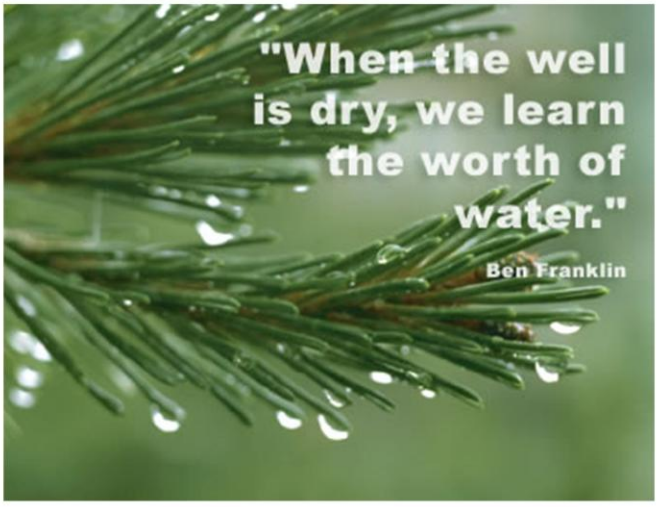
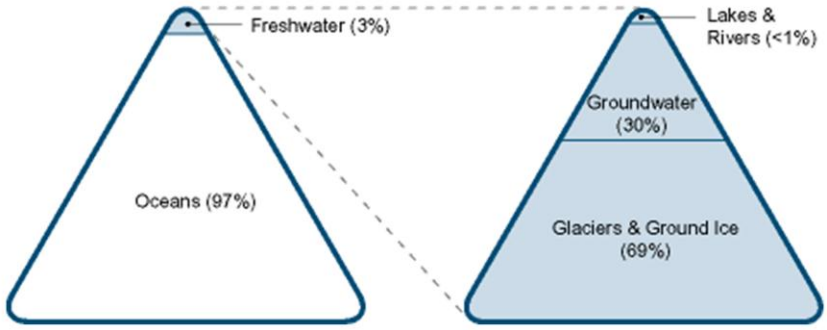
Pollution Prevention through Water Use Reduction

Welcome to online training to promote water conservation and economic savings for Ohio businesses. This training is provided by the Office of Compliance Assistance & Pollution Prevention. The objective is to provide numerous water use reduction opportunities for Ohio manufacturers, that can lower production costs and provide benefits to Ohio's environment.



Locally and globally the importance of water as a resource for agriculture, manufacturing and sustaining life has become a prominent issue.

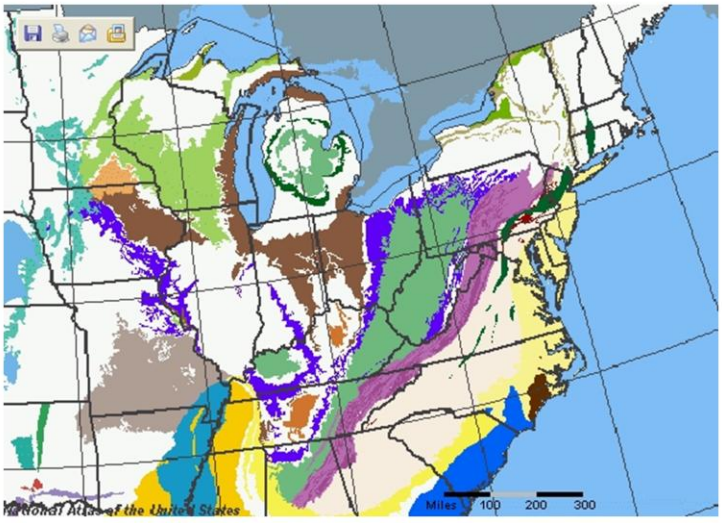
Less than one percent of the world's freshwater is readily accessible and located in the lakes, rivers and streams



Accessible, Clean Freshwater Is a Small Fraction of Total Global Water Resources

The freshwater that is available to meet the worlds needs is only a tiny fraction compared to the major oceanic water sources. As world population grows the demand for freshwater from competing interests will intensify. Water availability may be one of the most critical world policy issues of this century.

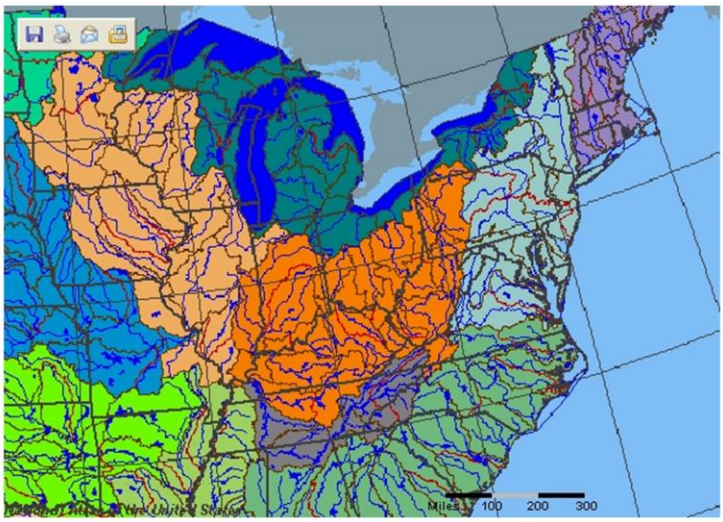
Ground Water Resources: Aquifers of Northeastern U.S.



http://www.nationalatlas.gov/natlas/Natlasstart.asp

A reliable supply of groundwater is an important asset for Ohio's businesses. Therefore the conservation and stewardship of this resource is extremely important. The long term depletion and or contamination of groundwater resources can cause economic hardships for businesses and communities. Groundwater quality is especially important when looking at the ability of a community to prosper and grow.

Surface Water Resources: Watersheds of Northeastern U.S.



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Surface water resources are vital to Ohio's economy for the same reasons, but are also a critical resource for the transportation of goods. Transportation on Ohio's waters creates additional risks such as invasive species and chemical contamination by boats & ships.

The Costs of Water Use Can Damage a Manufacturer's Bottom Line

Most companies incur significant costs for each gallon of water used a minimum of 3 times.

Once for initial purchase,

once to treat either before or after a process

and a third time to discharge/dispose of "waste" water.

These 3 costs, especially treatment or disposal in the form of hazardous waste are almost always significant to the success of a manufacturer.

Wasting Water, is wasting money!!!!!!

Many businesses don't believe that water use is a significant source of lost revenue, but many have found that water conservation and reuse are significant investment strategies. Many hidden costs can be associated with taking water use for granted. Most companies **pay** for each gallon of water used **a minimum of 3 times**. Once for initial purchase, once to treat either before or after a process and a third time to discharge/dispose of "waste" water. These 3 costs **especially treatment or disposal in the form of hazardous waste** are almost always significant to the success of a manufacturer.

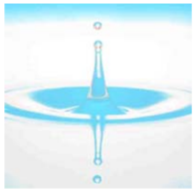
How to Conserve Water and Use It Effectively

- Water users can be divided into two basic groups: system users (such as residential users, industries, and farmers) and system operators (such as municipalities, state and local governments, and privately owned suppliers). These users can choose many different water use efficiency practices, which fall into two categories:
- Engineering practices: practices based on modifications in plumbing, fixtures, or water supply operating procedures
- Behavioral practices: practices based on changing water use habits

Water can be used efficiently and strategically. It is important to consider water use as an equally significant process component as any raw material or energy input. Many businesses don't believe that water use is a significant source of lost revenue, but many have found that water conservation and reuse are significant investment strategies. Many hidden costs can be associated with taking water use for granted. Most companies **pay** for each gallon of water used **a minimum of 3 times**. Once for initial purchase, once to treat either before or after a process and a third time to discharge/dispose of "waste" water. These 3 costs **especially treatment or disposal in the form of hazardous waste** are almost always significant to the success of a manufacturer.

Using Water Efficiently: Keys for Businesses

- **Designate a water efficiency coordinator.**
- **Develop a mission statement and a plan.**
- **Educate and involve employees in water efficiency efforts.**



Water use can be a significant source of cost savings and process improvements such as quality and productivity. As with any process attribute it can only managed if it is recognized, measured and goals are established.

General Methods of Reducing Water Consumption

1. Identify unnecessary uses and fix leaks.
2. Use minimum amounts of water to accomplish the task.
3. Re-circulate water within a process or a group of processes, or reuse water sequentially.
4. Treat and reclaim used water.
5. Displace potable water supplies with water from non-potable water supplies where appropriate.
6. Install meters at high-flow processes and equipment.
7. Identify alternative processes that are less water intensive.

Often businesses incur significant costs for process conditions that are very inexpensive to correct or upgrade. Many process changes can involve no more than measuring and reducing flows to optimal levels for a given process. Many facilities have unknown rates of flow through processes or flows at “historic” or established rates that current employees never consider changing.

Equipment

- Eliminate "once-through" cooling of equipment with municipal water by recycling water flow to a cooling tower or replacing with air-cooled equipment.
- As appliances or equipment wear out, replace them with water-saving models.
- Install spray nozzle aerators or faucets and high efficiency shower heads.
- Install ultra-low flow toilets, or adjust flush valves on existing toilets.
- Use water-conserving ice makers.

Many water use and water reuse opportunities are overlooked because water is not a primary focus of a manufacturing process or product. Equipment related to water use is often very cost effective to replace or modify. Even entire systems which allow continuous water reuse, have relatively low capital costs and significant investment (payback) value.

Case Study for an Auto Assembly Plant

Prior to performing this analysis, the plant had been using about 90 million gallons of water annually because they perceived that water was cheap and conservation measures were not warranted. **They estimated that the water cost them about $200,000 per year.**

The results of the assessment showed them that using this quantity of **water was actually costing them over $7 million dollars per year.**

http://www.wmrc.uiuc.edu/main_sections/info_services/library_docs/TN/tn07-086.pdf

A classic example of the misconception of water costs and water savings economic value can be found in this case study. In this case **the economic impact of water use was 35 times higher than estimated!!**

Case Study for an Auto Assembly Plant

Figure 1. Cost to Use Water in an Automotive Plant Phosphate Line

http://www.wmrc.uiuc.edu/main_sections/info_services/library_docs/TN/tn07-086.pdf

The company involved was amazed to find that they had costs of up to $200 per 1,000 gallons of water use.

Case Study for an Auto Assembly Plant

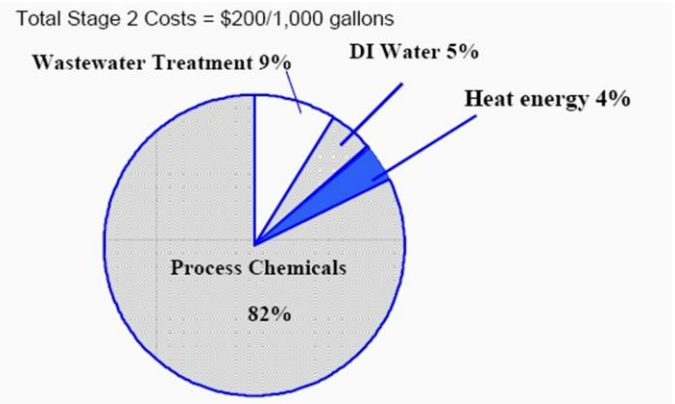


Figure 2. Cost Breakdown of Stage 2 Degreasing Process in an Automotive Plant's Phosphate Line

http://www.wmrc.uiuc.edu/main_sections/info_services/library_docs/TN/tn07-086.pdf

Companies often have water treatment and disposal costs allocated as "overhead" costs. These costs may be directed to EHS (environmental, health & safety) budgets which further blurs the direct relationship to production.

Water use costs should be accurately measured and directly attributed to the manufacturing unit that controls the usage. This allows water use to be accounted for on a "per unit" cost basis and facilitates realistic quality and process improvements.

Industry Specific Water Conservation

- Metal Finishing
- Power Plants
- Public Water Supply
- Food Processing
- Pulp & Paper

Many industrial sectors have unique attributes which provide a variety of challenges to efficiently managing water use. The following sections provide specific information on water use reduction for a sampling of industries common to Ohio.

Metal Finishing Water Conservation

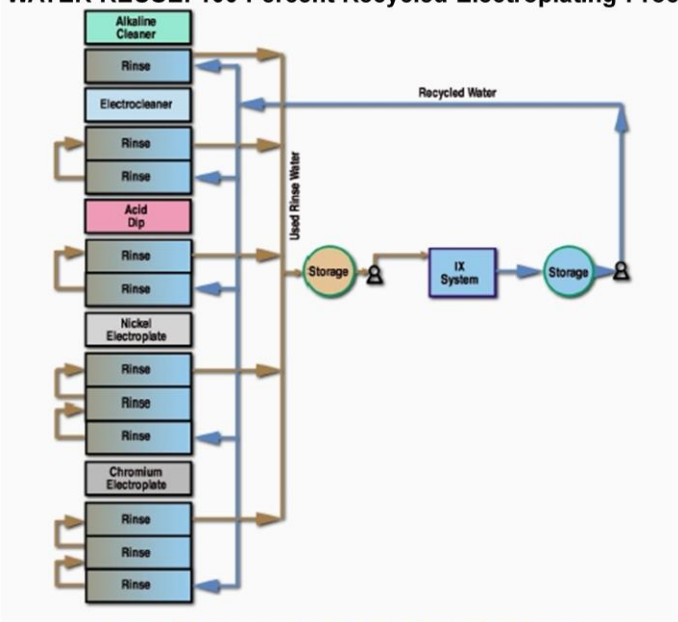
- Alternative Cleaning Methods
- Drag-out reductions
- Rinsing Over Plating Tanks
- Reactive Rinsing
- Counter-Current Rinsing

http://www.p2pays.org/ref/17/16250.pdf

http://www.epa.state.oh.us/opp/Metal%20Finishing%20Training%20Web.htm

Metal finishing is an economically significant manufacturing segment for Ohio. Large volumes of water are part of traditional process steps for Ohio's metal finishing facilities. Detailed steps on reducing water use can be found in the OCAPP on-line training "Metal Finishing Pollution Prevention Training" http://www.epa.state.oh.us/opp/Metal%20Finishing%20Training%20Web.htm

WATER REUSE: 100 Percent Recycled Electroplating Process



http://www.epa.gov/etv/pdfs/vrvs/06_vr_lobo.pdf

With the implementation of a few strategic investments in process redesign many companies could achieve a very high proportion of continuous water reclamation and reuse. This would have significant cost savings impacts for businesses and development and environmental benefits for communities.

Case Study: Steelcase Inc.

Water Conservation can be a key component of Lean & Clean efforts for saving Manufacturers Money

Steelcase

Focus of Lean and Clean

- ***Lean** Eliminates:*
  - Defects
  - Overproduction
  - Waste
  - Non-utilized people
  - Transportation
  - Inventory
  - Motion
  - Extra processing
- ***Clean** Strives for:*
  - Nature-friendly subs
  - Optimized material and energy efficiency
  - Waste elimination
  - Air / water emission reduction
  - Solid / Hazardous waste reduction
  - Toxic material reduction or substitution
  - Efficient packaging

Companies who focus on integrating all aspects of their performance, treat environmental performance as a core competency. When this integrated approach is used the concept of leaner (more efficient) production fits very well with cleaner (less waste, more safety). Water use reduction is a natural fit to improving performance in both of these areas.

Green Suppliers Network:

Steelcase

- What is the ***Green Suppliers Network?***
  - Collaborative venture among industry, US EPA and US Dept of Commerce's National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP). ***GSN*** works with large manufacturers to engage their small to medium-sized suppliers in low-cost technical reviews that employ ***Lean and Clean*** methodologies to increase productivity, reduce waste, and boost profitability.
- What is ***Lean and Clean?***
  - ***Lean and Clean*** expands the traditional definition of Lean *(eliminating non-value added time, labor and capitol)* to one that includes environmental wastes ***(e.g., reducing energy, water, waste, and emissions).*** *This targets the root causes of wasteful practices and provides a framework for achieving specific, measurable business and environmental goals.*

Companies that pursue integrated performance improvement also extend this approach to all facets of their supply chain. Many companies that are tier 1,2 or 3 below a manufacturer as a supplier will be encouraged to integrate their environmental performance and reduce water usage.

- **"Skimming" counter-flows:**
  - Advantages:
    - Constantly removes surface scum
    - Simple . . . Yet effective
    - Promotes the "reuse" of water
    - Minimizes "total" water volume used
    - Reduces discharge flows and points of discharge
    - Keeps rinses clean
    - Lowers conductivities in the final rinses
    - Promotes "hydraulic balancing" and water minimization
    - Promotes high quality / high volume rinsing on parts

A key component of the SteelCase project was the implementation of skimming their counter-flow rinse process. Often very simple and inexpensive solutions are available for dramatic water use reduction.

- Use of ***innovation*** chemistry – **Secure TEC ES**
  - Low temperature formulation – Energy reduction potential
  - Low sludging – side benefits when coupled with RO water
- **Focus on 100% use / reuse of RO water**
  - Reduce environmental footprint (***GSN focused activity***)
  - TDS reduction / hardness salt elimination / scale reduction
  - Main driver of "cleanliness" and "water reduction"
- **Stabilization of chemical processing bath**
  - Match product addition to consumption/depletion rate
  - Control board methodology – "plug-n-play"
- **On-site Reps to track *"Life Cycle Analysis"***
  - ***And <u>implement</u> "skimming counter-flows"***

In the approach pursued by Steelcase, both water quality and water quantity were reduced by careful analysis of the production process.

GSN – Lean and Clean

Steelcase

Started our project down the path of . . .

- **LCA** or "*Life Cycle Analysis*"
- **COO** or "*Cost of Ownership*"

Mid-way into our project discovered the "TCO for Metalworking" reference @ the WMRC web site.

- **TCO** or ***"Total Cost of Ownership"*** **has been defined as** *"the sum of all expenses and costs associated with the purchase and use of equipment, materials, and services."* (Monczka 1998)

Steelcase found that further integration of looking at the total operational costs including downstream environmental performance pays big dividends. This case study provides a clear example how simple things like water use reduction can lead to much larger process improvements, cost savings and environmental achievement.

"AAR" – Lesson's Learned!

- **Purified water offers value and consistency**
- **Skimming counter-flows reduce water volume**
- **Washer stays cleaner *(screens, nozzles, tanks)***
- **Processing results are very consistent**
- **Water, energy, labor, and chemical reductions offer "TCO" improvements.**

Steelcase found that quality improvements came with environmental performance and reduced costs as a result of this strategy.

"TCO" Results ***(after 5 months)***

- ✓ **Energy reduction** – *60% reduction in BTU's required*
- ✓ **Water usage reduction** – *80% less water required*
- ✓ **Innovative chemistry** – *20% to 30% less volume*
- ✓ **Waste stream reduction**– *85% to 95% less discharge*
- ✓ **Labor to maintain washer** – *>50% reduction*

Steelcase was able to accomplish fantastic results by utilizing this integrated approach reducing water, labor, chemicals, energy but also costs.

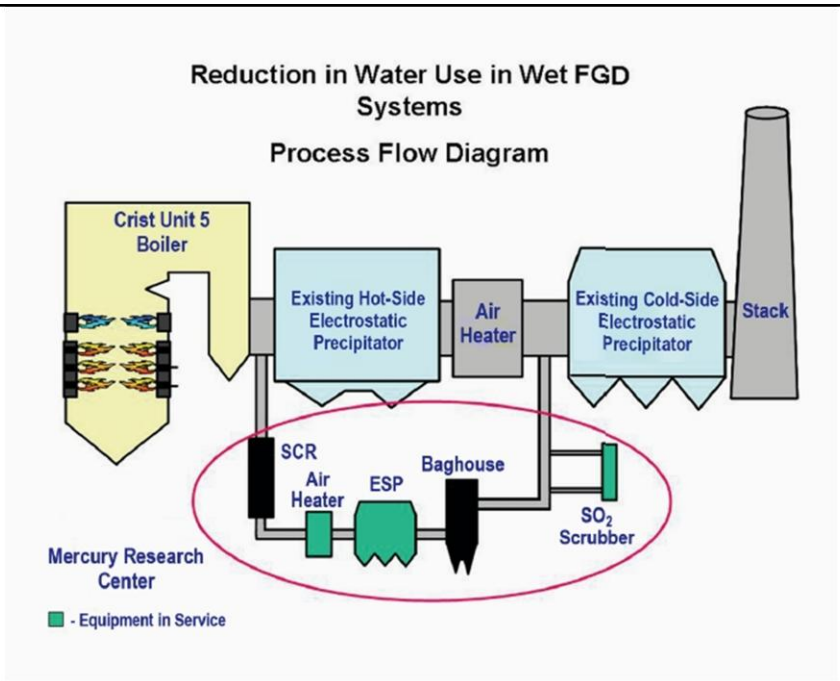
Thermoelectric Power Generation

- Water recovery and re-use
- Alternative cooling technologies

Thermoelectric power accounts for about half of total water withdrawals. Most of the water is derived from surface water and used for once-through cooling at power plants. About 52 percent of fresh surface-water withdrawals and about 96 percent of saline-water withdrawals are for thermoelectric-power use.

http://www.nationalatlas.gov/articles/water/a_wateruse.html#two

Water for thermoelectric power is used in generating electricity with steam-driven turbine generators.Thermoelectric power plants utilize significant quantities of water for generating electrical energy. For example, a 500 MW power plant that employs once-through cooling uses over 12 million gallons per hour of water for cooling and other process requirements. The United States Geological Survey (USGS) estimates that thermoelectric generation accounts for approximately 136,000 million gallons per day (MGD) of freshwater withdrawals, ranking only slightly behind agricultural irrigation as the largest source of freshwater withdrawals in the United States.



http://www.netl.doe.gov/publications/factsheets/project/Proj432.pdf

Regenerative Heat Exchange System-

The primary goal of this project is to demonstrate the use of regenerative heat exchange to reduce flue gas temperatures and thereby minimize evaporative water consumption in wet FGD systems on coal-fired boilers.

This project, conducted by a team lead by URS Group, is working toward a main objective of reducing freshwater consumption by wet FGD systems by 50 percent or more.

Demonstrate that cooling flue gas upstream of the electrostatic precipitator (ESP) and reheating flue gas downstream of the FGD system will result in the following benefits to air pollution control (APC) systems:

- Improved ESP performance due to reduced gas volume and improved ash resistivity characteristics

- Control of SO3 emissions through condensation on the fly ash

-Avoided need to install wet stacks or to provide flue gas reheat

-Examine the potential of increased mercury removal across the ESP and FGD systems due to the cooler flue gas temperature.

Food Processing

- Institute process measurement & controls
- Install high-pressure low-volume nozzles on spray washers with counter flow re-use
- Use fogging nozzles to cool product
- Replace water-intensive units with alternatives - rubber-disk units for raw product cleaning and peeling, steam for water blanchers, or evaporative coolers for hydro-cooling systems
- Use physical methods for clean-ups instead of water
- Water Reclamation and reuse where possible

http://www.mde.state.md.us/programs/waterprograms/water_conservation/business_tips/food.asp

Food processing companies have unique water needs due to sanitation concerns. However, many opportunities exist for water reductions and water re-use.

Case Study: Anheuser-Busch Inc.
Engaging the Organization in Water Strategy Implementation

Facility personnel play a major role in identifying and implementing water conservation initiatives. With corporate assistance, AB facilities have **installed water meters and information systems to provide facility personnel with real-time information** on water use throughout facility processes. AB facilities use this information to develop a “roadmap” of water uses and flow rates, using a "materials balance" approach. Process engineers, utility conservation engineers, and other specialists from the facility and corporate EHS use these roadmaps to identify specific water-saving opportunities. For example, in 2000, a multi-disciplinary Utilities Task Force at AB’s Williamsburg, Virginia brewery identified opportunities to save over **175 million gallons per year.**

The case study at Anheuser-Busch exemplifies the concept of involving personnel in developing waste reduction strategies.

Case Study: Keystone Foods

Adoption of Dry Cleaning Methods and Scrap Reduction

Table 1. Initial Results of Equity's Water Use and Wastewater Reduction Program

Measure	Before	Now	Goal
Water Use (gal/month)	4,250,000	3,000,000	2,000,000
Waste Loads-BOD_5 (lb/day)	4,500	1,000	500
Landfill Disposal (tons/wk) (Scrap, inedible product)	30	0	0
Animal Food Collection (tons/wk)	0	50	80
Dry Cleanup Pollution Prevented (lb BOD_5/day)	0	2,200	2,500

http://www.p2pays.org/ref/01/00039.htm

An important consideration of food processing is to find dry methods whenever possible to lower water usage.

Pulp & Paper Production

- Process measurement and control
- Water recovery and re-use

Water usage in pulp and paper mills can be staggering in volume. However this makes the potential cost savings all the more lucrative for making even small percentage improvements. Mills have the ability to make large reductions in water use and treatment related costs.

Case Study for Appleton Paper in West Carrollton Ohio

Recommendation	Annual Savings ($)	Project Cost ($)	Simple Payback Period (years)
Recover heat from paper machine vents	1,015,000	1,500,000	1.5
Recover fiber from low-consistency screen rejects	572,634	110,000	0.3
Install oxygen and carbon monoxide monitoring equipment to control boiler combustion	474,694	200,000	0.4
Reuse uhle-box seal water	288,185	132,600	0.5
Reduce silo temperatures	212,310	None	Immediate
Combine "good" and "bad" batches of post-industrial pulp	177,728	50,000	0.3
Use direct-fired water heating for de-inking operation	162,164	135,000	0.8
Use high temperature exhaust from flotation ovens to heat pocket ventilation air	141,372	127,576	0.9
Use dryer heat to heat vacuum pump seal water	88,900	11,980	0.2
Reuse centrifugal pump seal water	80,080	20,000	0.3
Recirculate vacuum pump seal water	51,857	25,000	0.5
Use well water to cool paper machines	48,273	45,000	0.9
Feed dryer vacuum pump seal water to paper machine silos	40,407	2,000	0.1

http://www1.eere.energy.gov/industry/bestpractices/pdfs/newapple.pdf

This case study by Appleton Paper demonstrates the favorable investment potential of pursuing water use reductions most projects identified had payback in only a few months and yielded millions of dollars in savings.

Public Water Supply

- Leak detection and repair
- Gray-water substitution
- Flow restriction education & outreach

Even though public water systems are in the business of selling water to consumers, the concept of reducing losses is still a very important consideration. Leaks and operational losses can cost companies and communities large sums of money. Also water availability is an important development and commercialization consideration, water losses limit this valuable community resource.

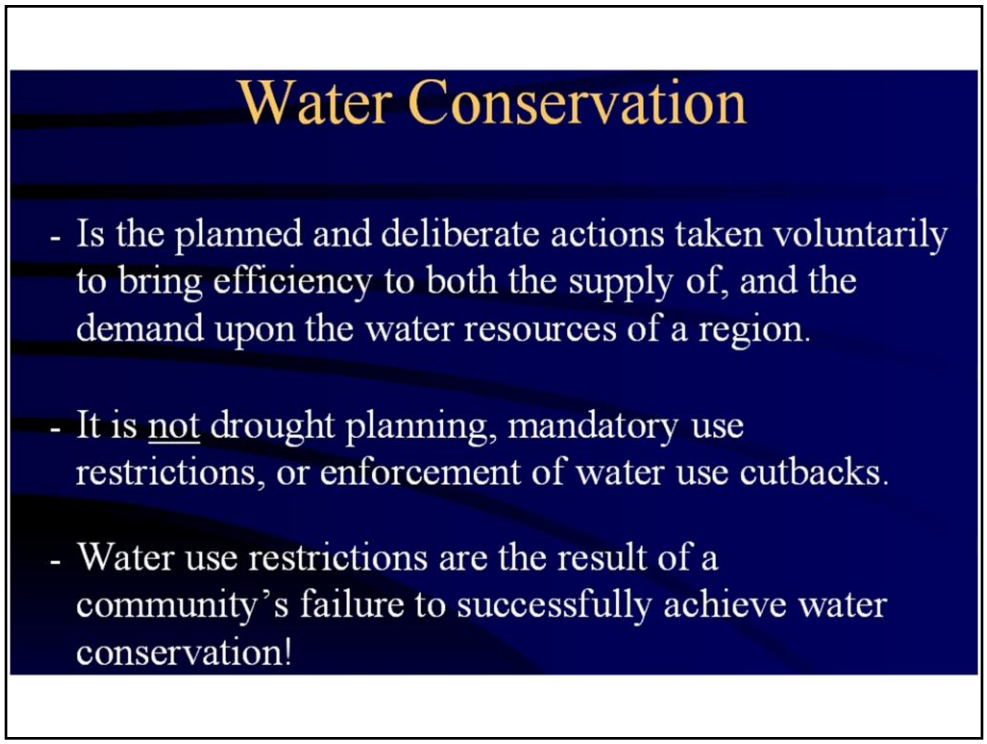
Agricultural Irrigation

- Drought resistant plantings
- Direct /on-demand watering

Irrigation accounts for about a third of water use and is currently the largest use of fresh water in the United States. Irrigation water use includes water used for growing crops, frost protection, chemical applications, weed control, and other agricultural purposes, as well as water used to maintain areas such as parks and golf courses. Historically, more surface water than ground water has been used for irrigation. However, the percentage of total irrigation withdrawals from ground water has continued to increase, from 23 percent in 1950 to 42 percent in 2000. Irrigated acreage more than doubled between 1950 and 1980, then remained constant before increasing nearly 7 percent between 1995 and 2000.

http://www.nationalatlas.gov/articles/water/a_wateruse.html#two

Although irrigation is not as common in Ohio as other parts of the country. Irrigation systems are used and they provide opportunities for companies to reduce costs by using them efficiently.

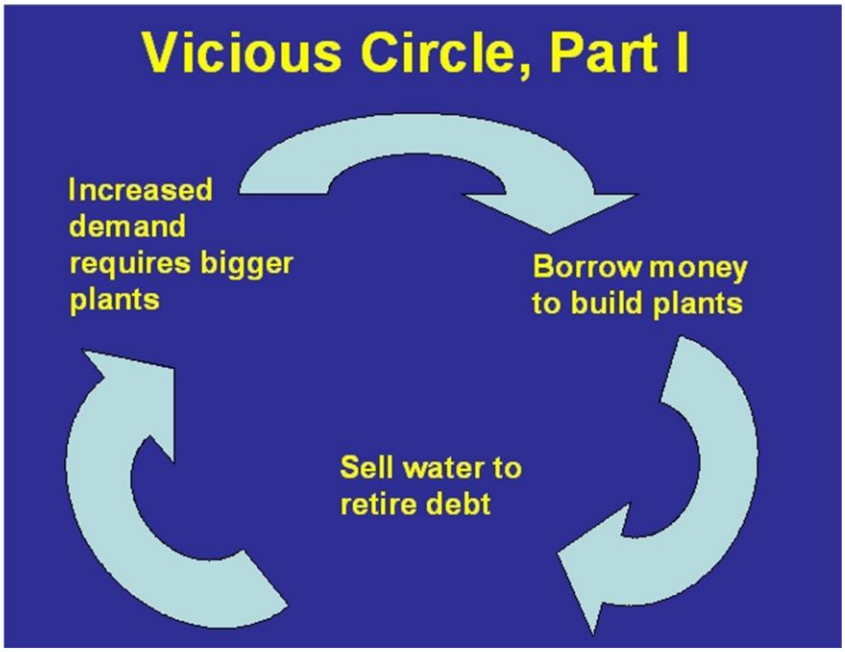


Water reduction efforts can also be addressed by approacjhing water as a community or regional resource. Because water has wide ranging economic and social implications for a community. Finding ways to cooperatively share information and techniques on water use can lead to successful water conservation.

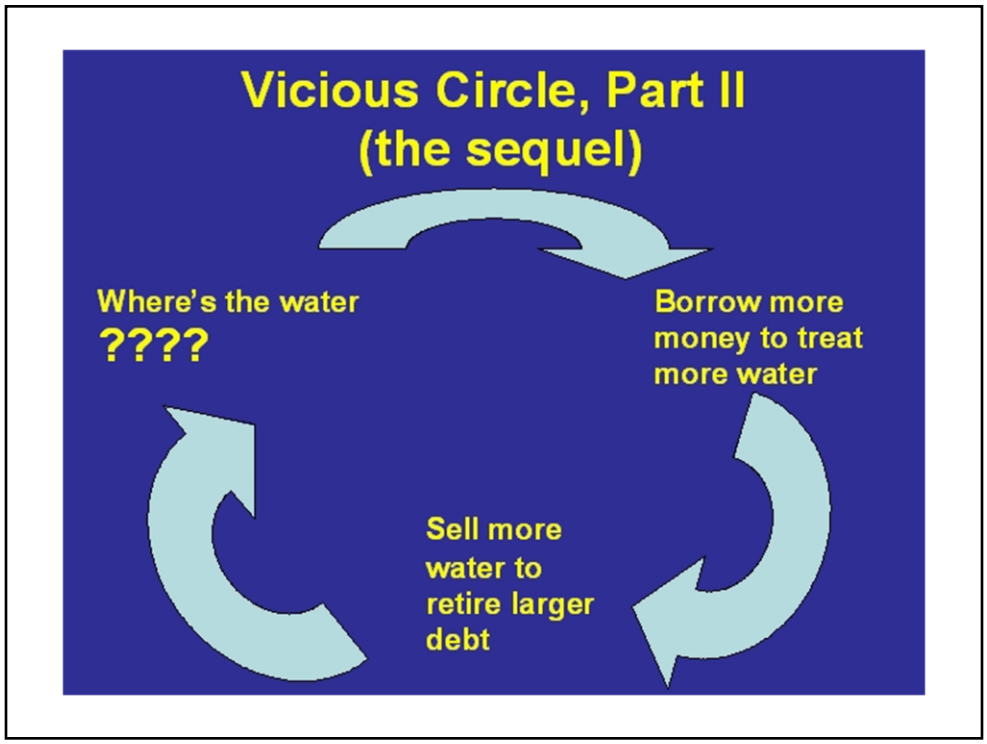
How is success defined?

- The ability of a community/region to withstand drought without the imposition of water restrictions.
- The ability to sustain the reasonable water demands of a community while providing for economic growth.
- The protection of the natural resources of the region.

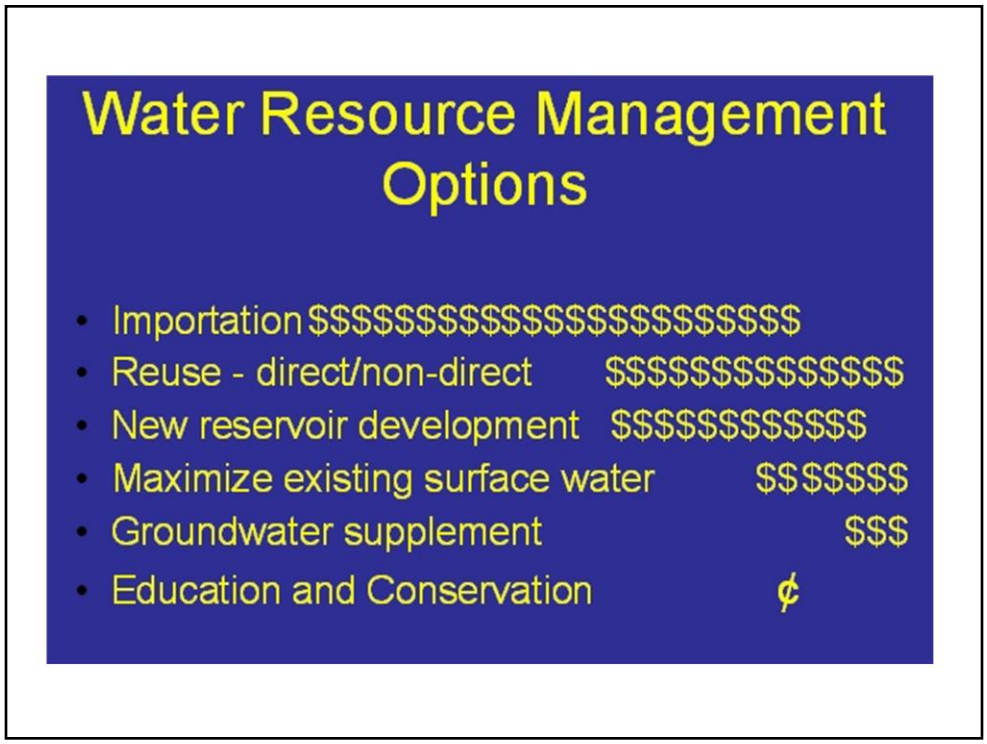
From a sustainability perspective, water use and water availability should be treated as key necessities to long term viability of a community or region. Taking steps now to address future water use issues can be an important economic benefit.



Communities that rely on ever increasing sales of water and treatment of waste waters can be counter productive to the long term viability regional water resources.



Water for any region is a limited and valuable resource. By managing present and future water use a community can more effectively invest in water treatment and supply systems.



As with any waste reduction practice, education and simple conservation steps can be cost effective first steps to achieving significant results. Reducing waste is much cheaper than any other approach to increase supplies or treatment facilities.

Water Savings Tips for Small Businesses & Homeowners

- ✓Kitchens and Laundries
- ✓Landscaping
- ✓Outdoor Activities

The water use practices of small businesses and homeowners have significant impacts on regional water resources and on capital expenditures of public funds for both supply and treatment facilities. Small reductions by individual users often produce very large reductions for communities.

Kitchens and Laundries

- Turn off dishwashers when not in use. Wash full loads only.
- Scrape rather than rinse dishes before washing.
- Use water from steam tables to wash down cooking areas.
- Do not use running water to melt ice or frozen foods.
- Handle waste materials in a dry state whenever possible.
- Wash only full loads of laundry or select the appropriate washing cycle provided on the washing machine. Use a rinse water recycle system. Consider purchasing high efficiency equipment.

Kitchens and laundries can use considerable quantities of water, but have many significant opportunities for cost savings.

Landscaping

- Detect and repair all leaks in irrigation systems.
- Use properly treated wastewater for irrigation where available.
- Water the lawn or garden during the coolest part of the day (early morning is best). Do not water on windy days.
- Water trees and shrubs, which have deep root systems, longer and less frequently than shallow-rooted plants.
- Set sprinklers to water the lawn or garden only - not the street or sidewalk.
- Use soaker hoses and trickle irrigation systems.
- Install moisture sensors on sprinkler systems.

Many simple landscaping approaches can yield significant reductions of water and still provide resilient lawns and gardens.

Planting & Maintenance:

- Have your soil tested for nutrient content and add organic matter if needed. Good soil absorbs and retains water better.
- Minimize turf areas and use native grasses.
- Use native plants in your landscape - they require less care and water than ornamental varieties.
- Use mulch around shrubs and garden plants to reduce evaporation from the soil surface and cut down on weed growth
- Raise your lawn mower cutting height - longer grass blades help shade each other, cut down on evaporation, and inhibit weed growth.
- Minimize or eliminate fertilizing which requires additional watering, and promotes new growth which will also need additional watering.

The types of plants utilized and maintenance practices also have a significant impact.

Outdoor Activities

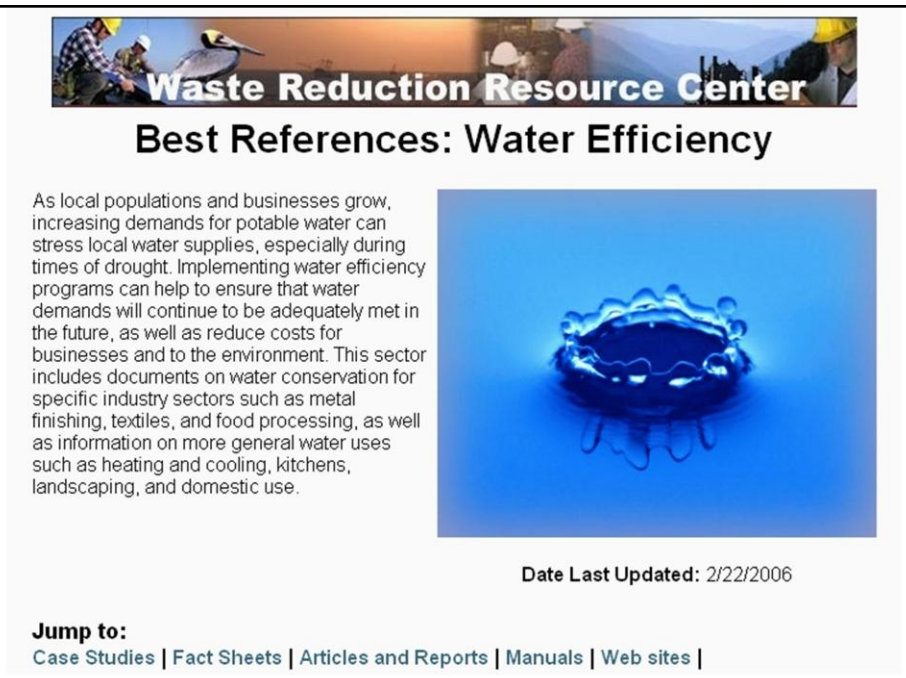
- Wash vehicles less often; use a commercial car wash that recycles water.
- If you have a swimming pool, consider a new water-saving pool filter.
- Lower pool water level to reduce amount of water splashed out.
- Use pool filter backwash for landscape irrigation.
- Use a pool cover to reduce evaporation when pool is not being used.
- Do not install or use fountains or other ornamental water features unless they recycle the water. Do not operate during a drought.
- Sweep or blow paved areas to clean, rather than hosing off.

Many general outdoor activities also utilize appreciable amounts of water.

Additional Information and References

- Water Wiser- the American Water Works Association Clearing house for water efficiency information http://www.awwa.org/waterwiser/
- USEPA Water Sense™ Program for for water-efficient products and services http://www.epa.gov/owm/water-efficiency/index.htm
- Water Efficiency Manual for Commercial, Industrial & Institutional Facilities http://www.p2pays.org/ref/01/00692.pdf

There are many excellent publications for water use reduction and water efficiency management. The references above a re a few of the best that we have found for small and large organizations to utilize.



http://wrrc.p2pays.org/indsectinfo.asp?INDSECT=27

For businesses searching for more in depth water reduction case studies, strategies and manuals this site is an excellent source.

Questions???

Office of Compliance Assistance & Pollution Prevention

http://www.epa.state.oh.us/ocapp/ocapp.html

614-644-3469

ron.smith@epa.state.oh.us

dave.foulkes@epa.state.oh.us

Specific processes may also be researched for pollution prevention opportunities by contacting:

Office of Compliance Assistance & Pollution Prevention (OCAPP)

http://www.epa.state.oh.us/ocapp/about.html

OCAPP is a non-regulatory office and is available to assist any Ohio company with more information on minimizing wastes.