- Bring about cultural change within the organisation by communicating the policy internally to all employees, contractors and external stakeholders.

Begin with a simple positive message to all employees about the importance the business is placing on the programme, why the organisation is doing it and explain their role. The message needs to emphasise the need for employee involvement and support. By doing so, the water conservation programme will become sustainable, as attitudes to water change from a *consumable* to a *business resource*.

3.3 Step 2: Appoint A Water Conservation Manager

The secret to a successful programme is having a champion within the organisation with responsibility and authority to transform the policy into a workable plan.

The manager needs to be given an achievable target, adequate funding and support. The target to be linked to the manager's remuneration package. This way the manager's personal goals are in alignment with organisational requirements.

3.3.1 Responsibilities of the Water Conservation Manager

- Form a water conservation working group drawn from different divisions and units.
- Carry out a management review of business practices – otherwise known as a management diagnostic. The objective is to identify the

system barriers or lack of systems that are inherent within an organisation, which prevents the organisation from developing a successful sustainable water management programme.
- Review and evaluate the organisation's existing (or previous) water conservation programmes. Note areas that were successful and areas that were not effective.
- Establish a budget and secure the necessary funding.
- If site-wide audits are not being done, initiate water audits and provide assistance to auditors. Investigate water reuse opportunities.
- Create the water conservation action plan. The plan should include the goals of the programme as well as the details for implementing specific water conservation measures (both technical and management improvements).
- Establish the process by which the water conservation plan will be documented and evaluated.
- Implement the water conservation programme. Begin with the lowest cost conservation measures that have quick paybacks. This will give the programme a boost through quick wins and motivate others.
- Recognise and reward employees whose suggestions and actions achieve water reductions and publicise those achievements both internally and externally; for example through newsletters.
- Continually monitor water use through water meters (Worksheet 1).
- Regularly report water conservation progress against targets to senior management. Each initiative needs to have a goal, when it would be implemented and what was achieved and issues encountered. Review the plan annually, analyse the gap against goals and commitments and make changes to create additional water reductions.

3.4 Step 3: Gather Baseline Data and Review Usage

The first task for the water management champion is to collate information pertaining to water usage and costs to develop a water balance for the site.

Lack of usage data creates the myth that water is a fixed cost. This is not the case. Water is a variable cost and it empowers the user to reduce its consumption.

Table 3.1 gives the type of data that should be collected to gain an understanding of a water balance.

Actions

1. From the water and sewer bills for the last 2 years develop a spreadsheet of water consumption, charges for water, wastewater and trade

Table 3.1 Gathering existing data

Type of data	Description
Water charges (fixed plus usage)	Collect water bills for the previous 2 years. If not available contact your local water authority.
On-site treatment costs (fixed plus variable)	Chemical treatment (or other costs) to purify the water further, such as using reverse osmosis, ion exchange.
Sewer usage charges and trade waste charges	Wastewater bills for the previous 2 years. If not available contact your local water authority.
Effluent pre-treatment costs and quality	Chemical treatment costs for dissolved air flotation and other pre-treatment systems and discharge wastewater quality.
Sewer usage discharge factor	Per cent of effluent discharged to the sewer as per cent of inlet water.
Effluent- and sludge-removed off-site	Waste disposal costs and frequency of sludge removal.
Site plans	Location of meters, hydraulic plans, distribution system.
Number of main and sub-meters	List the number of main meters and sub-meters, type and size and if they are capable of being remotely logged.
Unit operations description	Process flow and pipe/process technical drawings.
Production data or metrics used by the organisation	In retail outlets use number of transactions. For service establishments like hotels; laundries; hospitals; canteens; military establishments; school records of meals served; rooms occupied; patients or kilogram of dry linen.
Number of employees and contractors	Useful to generate benchmark information.
Labour	Labour costs to operate wastewater treatment plant.
Energy costs	Gas and electricity costs.
Major water using equipment	A detailed inventory of major water using equipment including their water usage rates etc.

waste. Use Worksheets 2 and 3 in the Appendix or request it from the water utility. Sydney Water' Every Drop Counts Business Program provides this service as shown in Figure 3.4.

2. Chart water consumption per month or billing period and insert production data. Generate raw benchmarks as shown in Figure 3.5.
3. Link water usage to other costs such as chemicals to find true cost of water for your business.
4. Begin monitoring water usage through main meters and sub-meters to gather baseline data.

Figure 3.5 shows a water consumption profile in an office building with target benchmarks.

Every Drop Counts – Business Program – Customer Water Usage Profile

Properties		Tradewaste Details		
Property	SUDF	Permit	Risk Index	Business Name
	100%			
	100%		6	

Current Water Use*	553.1	kL/d
Historic Water Use*	799.3	kL/d

Sydney Water Charges

	Current
First Invoice:	27/04/05
Last Invoice:	3/04/06
Water Usage:	$215,045
Water Service:	$1,906
Sewer Usage:	$231,466
Sewer Service:	$9,181
Trade Waste:	$52,812
Stormwater Service	$0
Other changes:	$27,970
Total:	$538,381

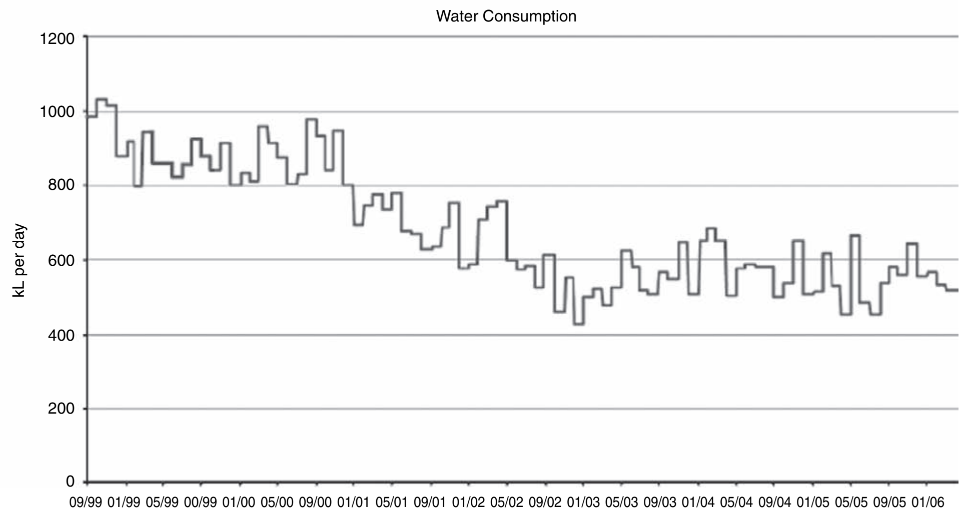

Figure 3.4 Sydney Water customer usage profile

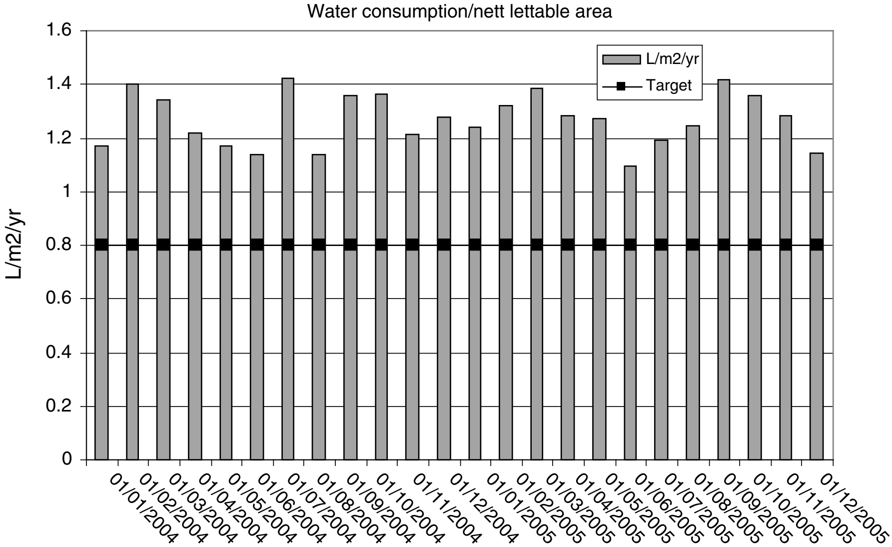

Figure 3.5 Water consumption profile in an office building per square metre

3.5 Step 4: Identify Improvement Opportunities

To identify improvement opportunities it is necessary to carryout an assessment of management systems and physical systems. It will become apparent that the two need to be addressed simultaneously for long-term gains.

3.5.1 Carry Out an Assessment of Management Systems

A self-assessment of management systems will identify system barriers to water conservation as well as help to ensure that systems and processes are developed to maintain the gains over the long term. A structured systems approach eliminates the reliance on the motivation of one single person.

The objectives of a management diagnostic are to identify the following:

- links water with the organisation's value drivers such as raw material inputs, production processes, distribution, product use and discharge
- identifies the key system barriers, opportunities and risks associated with developing a sustainable water management plan
- allocates responsibilities that go beyond the immediate project team and
- ensures that water-related actions, opportunities and risks are tracked and managed effectively using a continual improvement process.

3.5.1.1 One-2-Five Water® – Management Diagnostic System

There are many different types of management diagnostic systems such as the management diagnostic developed by the Global Environmental

Figure 3.6 One-2-Five Water® Rating

Courtesy of Energetics Pty Ltd.

Management Initiative and known as *Connecting Drops Toward Creative Water Strategies* [2] that can be accessed from their website: www.gemi.org. We will focus on One-2-Five Water® [3].

One-2-Five Water® was developed by the environmental consultancy Energetics with the assistance of Sydney Water. It is based on a five-star rating system as shown in Figure 3.6.

The One-2-Five Water® diagnostic tool allows a team of management and operational staff – in an hour or so – to conduct a self-diagnostic. At the end of the session the tool provides

- a star rating
- a percentage development required to reach the next level
- five critical actions for the organisation to carry out to reach the next level of development.
- allocates responsibilities and completion dates.

Sydney Water through its Every Drop Counts Business Program has facilitated over 230 such management diagnostics. These are shown in Figure 3.7.

The rating analysis looks at the ten building blocks necessary for water management. These are shown in Figure 3.8.

A One-2-Five Water® diagnostic results are shown in Figure 3.9. For each critical action it shows the action required.

3.5.2 Technical Assessment

The management diagnostic will indicate if the site requires a water audit if one has not been done recently. The water audit will identify where the water is used as well as show the amount of water used by critical equipment,

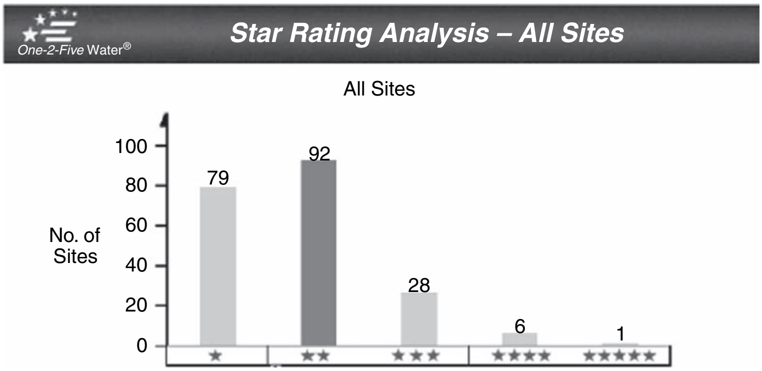

Figure 3.7 Distribution of One-2-Five Water® Star Ratings

Courtesy of Energetics Pty Ltd.

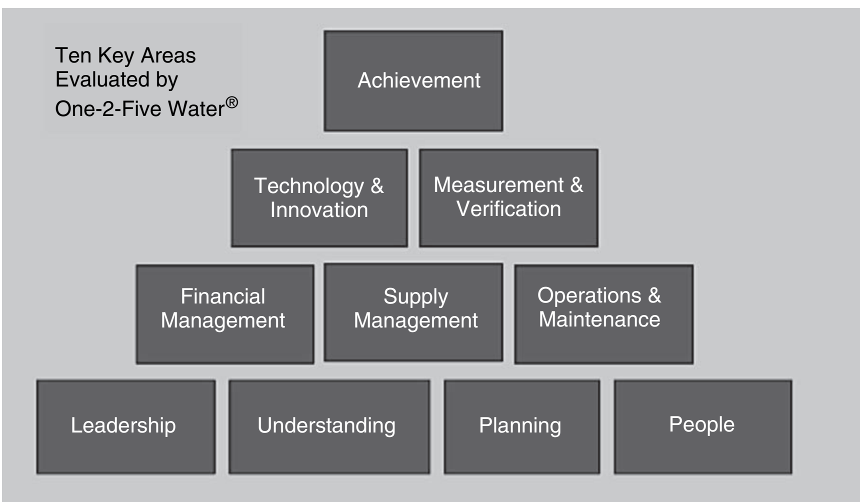

Figure 3.8 Elements of One-2-Five Water®

Courtesy of Energetics Pty Ltd.

identify leakage, help to develop a water balance and provide a benchmark for the individual site.

3.5.2.1 How Detailed Should the Water Audit Be?

This decision should be made upon the following considerations:

- Average daily water consumption on site. A walk through audit is adequate if the water usage is less than 50 m^3/day (<13 000 US gal./day).

Diagnostic Results

Element		Level of Development					Critical Action Items
		1 Star	2 Star	3 Star	4 Star	5 Star	
1.1	Demonstrated corporate commitment	-	✪	-	-	-	Critical
2.1	Understanding of performance and opportunities	-	-	☟	-	-	-
3.1	Targets, performance indicators (KPI) and motivation	-	☟	-	-	-	-
3.2	Plans	-	-	-	-	☟	-
4.1	Accountabilities	-	☟	-	-	-	-
4.2	Awareness and training	✪	-	-	-	-	Critical
4.3	Resourcing	-	-	☟	-	-	-
5.1	Criteria/Budgets for capital expenditure (CAPEX)	-	-	☟	-	-	-
5.2	Operating budgets	-	☟	-	-	-	-
6.1	Water supply, Quality & Reliability	-	-	-	-	☟	-
6.2	Compliance with legal and other requirements	-	-	-	☟	-	-
7.1	Operating procedures	-	☟	-	-	-	-
7.2	Maintenance procedures	-	☟	-	-	-	-
8.1	Efficiency of existing plant design	-	-	☟	-	-	-
8.2	Innovation and new technology	-	-	☟	-	-	-
9.1	Metering and monitoring	-	✪	-	-	-	Critical
9.2	Reporting, feedback and control systems	-	✪	-	-	-	Critical
9.3	Documentation and records	✪	-	-	-	-	Critical
10.1	Water cost performance in the past 12 months	-	☟	-	-	-	-

Overall Ranking: 2 Star   % Achievement: 38%   % Achievement to reach next level: +8%

Figure 3.9 One-2-Five Water® Results

Courtesy of Energetics Pty Ltd.

A detailed audit if the water usage is greater than 50 kL/day (>13 000 US gal./day).

- Is it a regulatory requirement? In Sydney, the NSW Government has mandated that businesses using over 50 ML/yr (over 200 businesses) and local government councils develop water-saving action plans. This requires that water audits to be done in these premises.
- Is the majority of the water used in one equipment? – such as in commercial laundries where almost 80% of the water is used in the tunnel washers. Then the focus needs to be on water reuse from the tunnel washer or replacing the washer if it makes financial sense.
- Likelihood of identifying cost-effective opportunities to save water based on a comparison with industry benchmarks or industry best practice if readily available. See Section 3.5.2.2.
- Multiple similar sites (a single detailed audit can be used to benchmark other sites).
- Other potential savings in energy or materials.
- Availability of budget for funding water audits or other investigations.
- Cost of water audits and other investigations.
- Age of the infrastructure – in many instances, leakage from underground pipes, urinals and taps can account for 20–30% of the usage in facilities such as in hospitals, prisons, hotels and so on. Avoiding water wastage should be the first priority.

3.5.2.2 Estimating Water-Saving Potential

Various state government agencies have over the years carried out studies to estimate the water-saving potential from the business sector. The Metropolitan Water District of Southern California found that for the commercial sector the average potential water savings per year is about 20% of average consumption and the institutional sector is about 19% [4].

Another study conducted by the US Environmental Protection Agency (EPA, 1997) found that commercial water-use volume might be cost effectively reduced by approximately 23% [5].

Two US studies conducted by the Pacific Institute and the New Mexico Drought Task Force puts this figure at 40% [6, 7]. In some sectors this can reach as high as 75% through water reuse and recycling – such as in oil refining.

According to the UK Environment Agency, water reduction of 40% in commercial buildings and up to 90% in industrial sites can be achieved [8].

Sydney Water's Every Drop Counts Business Program has found that the average water savings based on water audits in commercial and institutional sectors range from 20 to 40%. Similar to the findings of the Pacific Institute study, industrial facilities can save from 20 to 80% through water efficiency, water reuse and recycling.

A general rule of thumb

- If no water-saving measures have so far been implemented, savings could be 20–50% or more of water-related costs.

- If some water-saving projects have been implemented but not applied using a systematic approach, the potential savings could be at least 20% of water-related costs.
- Water-saving potential needs to be considered using the resource minimisation hierarchy of **Avoidance, Reduce, Reuse and Recycle**. In some cases, through avoidance 100% of water savings can be achieved.

Table 3.2 shows the potential water savings in the commercial and institutional sectors from a large number of audits carried out in the commercial, hospitality, government and institutional sectors in the United States.

Table 3.3 shows potential water-saving projects in industrial plants.

Another way of estimating water-saving potential is to compare against industry benchmarks. For instance in the United Kingdom, public buildings are required to reach a best practice water usage level of 6.4 m^3/person/yr [10]. Other examples of benchmarks are given in Table 3.4 and in Chapters 10–15.

The percentage reduction values and industry benchmarks whilst useful as a guide are only to be used for comparative purposes. In many instances the age of the equipment, layout, production method and other local factors may have a bearing on the target. For instance, the UK brewing industry produces more draught beer which consumes less water and energy than canned beer.

3.5.2.3 Complying with Regulatory Standards

Increasingly regulatory authorities are mandating that water-efficient fixtures be offered for sale and installed in buildings. For instance, from July 2006

Table 3.2 Potential water savings from on-site water audits [9]

Type of Business	Number of Audits	Average (%)
Car wash	12	27
Church non-profit	19	31
Communications and research	10	18
Corrections	2	14
Eating & drinking	102	27
Education	168	20
Healthcare	90	25
Hospitality	222	22
Hotels & accommodations	120	17
Landscape irrigation	6	26
Laundries	22	15
Meeting and recreation	20	27
Military	1	9
Offices	19	28
Sales	56	27
Services	58	30
Transportation and fuels	24	31
Vehicle dealers and services	12	17
Total sites	963	

Table 3.3 Water-Saving Potential in Industrial Plants

Area	Project	Potential saving
All	Minimise leaks	10–30%
Amenities	Water-efficient fixtures	3–10%
Utilities	Conversion from once-through cooling to closed-loop recycle	90%
Utilities	Conversion from once-through cooling to open evaporative cooling	Upto 60%
Utilities	Recovery of steam condensate	Upto 75–80% (depends on sector)
Utilities /Process	Reuse of effluent in cooling water systems and in process	Upto 75% (depends on water quality)
Process	Clean in Place – Automation, Optimisation	60% [8]
Process	Air rinsing of containers	100%
Process	Air thawing of meat	100%
Process	Counter-current rinsing	30–40%
Process	Spray jet upgrades	20% [8]

Table 3.4 Water usage/metrics

Category	Australian, UK and European metrics	US metrics
Oil refining total water usage/unit	0.1–4.5 [11] m^3/ton of crude	65–90 gal./barrel of crude
Office buildings	30–135 [12] L/employee/day 0.8 $m^3/m^2/yr$ (Sydney) 9.3 m^3 per person per year (UK)	8–20 [13] gal./employee/day
Hospitals	1.17–1.66 [14] $m^3/m^2/yr$	130–250 [13] gal./bed/day
Brewing	2.5–7 L/L of beer	2.5–7 gal./gal. of beer
Prisons	92.4–115.3 [14] m^3/prisoner/yr	80–150 [13] gal./prisoner/day

in Australia, only water-efficient fixtures can be sold under the Australian Water Efficient and Labelling and Standards (WELS) scheme. This means it will be mandatory for showers; clothes washing machines; dishwashers; toilet equipment; urinal equipment; and tap equipment intended for use over kitchen sinks, bathroom basins, laundry tubs or ablution troughs to carry a WELS Water Rating label when they are offered for sale (*AS/NZS6400:2005 Water-efficient products – Rating and labelling* (Schedule 1 to the *Water Efficiency Labelling and Standards Determination 2005*)).

Based on a six-star scheme, the more stars the more water efficient a fixture is. Figure 3.10 shows a three-star water rating label for showers.

In the United States, the Energy policy Act of 1992 requires that Federal agencies not later than 1 January 2005 implement in Federal buildings all

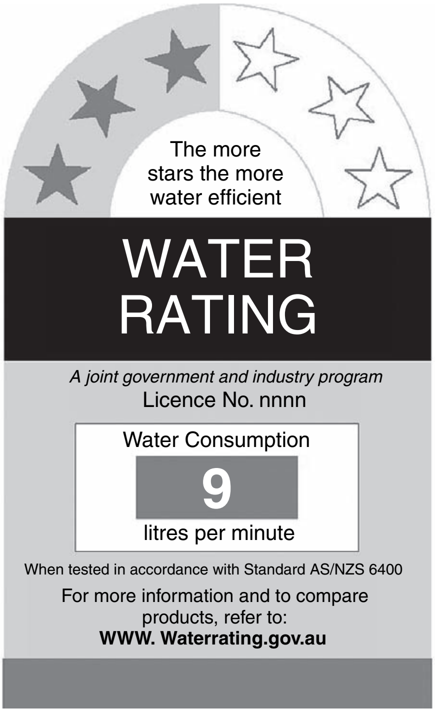

Figure 3.10 WELS Rating for showers

Courtesy of Department of Environment and Heritage, Australia.

energy and water conservation measures with a payback period of less than 10 years.

In the United Kingdom, under the Water Smart project, all government office buildings are required to monitor water usage, report it on the World Wide Web and make progress towards the target. For more details, refer to Chapter 11.

3.5.2.4 Carrying out a Water Audit

Establish base flow. Base flow is the water that is consumed by a site during non- working hours usually shown by a constant consumption during these hours. Base flow occurs due to water-using equipment left on after hours such as cooling towers operating continuously, due to faulty maintenance or due to pipe leaks. The 2-year water consumption profile does not indicate if there are leakages occurring during non-working hours. To establish whether there are any leakages on site, connect a data logger to the main meter or to sub meters.

Figure 3.11 shows the value of real-time data logging to detect a 3 L/s base flow (259 m^3/day).

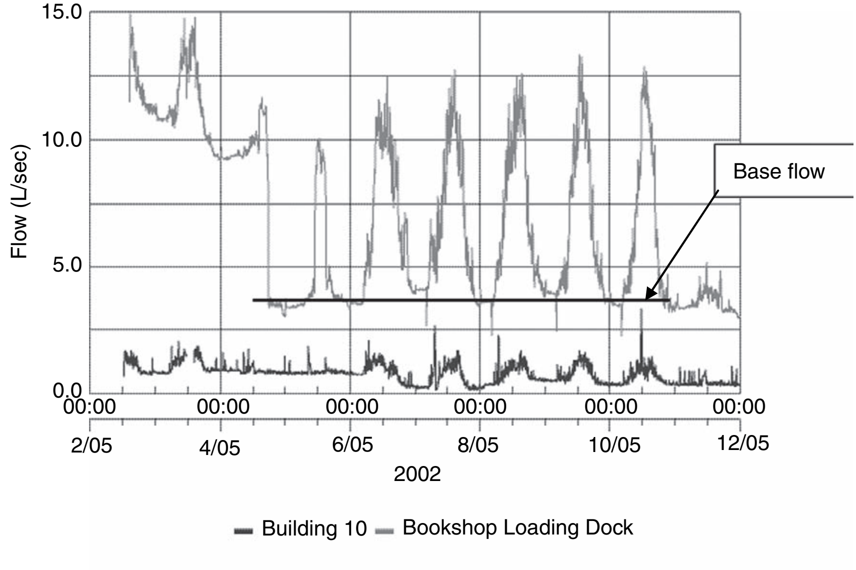

Figure 3.11 Real-time data logging to identify base flow

Table 3.5 Water losses and its cost

Base flow L/s	Base flow/day		Example	Cost* per annum
	m^3/d	Thousand US gal./d		
0.5	43	11.4	25 mm (1 in.) Hose	A$37, 668
1	86	23	Vacuum pump once-through usage	A$75, 336
2	173	46	Underground leak to stormwater	A$151, 548
4	345	91	Tank and cooling water overflow from cooling tower	A$302, 220
4.6	400	106	Tank overflow	A$350, 400

* Cost are based on water usage $1.20/m^3 and wastewater discharge $1.20/m^3.

Base flow can consist of tank and cooling tower overflows, hoses not shut or equipment using once-through water. Examples on how base flow can account for significant water wastage is shown in Table 3.5.

The case study below shows how a hospital was able to reduce their water costs by A$200 000 by merely monitoring the main meter and taking simple corrective action to eliminate base flow.

If dataloggers are not available (or if the meter cannot give a 4–20 mAmp signal), then either change the meter or take manual readings after working hours and the following day before work begins. For more details, refer to Chapter 4.

Case Study: Prince of Wales Hospital, Sydney, NSW, Australia

The Prince of Wales Hospital, through data logging of the main meter, identified a 4-litre-per-second leak amounting to 345 m^3/day. This had gone unnoticed (since it only leaked at night) and was only detected due to the data logging of the main meter. Cost saving – A$230 000 per annum.

Sydney Water. *Leaks Waste More than Water. The Conserver*, Issue 9, August 2005.

The location of the meter can be further investigated through progressive shutdowns.

Verify flows. Fixtures such as taps, showerheads and toilets can waste a lot of water or may be in excess for the purpose. Chapter 10 discusses methods to reduce water wastage in amenities.

Figure 3.12 shows annual water losses from taps.

- From the hydraulic plan identify the equipment that uses more than 15% of the total water consumption and install sub-meters to these areas. This will help in developing the site water balance. Either read the meters manually or better install dataloggers. These sub-meters can be either permanent or temporary. If sub-meters are difficult to install then measure flows using an ultrasonic flowmeter. Refer to Chapter 4 for more information on meters, dataloggers and telemetry.

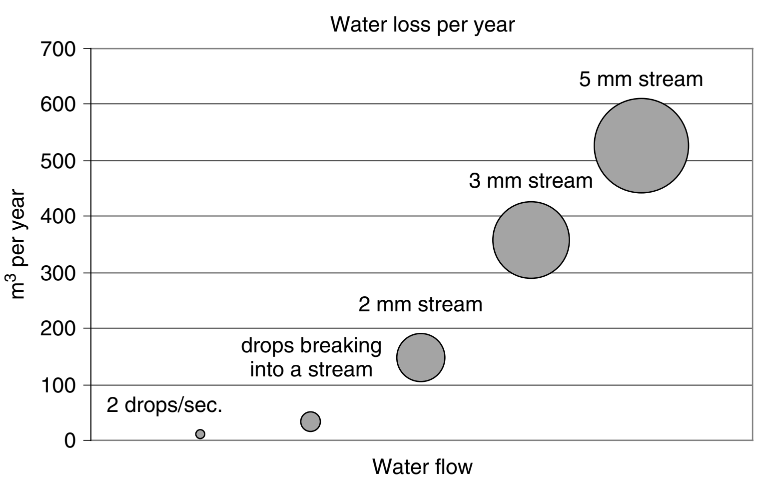

Figure 3.12 Water losses from taps – what it means

- Use manufacturer's data and compare the equipment's water use with the manufacturer's rated flow amounts. Some equipment may be using more water than the specified flow rates. If there is a significant difference, consider having a specialist review equipment operation and make adjustments to reduce water consumption.
- Estimate water use from knowledge of the process.
- Identify the quality of water as it travels through a unit or facility. Discharges from one area could be used as the supply water for a second use. Typical areas of interest are temperature, chemical constituents (including pH), total dissolved solids and/or conductivity.
- Observe visual leakage and note for immediate action. On a regular basis, thoroughly check the following areas:
  - restrooms, and shower facilities
  - kitchens, dishwashing facilities and food preparation areas
  - wash-down areas and janitor closets
  - water fountains
  - water lines and water-delivery devices
  - process plumbing, including tank overflow valves and
  - landscape irrigation systems.

3.5.2.5 Develop a Water Balance

A water balance needs to capture the main water-using areas. It should account for at least plus or minus 80% of the input flows.

The decision on how detailed the water balance should be would need to consider the following:

- likelihood of identifying cost-effective opportunities to save water
- cost
- calculation of the additional cost savings.

The higher the amount of water used, the greater the potential to identify additional water savings.

From the flow monitoring data we can assign flow rates to the major water using facilities. Figure 3.13 shows the water balance of a hotel. Any discrepancies are due to hidden losses, incorrect meter readings, incorrect assumptions or faulty meters.

The collected information can also be expressed as a pie chart. A pie chart as shown in Figure 3.14 is an effective visual means of showing the main water-using areas and can be used as a management reporting tool.

3.5.2.6 Identifying Other Opportunities to Reduce Water Use

Use the water balance to further identify opportunities to reduce water usage. Involve the operators of the equipment to generate other water-saving ideas.

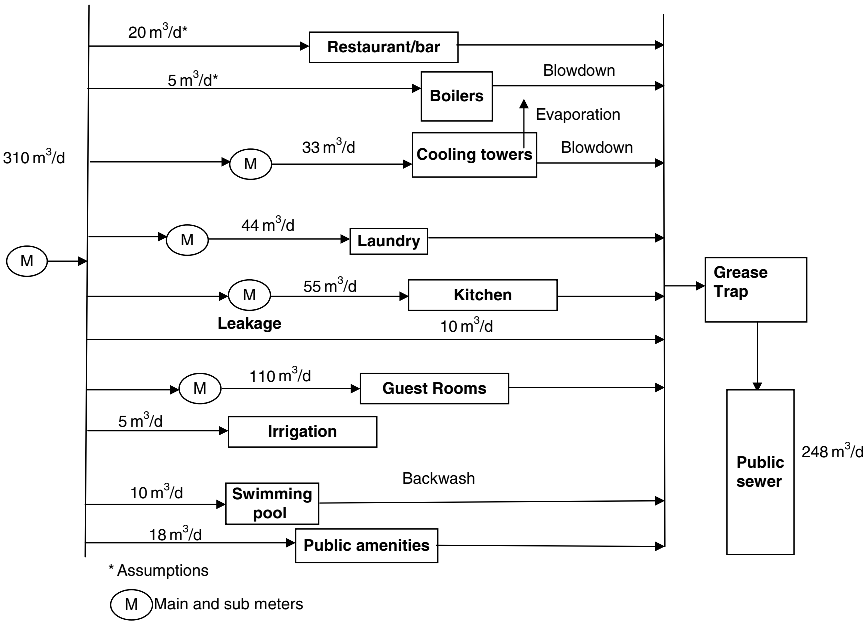

Figure 3.13 A Water Balance of a 300-Room Hotel

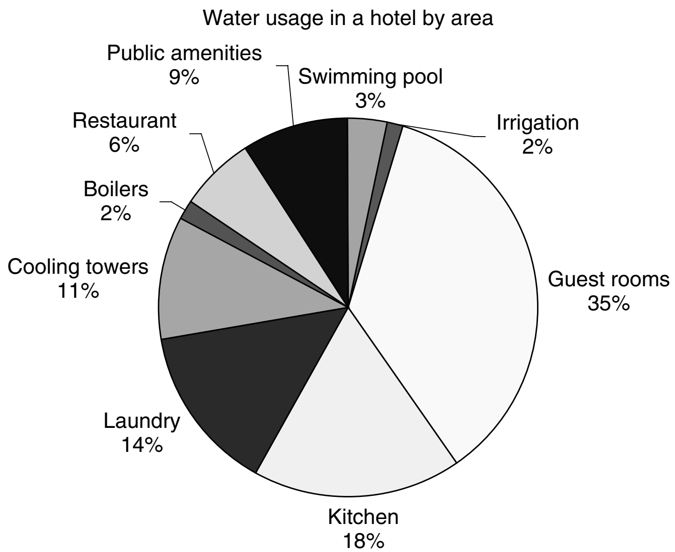

Figure 3.14 Pie chart of water usage in a typical hotel

In generating the options list use a checklist that includes the following:

1. Can the maintenance activities be improved? For an example, steam traps require a regular preventative maintenance programme. Other areas are missing jets in dishwashers, leaking pipes, flange joints, overflowing of cooling towers due to faulty float valves and so on.
2. Can water pressure be reduced?
3. Improve housekeeping. Use brooms to reduce hosing of kitchen and plant floors without compromising operational guidelines.
4. Is it possible to reduce the water usage in the process/activity? – For example, liquid ring vacuum pumps waste water if the sealing water is once through. A dry running pump eliminates the need for water. Or recycling the water reduces the water usage significantly.
5. Will a lower-quality water be sufficient? – For example, as cooling tower make up.
6. Can the water currently sent to the sewer be recovered? – As low grade water or after treatment to be used in non-potable applications.
7. Compare with industry benchmarks to ascertain water usage per activity if this data is available.
8. Do the hoses have automatic trigger guns?
9. What behavioural practices require changing? Changes to flushing of toilets when cleaning guest rooms. Retraining of kitchen staff to load the dishwasher to the maximum.

3.6 Step 5: Preparing the Plan Prioritising the Opportunities

From the gathered data calculate the potential water savings and associated cost savings – including heat recovered. Determine costs to implement water-saving actions. Where applicable obtain quotes from contractors and suppliers, including time required for implementation. If not already known, find out the typical capital expenditure hurdle rates used by your business and calculate return on capital. Or for simplicity use the payback method.

The recommendations can be prioritised as shown in Table 3.6.

The water-saving plans need to be specific, quantifiable and achievable.

The goals need to include the following:

- a volumetric reduction target as m^3/yr, or a percentage of water saved and/or a benchmark figure as m^3/unit of output (L water/L of milk, L/person/yr or L/area/yr)
- a time frame for achievement and
- an area (of the facility or unit) where the water savings will be realised.

Table 3.6 Tabulation of recommended actions

Priority	Technical risk
Requires immediate action (arrest leakage) Short payback	None. Maintenance activity.
Cost effective and practical. Generally accepted as payback within 2–3 years	Low technical risk. Does not require further investigations
Potentially viable. Payback above 3 years but less than 5 years.	Medium technical risk. Require further investigations.
Not cost effective. Payback above 5 years	Medium technical risk.
High technical risk and unknown payback.	No proven case studies. Require extensive investigations.
Measures not having a quantifiable payback (e.g.: installing a centralised water monitoring system, increasing employee awareness)	None.

The benchmark figure is preferred because it is a true measure of water efficiency. It allows for increasing water usage if production capacity increases by measuring water usage per unit of output. These goals can be revised with time.

Worked example

A 300-room hotel in Sydney uses 310 m^3/day of water. From the Best Practice Guidelines for Hotels (refer to Chapter 10) it has been estimated that a 300-room hotel with a cooling tower and laundry require only 150 m^3/day. The hotels current consumption is 310 m^3/day as per the water audit and water balance. Therefore there is the potential to save 160 m^3/day.

The opportunities are shown in Table 3.7 based on the water-use inventory (Worksheet 3).

Implement the prioritised measures and measure the reduction in water usage. Set a new benchmark. In the example the target benchmark is 150 m^3/day.

3.7 Step 6: Report the Results

By communicating water conservation achievements and new targets and challenges to senior management, staff, tenants and guests, contractors and suppliers and regulatory authorities there will be greater support for the programme from all making it easier justify projects and new ideas will be generated and gain recognition for the programme.

Table 3.7 Prioritisation of water saving measures

Water-saving measure	Number Of fixtures	Water Savings m^3/day	Cost savings /yr A$	Cost to implement A$	Simple payback	Can this be done immediately?	Time required to make changes	Technical risk	Order of Priority for implementation
Fix leaks	5	20	17,500	$3000	2 months	Yes	5 days	None Maintenance activity	1
Guest rooms – retrofit showers with 9 L/min showers in guest rooms instead of 15 L/min	300	32.4	18,921	$36,000	1.9 years	Yes	14–30 days	None Proven technology	1
Retrofit taps with water-efficient aerators 6 L/min instead of 12 L/min	400	36	23,652	8,000	4	Yes	30 days	None	
Cooling tower float valve replacement	1	10	8,760	200	0.3 month	Yes	14 days	None Maintenance activity	1
Kitchen – replace pre-rinse spray valves	3	11.6	13,033	1,200	1.0 month	Yes	1 day	None	1
Kitchen – replace wok stoves with waterless woks	2	10	8,760	10,000	1.1 year	Yes	7 days	Proven product	1

(*Continued*)

Table 3.7 (*Continued*)

Water-saving measure	Number Of fixtures	Water Savings m^3/day	Cost savings /yr A$	Cost to implement A$	Simple payback	Can this be done immediately?	Time required to make changes	Technical risk	Order of Priority for implementation
Reuse of laundry effluent in laundry	1	30	26,280	$65,000	2.5 years	No	Shutdown	Medium risk Further investigations required	2
Guest rooms – replace single-flush toilets with dual-flush toilets	300	11	3,000	$120,000	40 years	No	12 months	None	3 Not cost effective
Employee training programme		TBD	TBD	3,000		No	3 months	None	2
Employee training programme		TBD	TBD	3,000		No	3 months	None	2
Install dataloggers to sub-meters	5	TBD	TBD	6,000		Yes	1 month	None	2
Total		161	119,906	252,400					

1 = First priority, 2 = Medium priority, 3 = Not a priority
Discount Rate 10%
Net Present Value $ 227,536
Internal Rate of Return 70%
(Please refer to Chapter 9 for an explanation on Net present value and IRR)

This can be done by

i) A newsletter
ii) Media release
iii) Bulletin boards with graphs showing the reduction in water usage
iv) Hotel room cards
v) Pay-check inserts
vi) Staff meetings
vii) Employee recognition and incentive programmes.

3.8 Conclusion

A holistic organisational approach is required to achieve sustainable reduction in water usage. It starts with the organisational commitment; an appointment of a competent person as a water manager; and water management needs to be done in a systematic manner. A systems approach ensures continuous improvement, eliminates ad hoc approaches and keeps the whole organisation focused on achieving the policy objectives and informed of the progress towards targets.

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