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DATE: January 30, 2004

**SUMMARY REPORT OF JORDAN ON-SITE ACTIVITES AND CONSULTANT RECOMMENDATIONS**

During the Summer of 2003, I visited the country of Jordan at the request of the Academy for Education Development to provide specialized assistance to WEPIA staff in its preparation for a conference on Water Demand Management to be held in 2004. I was also asked to provide training for staff at the Jordan Ministry of Water and Irrigation, and to evaluate how Jordan could best maximize its water conservation options in a systematic planning process.

The assignments are taking more time than expected. While I am late with my deliverables, I am also providing more information than originally requested. After spending my two weeks observing Ministry and WEPIA activity, I concluded that preparing material to help Ministry staff develop its own self-sufficient water demand management program would be more important than leaving behind specific recommendations that might not be grounded in good data analysis. The lack of credible water consumption data by sector (residential, commercial, industrial, and agricultural) make recommendations for reduction in those sectors difficult. Tanker truck deliveries further complicate the data analysis, as these deliveries are not measured in any way but appear to represent a significant amount of water consumption in both the residential and commercial sectors.

The final report is providing a conservation planning strategy and process, as well as some specific water conservation recommendations. Primary on the list of recommendations is a serious program for network water loss management, which I understand is being handled in another set of projects other than WEPIA. The astounding amount of water loss in Jordan makes this the absolute first priority for water conservation. Secondly, although residential per capita water use is low in Jordan, it is not clear that there aren't still savings opportunities, particularly in large homes in Amman. Third, the water use in the commercial sector has much opportunity for further reduction. The audits begun by WEPIA

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should be continued and expanded, and incentives provided to businesses to undertake the recommended retrofits. One option for an incentive would be a preferential rate for water; a much higher rate should take effect for the commercial customer without retrofit improvements. Other specific recommendations are in the report.

**My deliverables are as follows:**

- A program schedule of paper tracks and workshops for the demand management conference;
- A schedule of workshop sessions for the demand management conference;
- Recommendations of specific speakers for both paper tracks and for workshops;
- Recommendations of instructors for a university curriculum on water demand management;
- Recommendations concerning layout of a conference venue;
- A cursory evaluation of Jordan's water supply situation and options for possible water efficiency programs;
- A Paper on developing a water conservation strategy for Jordan; and
- Sample ordinances, regulations and policies that might be applicable to Jordan's situation.

Attached to this memo are the following items for the Water Demand Management Conference:

1. Master Conference planning layout
2. Detailed speakers and workshop tracking sheet
3. Abstract tracking sheet
4. Abstract Rating form
5. Call for Papers announcement (website)
6. General Website announcement listing

Attached to this memo are the following items for the Conservation Planning Process:

1. Draft (still in process) Water Conservation Strategy Paper
2. Conservation Strategy Timeline
3. Conservation Projects Timeline
4. Power Point Presentation to train Ministry staff
5. Power Point Presentation for the Wadi Hydrology Conference

**Conference Recommendations**

During my visit to Jordan, I visited one venue for the conference, the Hyatt in Amman. I was asked for my recommendations concerning layout. Although the venue has

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since been moved to the Dead Sea, the comments that I prepared at that time regarding the Hyatt layout may be useful for the conference location at the Dead Sea.

1. **The registration area should be large and organized with many stations to reduce lines.**

   A typical downfall of a conference is a registration area that requires long waits for processing. The registration area should allow the pre-registered attendees to just pick up their badges and final programs without any fuss. Stations marked with letters of the alphabet (A-F, G-M, N-S, T-Z) are a good plan. A completely separate area should register the on-site registrants where the processing delays won't hold up others. In addition, stations for selling tickets to social events and dinners should also be separately available, so a pre-registrant doesn't have to stand in a new registration line just to buy a spouse ticket for something.

   Conferences are made and broken based on the quality of the opening registration. It sets the tone for the professionalism of the program. It is also a good idea to have uniformed conference volunteers to direct attendees in hallways.

2. **It is important that the Exhibit Hall be proximate to the technical paper sessions.**

   At the Hyatt, the Exhibit Hall would have been actually three floors below the bridge that most people would have taken from the hotel. A large separation makes the exhibitors feel very isolated from the events. I had thought that putting the registration desk outside the exhibit hall at the Hyatt would help, but upon further reflection I think that would have been too far away. The primary issue is making sure that conference attendees don't have to work hard to find and spend time in the Exhibit Hall.

   Another suggestion about the Exhibit Hall: A bookstore of water demand management materials would be an excellent source of information for attendees and would likely fetch a brisk business. I can provide a list of books if you are interested in this idea.

3. **The Workshop Rooms should be easily identifiable, proximate to each other, and similarly sized.**

   At the Hyatt, there were only 3 large workshop rooms, with 2 smaller rooms off the skinny hallway off the auditorium. Thus all the rooms would have been scattered and not easily identifiable to participants. Most convention areas are set up in a linear fashion, so attendees don't have a problem finding their room location. Good maps in the program are a must. You might want to consider volunteers dressed in identifiable convention uniforms to guide people at critical corners as well.

4. **Beware of dividing ballrooms for main track sessions.**

   In most hotels, the ballroom divides into parts for the tracks. This conference needs three main "track" rooms. If the ballroom is going to be divided, I would strongly recommend sound checking the interior track section before committing to doing all three tracks next to each other. You may wish to hold a third track in a different location if competing sound will be an issue. It often is unless the ballrooms are very large and well insulated for sound. Typically the dividers are not very sound-proof and speakers will end up competing with each other.

## Other Recommendations

The staff at the Ministry of Water and Irrigation would benefit from participating in water demand management conferences and programs elsewhere. It would be especially helpful to have training that incorporates field visits to potential water conservation project sites. Training in the United States is available from a number of agencies, including the California Urban Water Conservation Council. The AWWA Water Sources conferences, held every two years, always have an excellent "introduction to conservation" class. The training expense will be amply repaid, as the staff will have an opportunity to assimilate what programs work in which types of situations. There are numerous existing programs that can apply to Jordan's situation, particularly in the commercial and industrial sector.

# STRATEGY FOR DEVELOPING

# A PERMANENT WATER DEMAND MANAGEMENT PROGRAM

# IN JORDAN

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1. Supply and Demand Overview of Jordan

2. Summary of Previous Conservation Program Activities

3. Developing a Two-Pronged Approach for the Ministry of Water

4. Analyzing Municipal Consumption
   a. Assembling Data
   b. Disaggregating consumption of sectors
   c. Inventorying end use consumption

5. Modeling Future Consumption
   a. Projecting future consumption by end use
   b. Calibrating the model against the Ministry's projections

6. Modeling Conservation Program Options
   a. Selecting programs based on benefit-cost analysis
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7. Choosing Immediate Demand Management Program Steps
   a. Estimating savings from current WEPIA programs
   b. Selecting current WEPIA activities to continue
   c. Setting a timeline for further codes adoption
   d. Selecting initial priority conservation activities
   e. Monitoring progress on Unaccounted-for-Water Improvements
   f. Developing short-range phased plan and timeline

8. Adopting the Long-Range Demand Management Plan
   a. Procuring the Approvals
   b. Phasing in the Budget and Staff

9. Evaluating Conservation Program Savings
   a. Gathering data in the field
   b. Continuously monitoring consumption
   c. Comparing consumption against the model projections

10. Readjusting the Long Range Plan In the Future

## APPENDICES

1. Water Demand Management Strategy Schedule of Tasks (Excel Spreadsheet)

2. Water Demand Management Retrofit Projects Schedule of Tasks (Excel Spreadsheet)

3. "Domestic Water Demand Management Through a Water Audit and Water Fixture Retrofit Policy," Paper submitted to the Journal of Water International (Grieser, Haddadin, Al-Qaisia, Tarawneh)

4. "Water Demand Management Through Building Codes," Paper submitted to the Journal of Water International (Grieser, Haddadin, Al-Qaisia, Tarawneh)

## 1. Supply and Demand Overview of Jordan

Jordan is suffering from its water scarcity. Located in an arid region, water supplies are difficult to obtain and expensive to construct. Per capita consumption of water is low at 57 $m^3$ per year or 156 liters per capita per day, well below the defined international "water poverty line" of 1000 $m^3$ per capita per year[1]. Present water use exceeds the renewable freshwater resources by more than 20%, and groundwater aquifers are currently being over-drafted to meet the demand.

This shortage will be exacerbated by 2020, when water supply availability on a per capita basis is expected to be half what it is today. Population is projected to double in the next twenty-five years, and the water deficit is expected to reach 437 Million Cubic Meters (MCM) by the year 2020[2].

The municipal water supply, excluding irrigation, runs generally around 240 MCM annually[3]. 37.2% of this amount is consumed by the Governorate of Amman. Industrial uses consume an additional 36.7 MCM of water annually, most of which comes from groundwater wells. Total consumption by all sectors in 2000 was 817 MCM.

The marginal cost of Jordan's water supply is high by world standards, estimated to be JD 1 Million per MCM. This adds to the scarcity issue, as supplies are expensive to procure and construct.

Unfortunately, a significant percentage of what little water Jordan has for municipal use is lost in the distribution network. Jordan has a very high "unaccounted for water" rate -- as much as 55% was measured as a loss in 1995. In 2000, these losses reached 66.4% in one quarter alone.[4] To compound the problem, most Jordanians are served by this leaking network: 97% of the population in urban areas and 83% in rural areas.

The Ministry of Water and Irrigation in Jordan has recognized this problem and is addressing it with a number of foreign as well as local donors. A goal of reaching 15% by the year 2020 has been set. Thus, a significant priority has been set on repairing and correcting this problem.

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[1] *Water Sector Planning and Associated Investment Program*, 2002-2011. Foreward.
[2] Ibid, page 8
[3] Draft Final Report, *The Study on Water Resources Management in the Hashemite Kingdom of Jordan*, August 2001. Volume I, page MA1-1.
[4] Ibid, page MB1-14

In order to address some of Jordan's water problems, a National Water Strategy was developed in 1997 and published in 2002. Among the 47 recommendations contained in the Strategy were the following:

- Priority of 100 liters per capita per day for basic human needs
- Creation of a national water data bank
- Full utilization of all wastewater for irrigation purposes
- Full but sustainable development of aquifer resources
- Adoption of a five-year resource development plan

In the Demand Management and Conservation area, the Water Strategy cites the following:

- Achievement of the "highest possible efficiency" in water conveyance, distribution and use
- Adoption of measures to "maximize the net benefit from the use of a unit flow of water."
- Definition and Assignment of roles in water conservation to be played by the different sectors of society.
- Promotion of water saving systems and devices.

The Strategy does not identify any specific demand management programs, or even what part of the projected supply shortfall might be relieved by conservation programs. However, it is clear that the Ministry supports the implementation of demand management efforts as a necessary part of the solution. The specifics of that long-term solution remain to be developed.

## 2. Summary of Previous Conservation Program Activities

The Water Efficiency and Public Information for Action Project (WEPIA), is a United States Agency for International Development (USAID) funded project that began in February, 1999 to assist the country of Jordan in its demand management efforts. There are three distinct areas of program activity:

a. ***Large Consumers.*** The program has targeted large users consuming over 500 $m^3$ per quarter and is auditing and installing water saving devices in these buildings. (Residences and the Military have been excluded.) The target universe for this program was defined as 647 large users. To date, 370 of these large users, or 61.5%, have been audited and their buildings retrofitted. Total water savings are estimated to be 874,090 $m^3$ annually.

b. ***Codes.*** Codes similar to international water standards (e.g. 6 liters per toilet flush) were developed and were recently adopted in the

Jordan building codes. These codes will govern all new construction in Jordan. Being examined at the present is whether the codes can be applied upon resale of a building or renovation. In addition, codes for limiting sale of inefficient plumbing fixtures are still being investigated.

c. ***Public Information and Education.*** The primary targets for this effort are residential and commercial consumers of water. Social marketing techniques are used to promote the use of water saving devices.

Finally, on-site audits were conducted of some major water-using industries by the Ministry of Water & Irrigation. The detailed reports, prepared by consultants retained by the Ministry, document the water savings opportunities available with retrofits and changes in industrial processes. To date none of the audits have resulted in significant retrofit or process changes.

## 3. Developing a Two-Pronged Approach for the Ministry of Water

During 2003, a Water Demand Management Unit was created within the Ministry of Water and Irrigation to monitor conservation retrofit programs and to evaluate savings. The unit's responsibilities will likely include planning, regulating, and monitoring water efficiency programs. At present it is staffed by a Unit Manager, an administrative assistant, and two engineers assigned to the unit from the WEPIA office

The first task for this newly formed unit should be to develop a demand management plan that will estimates the conservation potential for the country. A gap of 437 MCM by the year 2020 has already been identified as the shortfall between available supply and projected demand. Demand management programs can help to fill that gap and provide dependable verifiable water savings if the savings are achieved through retrofit programs. Behavioral changes as a result of public information programs, while measurable in the short-term, are often not reliable in the long-term. Plumbing and appliance changes, however, permanently modify the customer's use of water without the perception of "rationing" or hardship, and are thus reliable for a longer term period – usually the life expectancy of the fixture.

The steps listed below will help develop a credible estimate of the amount of conservation savings that can likely be expected, given the low per capita use consumption patterns in Jordan. A long-range conservation plan should be developed with the best data that can be assembled. In the meantime, however, there are conservation programs that can be undertaken that can achieve clear savings and

that will likely be part of the long-range conservation plan anyway. These programs can be started immediately. Some activities from the current WEPIA program should be continued.

Thus, a two-pronged approach is recommended, one where some interim programs are implemented while the long-range research is taking shape for the plan. At some point during the latter part of 2004, both sets of activities should be combined, and the ongoing programs absorbed into the master plan.

## 4. Analyzing Municipal Consumption

### a. Assembling Data

Accurate subscription consumption data is very important. Data for residential and non-residential water users should be gathered for a three-year period, if possible. These records should give consumption by quarter so that a consumption curve can be plotted to show the extent of the summer peak. A large peak is likely due to two factors: tourism activity during the summer, and outdoor irrigation. Conservation programs can be developed to target both of these.

The three-year period of data is necessary to provide a baseline set of numbers for comparing consumption before and after a conservation program. Without an adequate baseline, it will be impossible to determine the savings truly achieved from the programs that are implemented.

The Ministry is in the process of developing a new database in Oracle as part of its new Digital Master Water Plan. In the long run, this format should easily provide the type of subsector consumption data by quarter that would be needed for conservation program analysis. However, it is not clear at this time whether the records from prior years of consumption will be available during the data transfer to the new system. It is likely that considerable data entry will have to be done by the Demand Management Office to secure records of subscriptions that will likely be part of a conservation program. Unfortunately, recording this data and keeping track of ongoing consumption in these subscriptions is one of the most important activities that the Unit will undertake, as inherent in the data will be the proof of success of the programs.

Other data that are necessary for calculating the benefits and costs of conservation programs are the following:

- Water production costs, including source of supply costs, capacity expansion costs, energy costs, and chemical costs.
- Wastewater production costs, including source of supply costs, capacity expansion costs, energy costs, and chemical costs.
- Environmental benefits of water saved.
- Discount rates, both for the Ministry and for the society.

**b. Disaggregating consumption of sectors**

The WEPIA project has gathered some data for the subscription base and broken them down by sector. Their breakdown is as follows:

| Sector | Annual Consumption ($m^3$) | % Annual Consumption |
|---|---|---|
| Residential | 95,459,600 | 82.9% |
| Schools | 1,388,023 | 1.2% |
| Hospitals | 1,170,361 | 1.0% |
| Commercial | 14,626,426 | 12.7% |
| Industry | 351,399 | 0.3% |
| Governmental | 2,188,538 | 1.9% |
| Total | 115,184,347 | 100.00% |

This breakout is helpful. It shows that the recorded water deliveries are primarily to residential household and that a conservation program should address this sector. However, 10 MCM of water deliveries for the non-residential sector most likely does not represent the true consumption in these sectors, as they are likely to be receiving supplementary deliveries by tanker truck. The overall usage for the non-residential sector is likely to be considerably higher. Hospitals, for example, rarely rely on municipal deliveries, and therefore their recorded data are short by magnitudes of scale.

The data records in the Ministry for all subscriptions currently do not break down the subscriptions into sectors that can be easily analyzed. Without the records identified more precisely as to type of use, it is not possible to determine the extent and potential for water conservation as a whole. Residential consumption should be disaggregated into single family, villa, and apartments. Non-Residential consumption ideally should be disaggregated into the following subsectors for easy analysis:

- Restaurants
- Retail businesses
- Office Buildings
- Hotels
- Hospitals
- Government Buildings
- Military
- University
- Manufacturing
- Heavy industry
- Food Processing and slaughterhouses

Once the consumption data is categorized by subsector, the data should be sorted by the largest users. Sectors of high consumption patterns should emerge. Comparing the volume of water to the number of subscriptions can help determine where further conservation potential should be examined.

One problem with the non-residential data will make this analysis difficult. Some large uses (such as hospitals) purchase supplementary water, which is not recorded in their subscription records. Thus, their full consumption patterns cannot be determined without an on-site audit or individual contact with the user.

c. **Inventorying end use consumption**

Understanding how the customer uses water is important to understanding how where to get conservation savings. End use information – that is, information about water flow at each specific point that the customer uses water – is important not only to analyzing conservation potential, but also to forecasting increases in water demand in the future. The most precise way to analyze end use information is to monitor the flows with a computerized datalogger that will provide a computerized trace flow signal converted later to device and device flow volume. An analysis can be conducted over a statistically valid sample size and these results can be extrapolated to the whole.

During its project, a WEPIA staff intern[5] analyzed 50 sample houses for a breakdown of end use consumption. The resultant analysis found the following distribution of end use consumption in the average household:

[5] Data from Motasem Haddadin and Raed Nimri

| Household Fixture | Total Consumption ($m^3$) | % Total Consumption |
|---|---|---|
| Toilets | 29,592,476 | 31% |
| Showers | 24,819,496 | 26% |
| Clothes Washers | 12,409,748 | 13% |
| Kitchen | 12,409,748 | 13% |
| Cleaning | 2,863,788 | 3% |
| Faucets | 13,364,344 | 14% |
| Total | 95,459,600 | 100% |

This is a useful indicator of water use. Toilets and showers are the highest end uses in the household – 57% overall – and therefore represent clear conservation program opportunities. The extent to which a program should be conducted will be a matter for further analysis.

A statistical survey of urban agriculture was conducted by the Department of Statistics in 1998[6]. 13,000 households were surveyed in various regions around the greater Amman area. Extrapolated to the whole population, the survey's findings show the following:

- 50,097 households are practicing urban agriculture.
- The total cultivated area is an astounding 6,483,952 square meters.
- 86% of these households use the public network as a source of irrigation.
- Only 30% of the households suffer from water scarcity, thus leaving 70% who must be irrigating adequately or even excessively.

These findings suggest that an urban landscape program, particularly in the Amman region, may provide some water conservation potential. Although not likely to be a large quantity of water, it nonetheless would represent an area of savings worth exploring further.

## 5. Modeling Future Consumption

### a. Projecting future consumption by end use

### b. Calibrating the model against the Ministry's projections

[6] Department of Statistics, Mr. Khamis Raddad, Survey Supervisor

## 6. Modeling Conservation Program Options

This is the meat of the conservation program planning work. Once the necessary data have been assembled, analysis can begin on different conservation program options. Not all conservation programs can be quantified, however. For example, very little data exist on how much savings can be expected from public information programs. However, device retrofit programs are highly predictable and can be easily modeled in varying configurations. The chart below lists the types of conservation programs and whether they can be easily quantified.

| Conservation Program | Easily Quantifiable? |
|---|---|
| | |
| **Residential** | |
| Toilet retrofit | Yes |
| Showerhead retrofit | Yes |
| Aerator retrofit | Yes |
| Clothes Washer retrofit | Yes |
| Audit and Leak Detection | Yes |
| | |
| **Non-residential** | |
| Pre-Rinse Valve retrofit | Yes |
| Laundry retrofit | Yes |
| Cooling Tower retrofit | Yes |
| Ice machine retrofit | Yes |
| Waterless urinal retrofit | Yes |
| Plumbing retrofits | Yes |
| | |
| **Other** | |
| Public Information | No |
| School Education | No |
| Plumbing Codes | Yes |
| Behavioral Codes | No |
| Metering and meter calibration | Yes |
| Network Water Loss Management | Yes |
| Outdoor irrigation management | Yes |

For those programs that are quantifiable, the program design parameters can be modeled. By comparing the results of different programs in different design formats, a conservation program plan can be developed which best suits the needs of Jordan at this time.

### a. Selecting programs based on benefit-cost analysis

The best way to analyze conservation programs is to perform a benefit-cost analysis on various types of programs and program

designs to determine the overall cost, the benefit to cost ratio, and the unit cost of the conserved water, which can then be compared to the unit cost of water resource development. Programs then can be chosen which represent the best option for the budget provided.

Spreadsheet models have been provided to the Ministry staff. These are simple models for evaluating the cost-effectiveness of conservation programs. The models are all organized into five data entry steps and one analysis review step, as follows:

*Step 1 - Annual Costs: in this step enter information to calculate the expected annual costs to implement the conservation program.*

*Step 2 - Customer Water Savings: in this step enter information to calculate the expected water savings over time from implementation of the conservation program.*

*Step 3 - Agency Benefits: in this step enter information to calculate the benefits to the Ministry from the water savings estimated in Step 2.*

*Step 4 - Other Benefits and Costs: in this step enter information to calculate benefits and costs that may accrue to other utilities, if any.*

*Step 5 - Discounting Information: in this step provide discount and cost escalation rates needed for the present value analysis.*

*Step 6 - Review Results: in this step review the model results. These results are based on the information provided in the first five steps. For comparison, change the values in the program design (Step 1: Annual Costs) to compare program designs at different scales.*

*Cell Color Key*

*Green Cells are cells that require data from the user.*

*White Cells are cells that contain formulas used by the models. If you overwrite the formulas in White Cells the models will cease to work properly. Only enter data in Green Cells.*

*Data Requirements*

*The models requires a variety of data, including:*

- *Implementation costs, including staffing, materials, outside consultants, and marketing costs.*
- *Estimates of water savings from the chosen conservation program, including initial savings and rates of decay.*
- *Water production costs, including source of supply costs, capacity expansion costs, energy costs, and chemical costs.*

- *Environmental benefits of water saved.*

- *Discount rates, both for the Ministry and for the society.*

*Much of the data required to implement the models is available in the Council's "BMP Costs & Savings Study." This document provides best available estimates of water savings and program costs for most of the conservation programs for which water savings have been quantified. A copy of this report will be sent to the Ministry Office.*

*Variable Units*

*Model variables represent specific quantities denoted in particular units. These units must be used or the model will provide incorrect results. The called for unit is always indicated for each variable for which you are providing a value. In most cases this will be obvious. Unfortunately, the water volumes are mostly denoted in acre-feet (af). In some cases they are denoted in gallons-per-day (gpd). At the bottom of several worksheets a unit conversion calculator for converting water volume into acre-feet is provided. Once the results have been given in Step 6, the acre-feet number can be converted into MCM by multiplying by a conversion factor of 810.*

*Scenarios*

*Model scenarios of different conservation programs can be saved. A scenario consists of all the values entered for the model variables plus the benefit-cost results for those values. Scenarios are saved on the worksheet "Saved Scenarios." These scenarios can also be loaded back into the model at a later time using the "Load a saved scenario" button located on the "Saved Scenarios" worksheet. With scenarios it makes it simple to evaluate the sensitivity of the model's results to changes in key variables.*

**A sample calculation with these model spreadsheets shows some interesting results. Several designs for a toilet installation program were calculated.**

**b. Projecting future consumption with conservation programs**

## 7. Choosing Immediate Demand Management Program Steps

**a. Estimating savings from current WEPIA programs**

116 public buildings have been retrofitted for plumbing fixtures, according to the standards proposed in the codes. The savings estimate by the WEPIA staff for these retrofits is 49.5 MCM cumulatively over a twenty-year period.

The WEPIA staff are also in the process of analyzing the savings percentages possible across the entire subscription base. The average percentage of potential water saving in the domestic sector is estimated to be between 27 and 30%. This is with a combination of code enforcement and retrofits.

**b. Selecting current WEPIA activities to continue**

- Public Information Program.
- Large Consumer Audits.
- Faucet Aerator Retrofit. Availability of the product is good, and the cost is between JD 1.25 and 2.00. The program has not been actually retrofitting homes with aerators, but merely recommending that consumers purchase them. The Ministry should consider at this time directly distributing the devices to households. The best method for such distribution would be through a social marketing program using community groups or volunteers familiar to those in the neighborhood.

**c. Setting a timeline for further codes adoption**

Between 2002 and 2020 _____ new buildings are estimated for construction. With codes in place, the savings projected from these new buildings alone is estimated to be 157.6 MCM. Retrofitting existing buildings is likely to yield approximately 30% savings.

**d. Selecting initial priority conservation activities**

Based on the data that have been presented thus far, there seem to be a number of clear conservation programs that can and should be undertaken even while the detailed plan is underway. Bear in mind that the scale of a conservation program greatly influences its cost; that is, although larger programs cost more in the aggregate, they have lower per unit costs because of the economies of scale factor. Thus, it is important to analyze each of these suggested options with the benefit-cost spreadsheets to determine a reasonable beginning for these efforts.

- Residential Plumbing Retrofits for toilets, showerheads, bidets and faucets – targeting those residences consuming more than 50 $m^3$ quarterly
- Domestic leak detection and aerators for all households
- Complete Military Sector Audit and retrofit
- Cooling Tower audit program
- Restaurant and Hotel retrofit for Pre-rinse spray valves and ice machines
- Waterless urinals retrofit on a pilot test basis
- Codes and Standards enforcement
- Additional Public Information and Education programs
- Tariff adjustment
- Development of Efficient Products Market in Jordan

*Tariff Adjustment*

Tariffs or Rates are considered a powerful tool for giving the water consumer a signal of scarcity. In numerous water conservation programs around the world, tariffs have been successfully used to help lower demand. Although basic water use is not very elastic, high water use for non-basic needs can be influenced by properly set tariffs.

The tariffs in Jordan are currently set by the Ministry, and are tiered, consumption based rates. However, the overall cost is very low, and even in the higher consumption tiers where a price signal might be very effective, one can buy 150 cubic meters for only JD 100 in Amman (where the tariffs are highest). This cannot possibly cover the true cost of that 150 cubic meters' water procurement and delivery. Even with the 12% increase in tariffs in certain governorates in 2000, the tariffs remain below the cost recovery level.

Consequently, the Ministry staff should take a look at the possibilities for tariff adjustments in these large block areas. Not only will the tariff then cover the true cost of water supply and

delivery, but it may also raise need funds for conservation and supply development projects.

*Development of Efficient Products Market in Jordan*

Hampering the ability of a consumer to be efficient is the general unavailability of the low-water-using products, fixtures, and appliances that can be found elsewhere in the world. Perhaps customs fees are an issue. If so, Ministry staff should explore whether these fees can be waived. Another strategy would be to explore vendor relationships with foreign companies and Jordanian manufacturers so that these products can be manufactured locally and sold inexpensively in Jordan.

**e. Monitoring progress on Unaccounted-for-Water Improvements**

**f. Developing short-range phased plan and timeline**

**8. Adopting the Long-Range Demand Management Plan**

**a. Procuring the Approvals**

**b. Phasing in the Budget and Staff**

**9. Evaluating Conservation Program Savings**

**a. Gathering data in the field**

The WEPIA consultants conducting the audits and retrofits of public buildings have developed an Excel spreadsheet tracking system that could be adapted for use by the Ministry's conservation data-gathering efforts. The advantage to their tracking system is that it is in Excel, which is easy to use. However, it may be beneficial to reprogram it into another less consuming software language. Each audit that is conducted has a detailed record containing:

- Account number of the metered subscription
- Contact information
- Age of the building
- Number of floors
- Quantities of fixtures
- Fixture flow rates
- Number of users in the building
- Behaviors of the users
- Supplemental tank deliveries
- Water recycling data
- Outdoor irrigation data

- Estimate of the water savings potential from a full retrofit
- Estimate of the retrofit cost
- Date and type of the retrofit

All the fields in the tracking system are sortable and the linked records can be aggregated across the entire record base. The records cover all of the 254 sites that have been audited as of May, 2003. A separate tracking database exists for the hotel and school audits, which should be merged into this one as soon as possible.

A database like this enables the aggregation of retrofit activities and the analysis of water savings. It is recommended that either this tracking system or a similar one be used by the Ministry Water Demand Management Office to track all conservation program activities. Considerable care should be taken to set up the program accurately and to enter the data precisely. Cross-checks to verify the data should also be undertaken to guard against entry errors that could skew the analysis results.

**b. Continuously monitoring consumption**

**c. Comparing consumption against the model projections**

## 10. Readjusting the Long Range Plan in the Future

# Water Demand Management Strategy
## Schedule of Tasks



| TASK | 2004 | | 2005 | | | | 2006 | | | | 2007 | | | | 2008 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| **IMMEDIATE STEPS** | | | | | | | | | | | | | | | | | | |
| Estimate WEPIA savings to date | | | | | | | | | | | | | | | | | | |
| Select WEPIA activities to continue | | | | | | | | | | | | | | | | | | |
| Set a timeline for codes | | | | | | | | | | | | | | | | | | |
| Evaluate conservation options | | | | | | | | | | | | | | | | | | |
| Prioritize conservation options | | | | | | | | | | | | | | | | | | |
| Select initial programs | | | | | | | | | | | | | | | | | | |
| Monitor progress on UFW savings | | | | | | | | | | | | | | | | | | |
| Develop short range program timeline | | | | | | | | | | | | | | | | | | |
| Set budget for staffing | | | | | | | | | | | | | | | | | | |
| Begin program implementation | | | | | | | | | | | | | | | | | | |
| **CONSERVATION PLAN** | | | | | | | | | | | | | | | | | | |
| Assemble data | | | | | | | | | | | | | | | | | | |
| Disaggregate consumption by sector | | | | | | | | | | | | | | | | | | |
| Inventory end use consumption | | | | | | | | | | | | | | | | | | |
| Calibrate model against projections | | | | | | | | | | | | | | | | | | |
| Choose conservation programs | | | | | | | | | | | | | | | | | | |
| Model projections with conservation | | | | | | | | | | | | | | | | | | |
| Prioritize programs based on B/C ratio | | | | | | | | | | | | | | | | | | |
| Set timeline for long term programs | | | | | | | | | | | | | | | | | | |
| Adopt plan | | | | | | | | | | | | | | | | | | |
| Set budget for staffing and funding | | | | | | | | | | | | | | | | | | |
| Begin program implementation | | | | | | | | | | | | | | | | | | |
| **EVALUATION** | | | | | | | | | | | | | | | | | | |
| Record conservation activity by user | | | | | | | | | | | | | | | | | | |
| Develop master database | | | | | | | | | | | | | | | | | | |
| Compare consumption against models | | | | | | | | | | | | | | | | | | |
| Calibrate model | | | | | | | | | | | | | | | | | | |
| Revise program choices as needed | | | | | | | | | | | | | | | | | | |

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# Water Demand Management Retrofit Projects
## Schedule of Tasks



| TASK | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ADMINISTRATION** | | | | | | | | | | | | | | | | |
| Identify funding needed for project | ■ | | | | | | | | | | | | | | | |
| Decide on staffing or consultant to do project | ■ | | | | | | | | | | | | | | | |
| Issue RFP and hire consultant if needed | | ■ | | | | | | | | | | | | | | |
| Create project management schedules | ■ | ■ | | | | | | | | | | | | | | |
| Make provision for data entry of field activity | ■ | ■ | | | | | | | | | | | | | | |
| Require quarterly reports | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Monitor customer complaints | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Check quality control of retrofit devices | | | | ■ | ■ | ■ | | | | | | | | | | |
| Get budget approved for project | | ■ | ■ | | | | | | | | | | | | | |
| Develop public information program on project | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | | |
| **PROJECT DESIGN** | | | | | | | | | | | | | | | | |
| Identify number of subscriptions in project | ■ | | | | | | | | | | | | | | | |
| Choose retrofit technology | ■ | | | | | | | | | | | | | | | |
| Design distribution method | ■ | | | | | | | | | | | | | | | |
| Create project timeline with deliverables | ■ | ■ | | | | | | | | | | | | | | |
| Begin program implementation | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **EVALUATION** | | | | | | | | | | | | | | | | |
| Record project activity per subscription | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Collect data on all field activity | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Develop master databases | ■ | ■ | ■ | | | | | | | | | | | | | |
| Compare consumption against original estimates | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Revise program design as needed | | | | | | | | ■ | ■ | ■ | ■ | | | | | |
| Prepare final consumption evaluation | | | | | | | | | | | | | | | ■ | ■ |

California Urban Water Conservation Council

# California Urban Water Conservation Council

## A Statewide Partnership for Water Efficiency

Mary Ann Dickinson
Executive Director

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# California's Future Population

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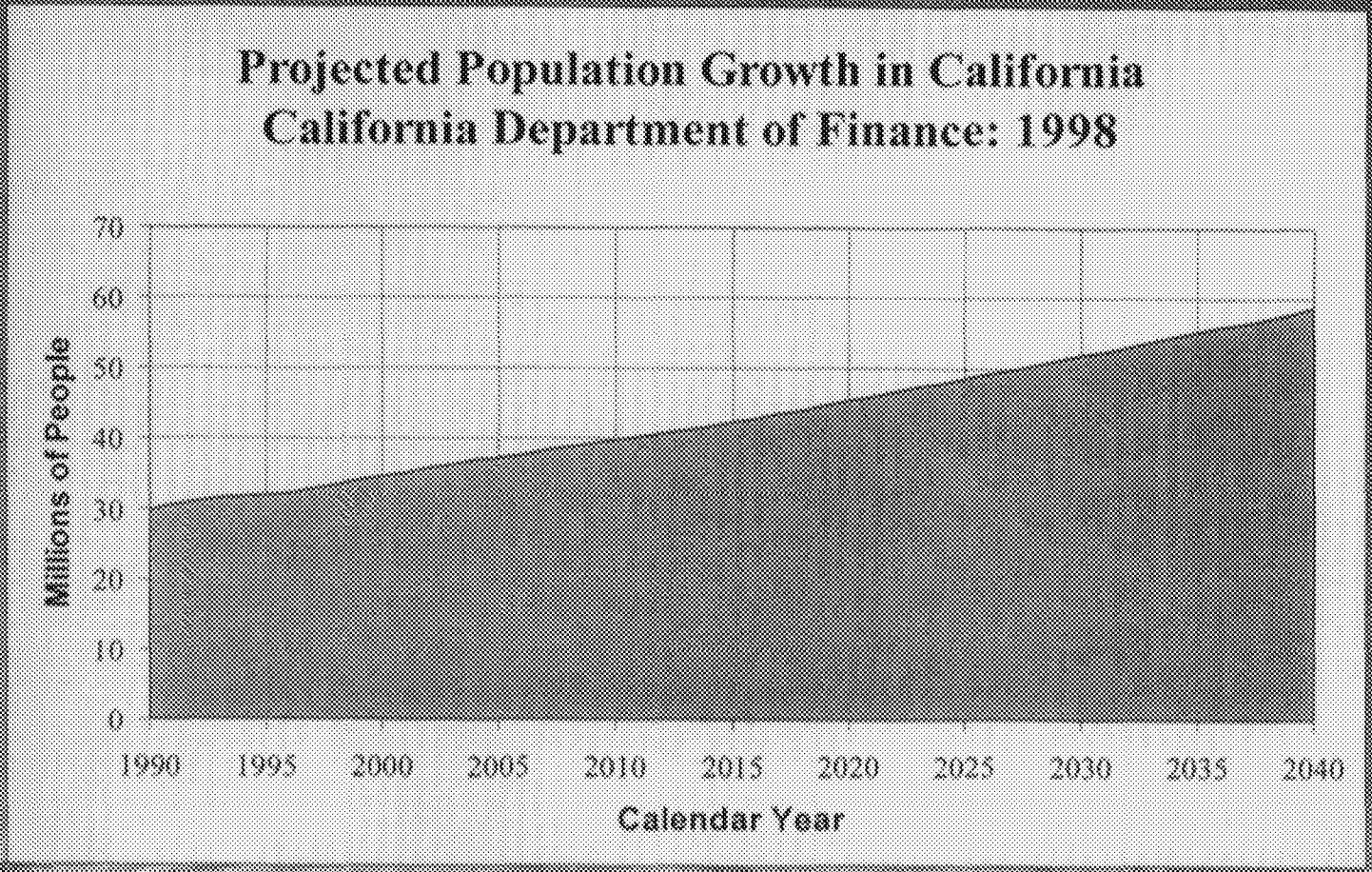


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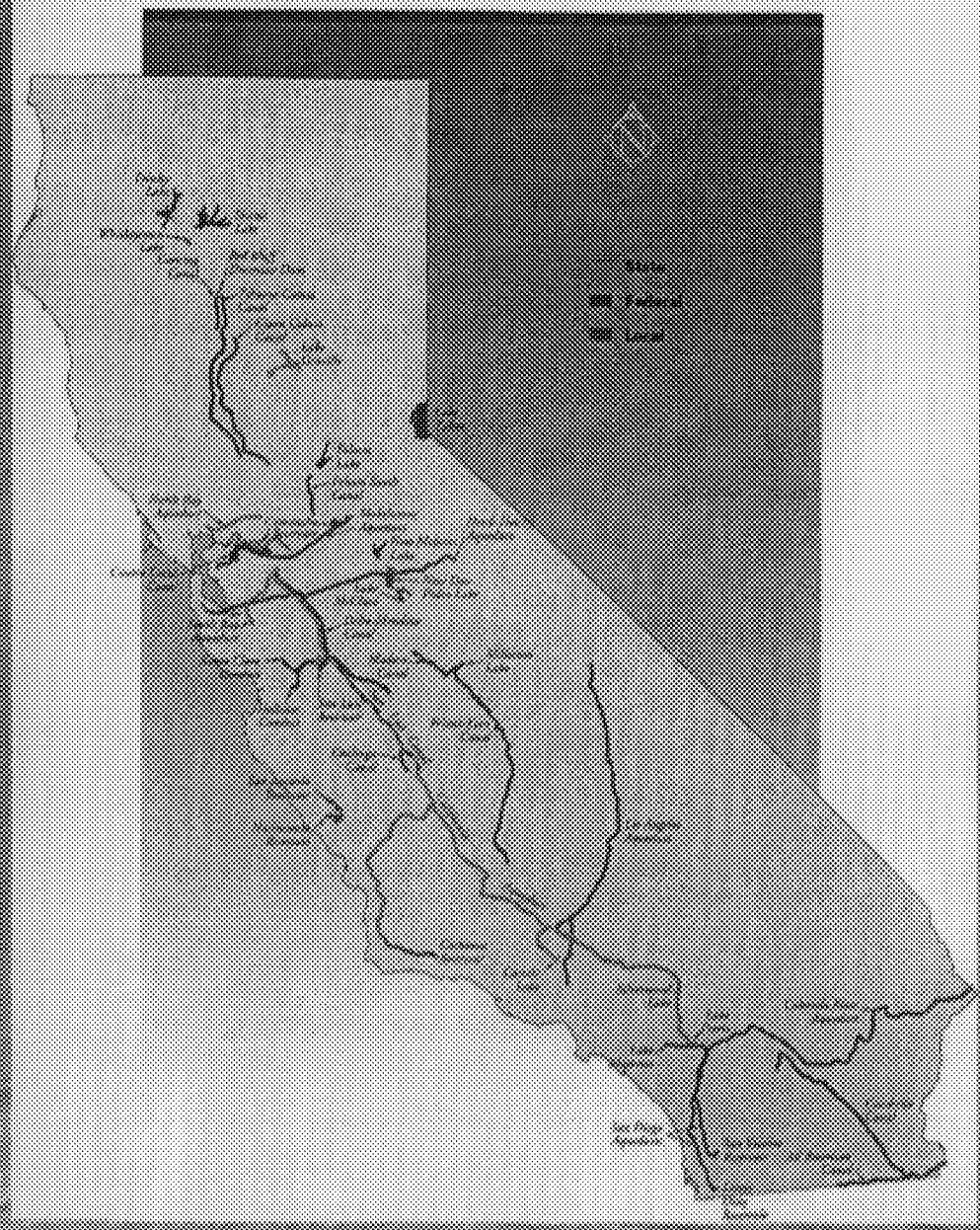
FIGURE 1-4

**California's Major Water Projects**

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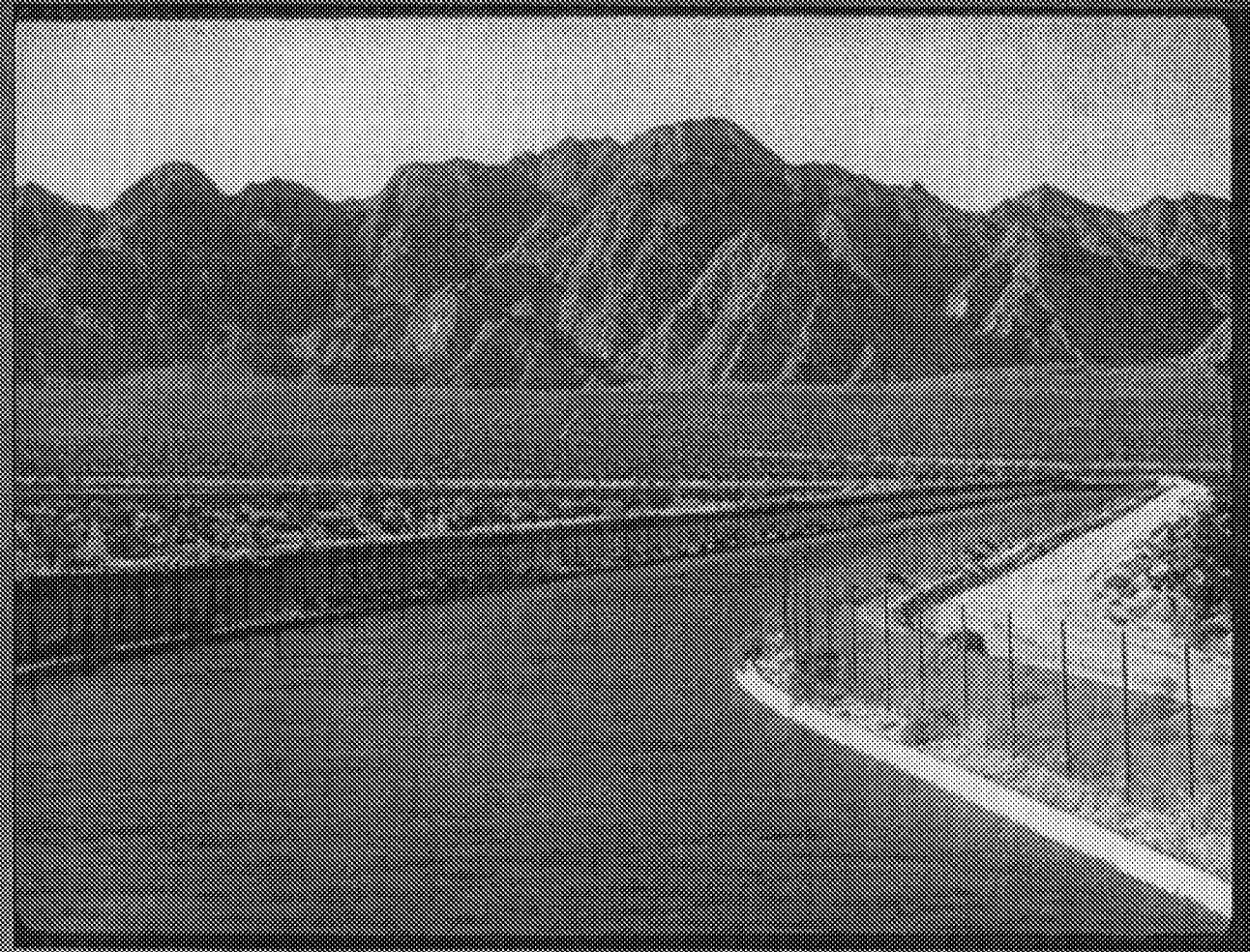

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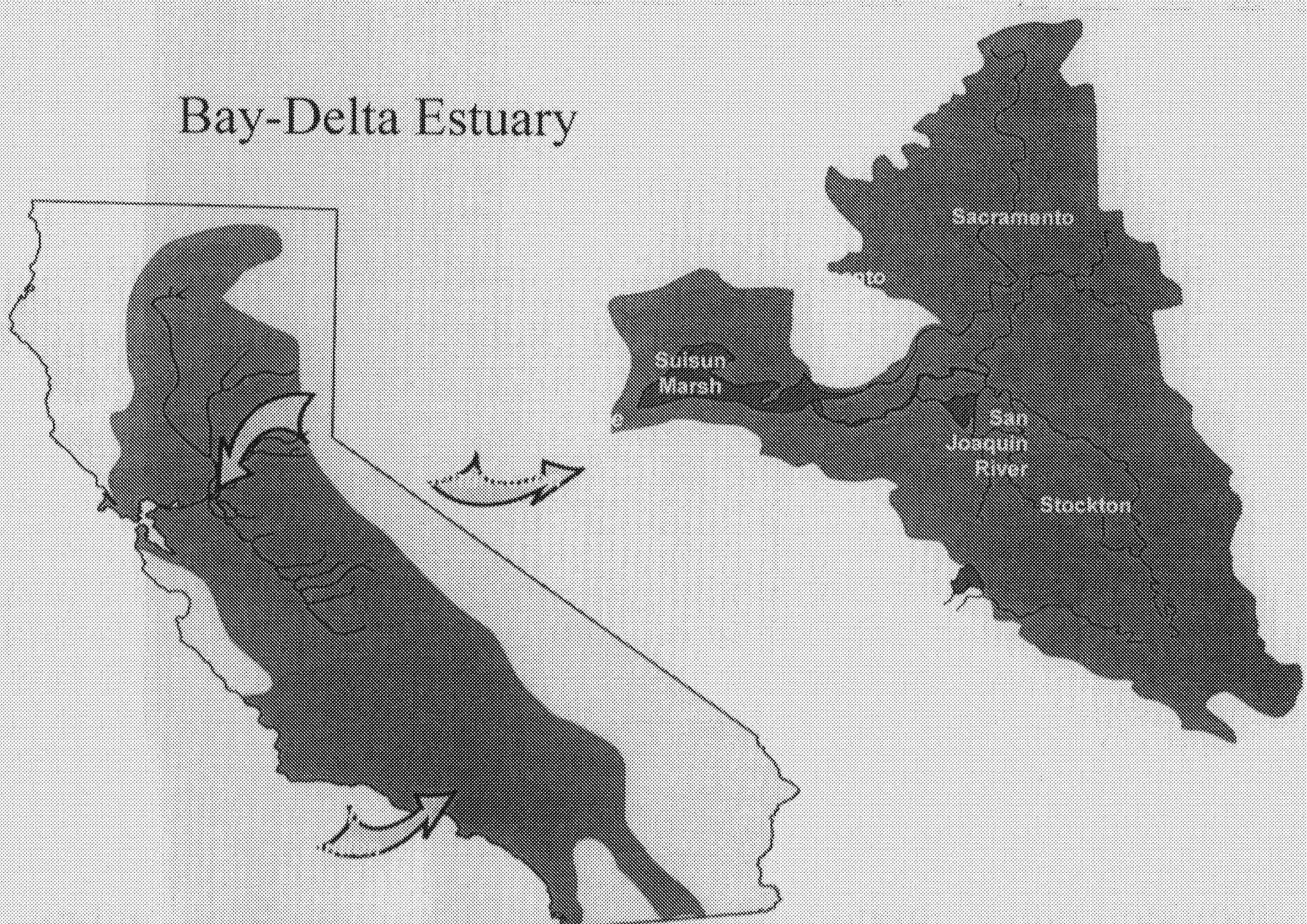
# Bay-Delta Estuary

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# Bay-Delta Estuary

- Ecological Restoration of Bay-Delta Estuary a critical priority
- Water Use Efficiency a key component
- Joint State-Federal program

CALFED BAY-DELTA PROGRAM

DEPARTMENT OF WATER RESOURCES STATE OF CALIFORNIA

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

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# Water Efficiency Benefits

- Drought Tool: short-term relief
- Planning Tool: lessen gap between growing demand and dwindling supply
- Economic Tool: defer capital facilities for drinking water and wastewater treatment
  - e.g. US will spend a quarter trillion dollars by the year 2020
  - Deferral of facilities will save millions
- Environmental Tool: Flows for rivers and streams

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# The Beginning: Federal Standards

- 1992 Energy Policy Act plumbing efficiency standards

| Fixture | U.S. Standard | Metric Equivalent |
|---|---|---|
| Water Closets (Toilets) | 1.6 gal per flush | 6 liters per flush |
| Showerheads | 2.5 gal per min | 9.5 liters per min |
| Faucets | 2.2 gal per min | 8.3 liters per min |
| Urinals | 1 gal per flush | 3.8 liters per flush |

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# Next: California's Action

- Memorandum signed 12/11/91 with 100 water agencies and environmental groups
- Signers pledged "good faith effort" to implement conservation programs that are cost-effective
- A Council was created as governing body and overseer of demand management programs



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# Adopting Benchmark "BMPs"

- State of the art conservation programs defined as "Best Management Practices"
- Original negotiations came up with 16 BMPs, covering residential, commercial, industrial, institutional, and large landscape sectors
- 3 years spent refining language in a negotiated process

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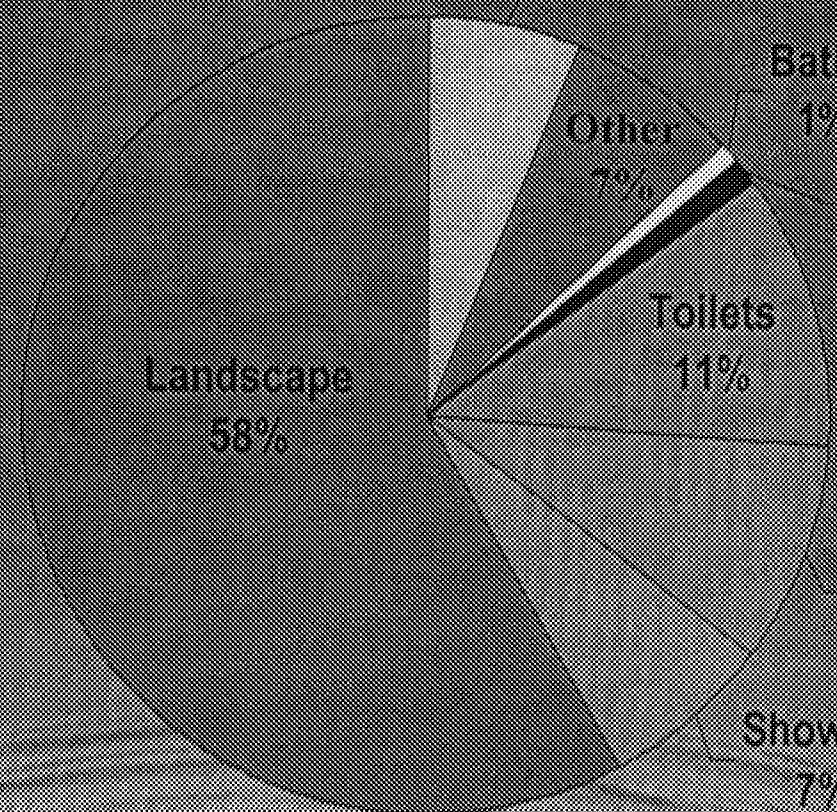
# Residential Water Use




Source: AWWRF Residential End Uses of Water, 1999

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# Current BMPs

1. Residential Water Surveys
2. Residential Plumbing Retrofits
3. System Audits, Leak Detection & Repair
4. Metering with Commodity Rates
5. Large Landscape Conservation

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# Current BMPs

6. High-Efficiency Washing Machine Rebates
7. Public Information
8. School Education
9. Commercial, Industrial & Institutional Conservation

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# Current BMPs

10. Wholesale Agency Assistance
11. Conservation Pricing
12. Conservation Coordinator
13. Water Waste Prohibition
14. Residential ULFT Replacement

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# Are the BMPs Affordable?

- Conservation typically costs between JD 85,200 to JD 256,000 per million cubic meters
- Only those BMPs are required where the agency's avoided cost of water is HIGHER than the cost per million cubic meters of the BMP program
- By contrast, most water supply development projects cost between JD 341,000 and JD 682,000 per million cubic meters, depending upon the type of project

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# The Council Today

- 303 Members
- BMP List revised significantly on 9/30/97
- 4 Plenary meetings of the membership yearly
- Members elect officers

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# Progress to Date

- $96 million spent annually statewide
- Over 2 million high-efficiency toilets retrofitted
- Over 925 million cubic meters annually saved
- Southern CA has same consumption as 1984 with 3 million more people

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# More Savings Needed

- 848 million cubic meters urban
- 432 million cubic meters agricultural
- 382 million cubic meters recycled water
- TOTAL: 1,662 million cubic meters

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# What Is The Council's Role?

- Technical Assistance
- Training Workshops
- Preparation of models and other tools
- Analysis of water savings and other research
- Grants and Program implementation

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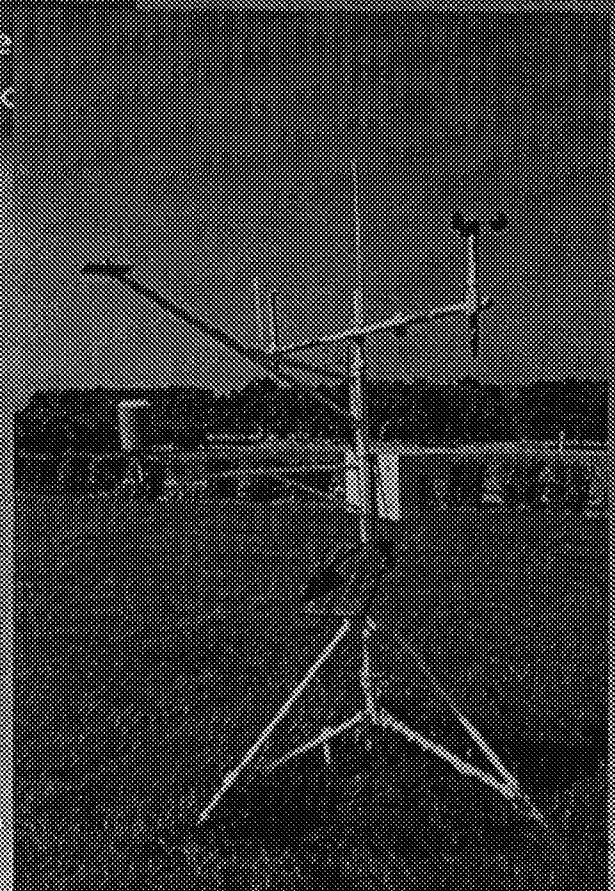
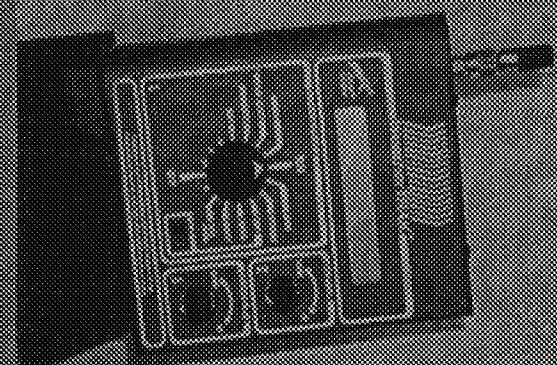
# The New Irrigation Technology



Et Weather Data

For Irrigation Scheduling



WEATHER TRAK

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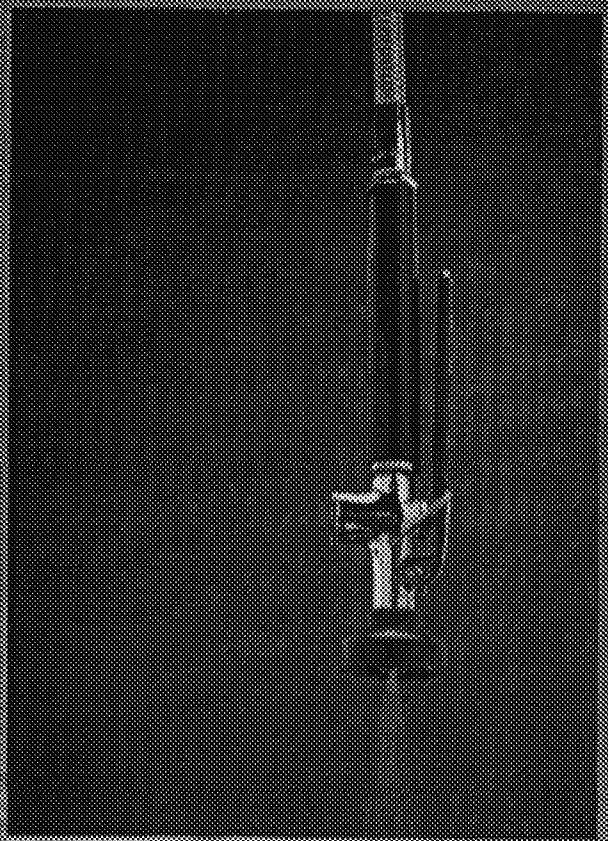
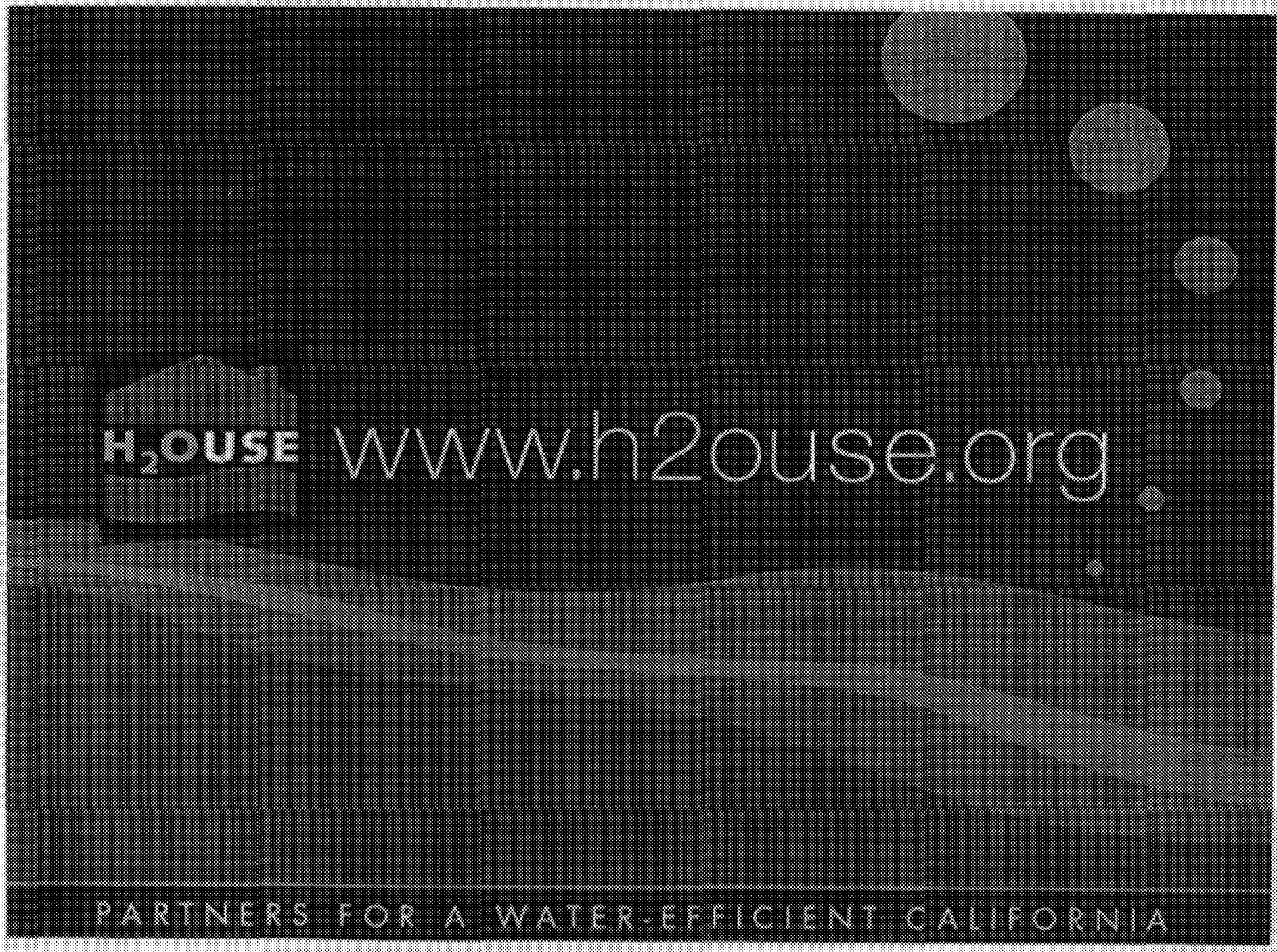
# Restaurant Spray Valves

- Saves 757 liters per day over non-efficient model
- 17,000 will be installed in Council pilot program by December
- Valve is free to restaurant owner

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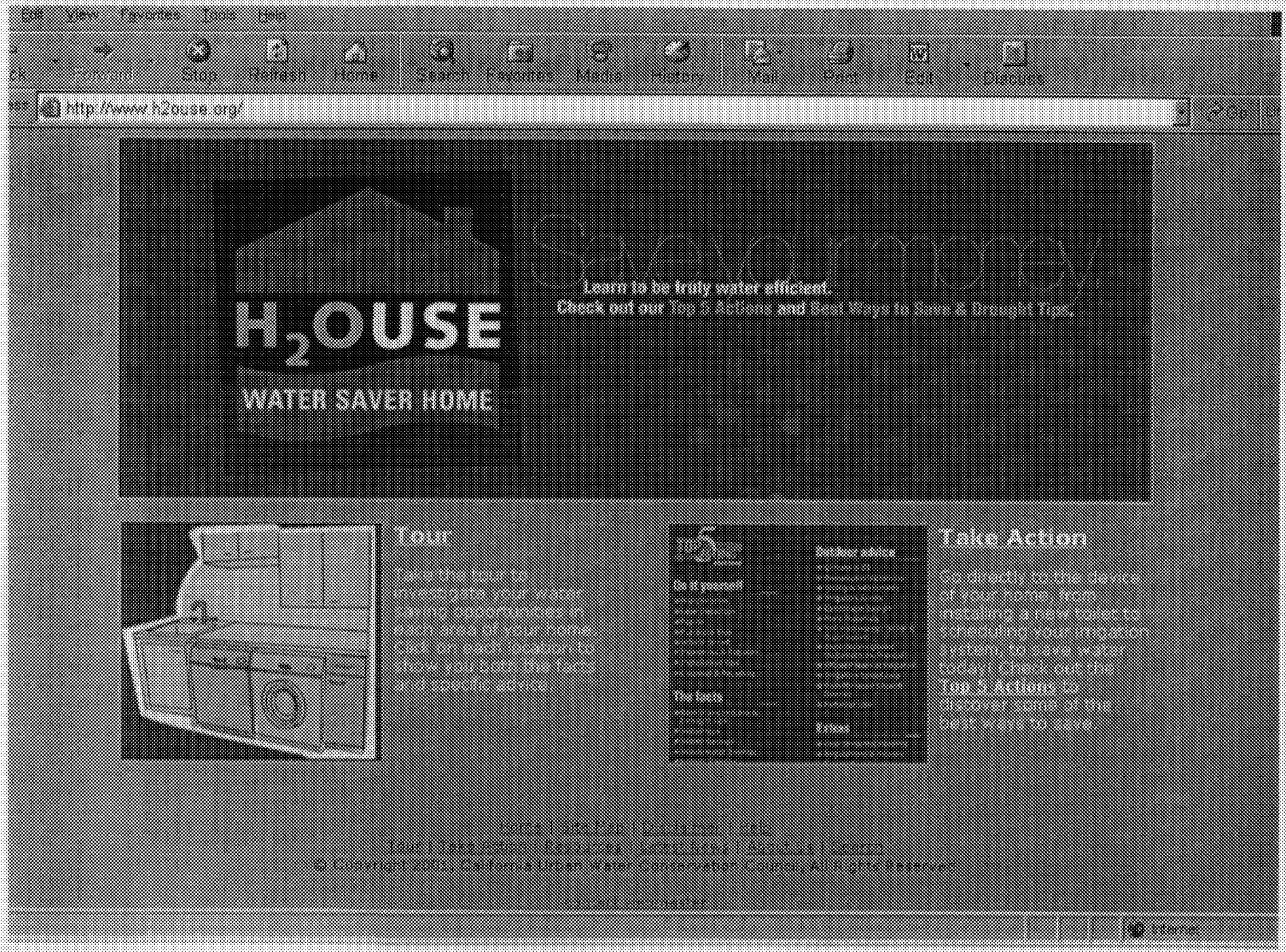
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Do it yourself
The facts
Outdoor advice
Extras
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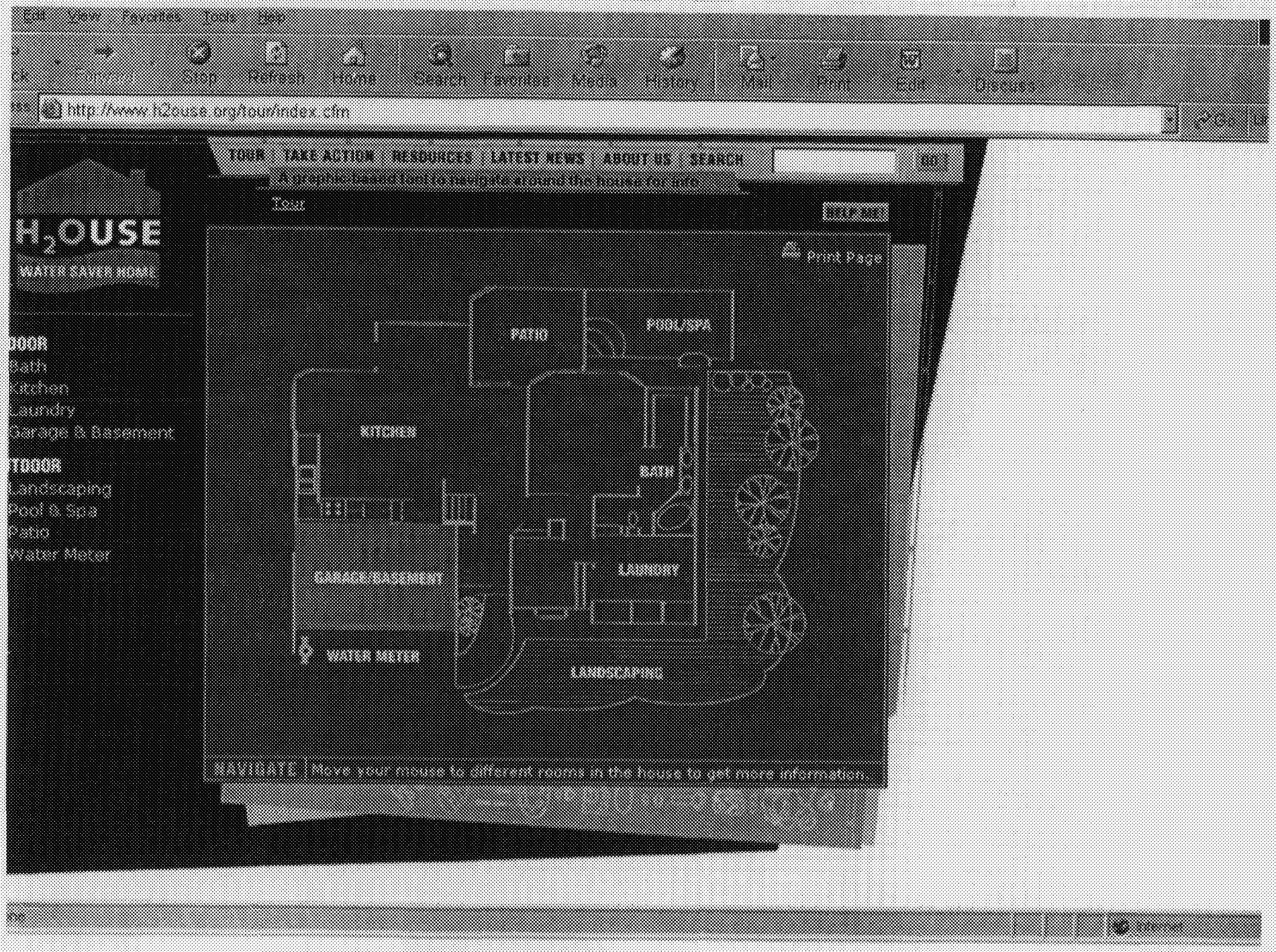
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Bath
Kitchen
Laundry
Garage & Basement
TDOOR
Landscaping
Pool & Spa
Patio
Water Meter
PATIO
POOL/SPA
KITCHEN
BATH
GARAGE/BASEMENT
LAUNDRY
WATER METER
LANDSCAPING
NAVIGATE
Move your mouse to different rooms in the house to get more information.
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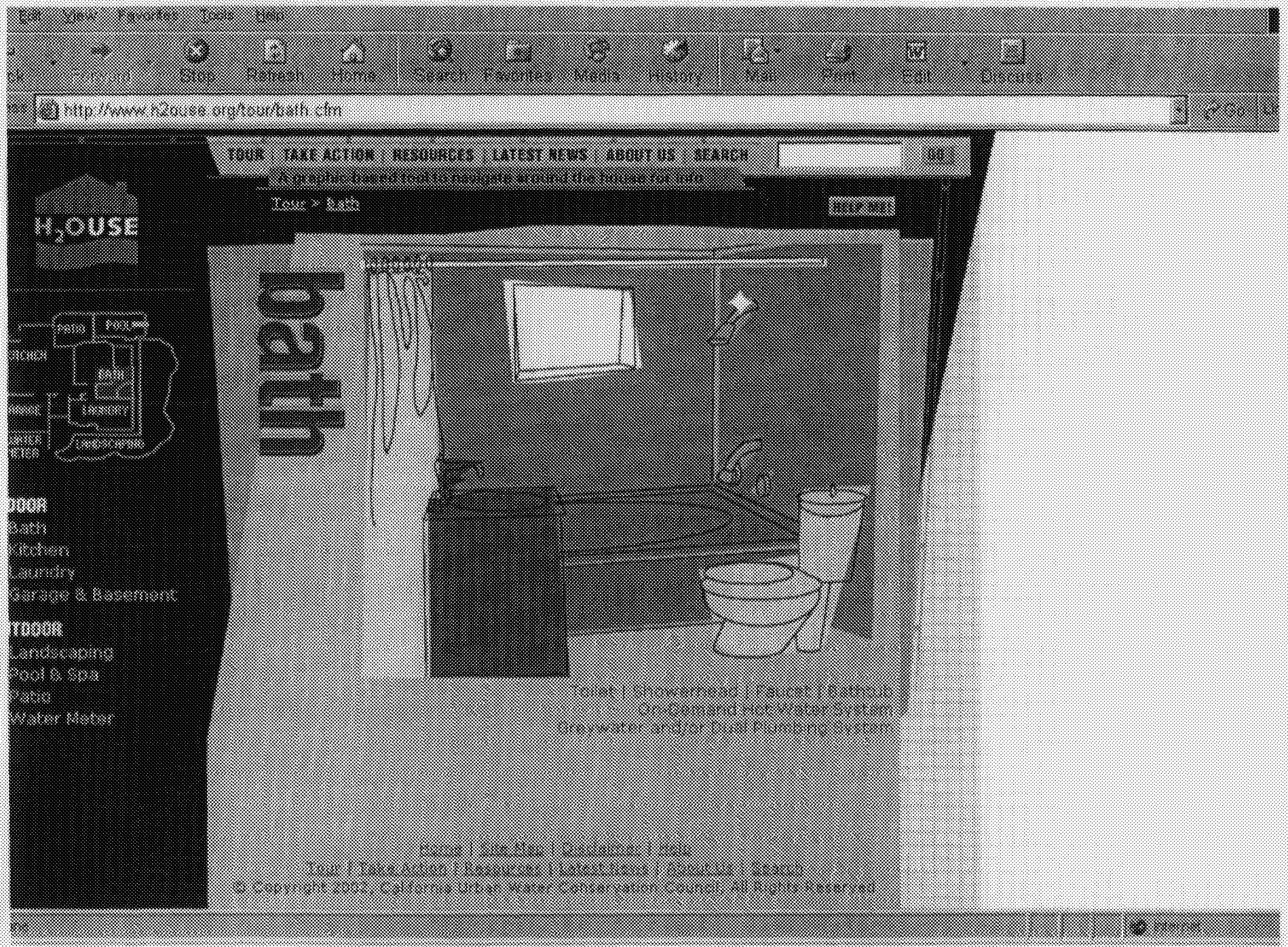
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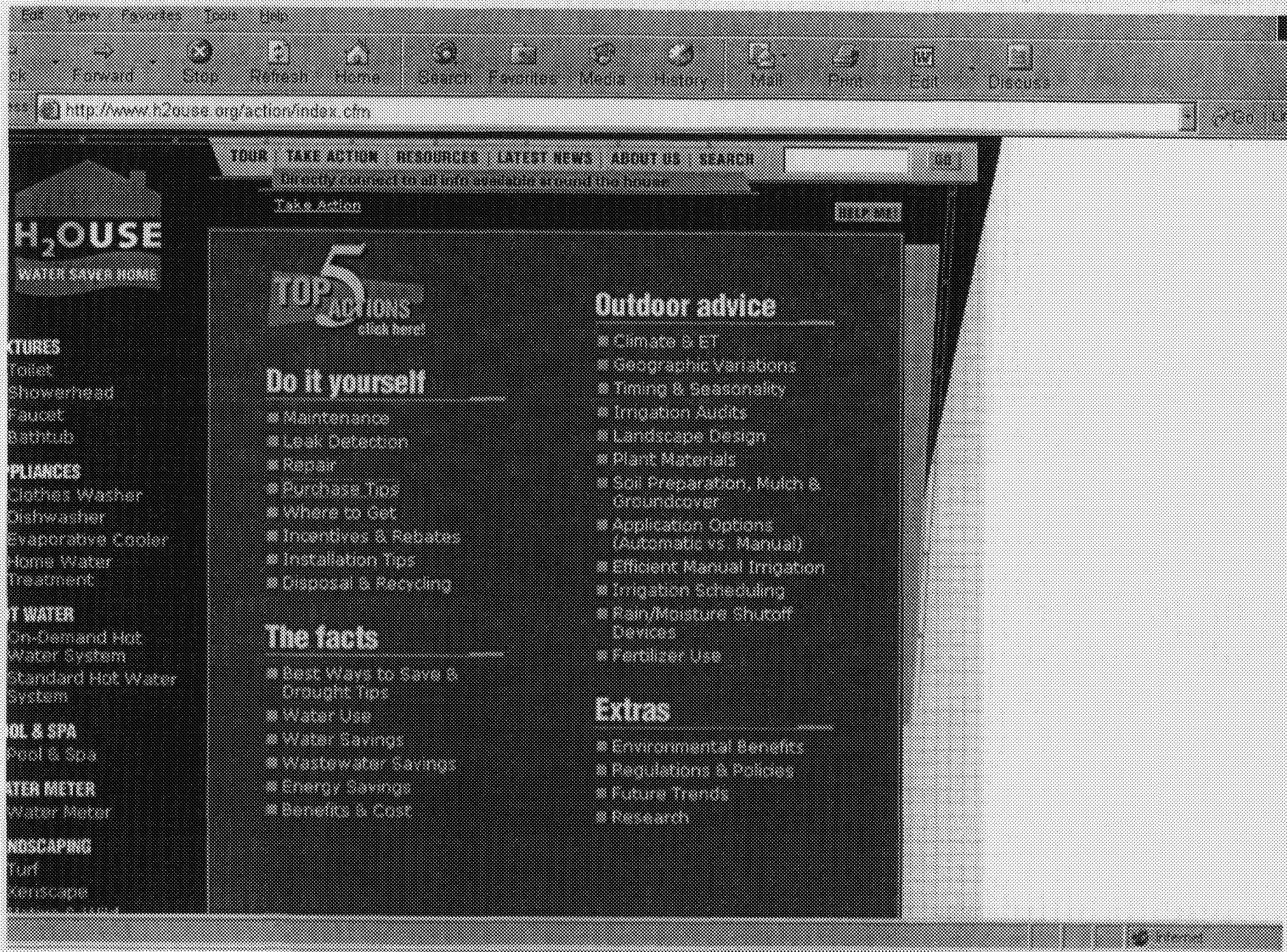
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Where to Get
Incentives & Rebates
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Best Ways to Save & Drought Tips
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Water Savings
Wastewater Savings
Energy Savings
Benefits & Cost
Outdoor advice
Climate & ET
Geographic Variations
Timing & Seasonality
Irrigation Audits
Landscape Design
Plant Materials
Soil Preparation, Mulch & Groundcover
Application Options (Automatic vs. Manual)
Efficient Manual Irrigation
Irrigation Scheduling
Rain/Moisture Shutoff Devices
Fertilizer Use
Extras
Environmental Benefits
Regulations & Policies
Future Trends
Research
Toilet
Showerhead
Faucet
Bathtub
Clothes Washer
Dishwasher
Evaporative Cooler
Home Water Treatment
On-Demand Hot Water System
Standard Hot Water System
Pool & Spa
Water Meter
Turf
Xeriscape

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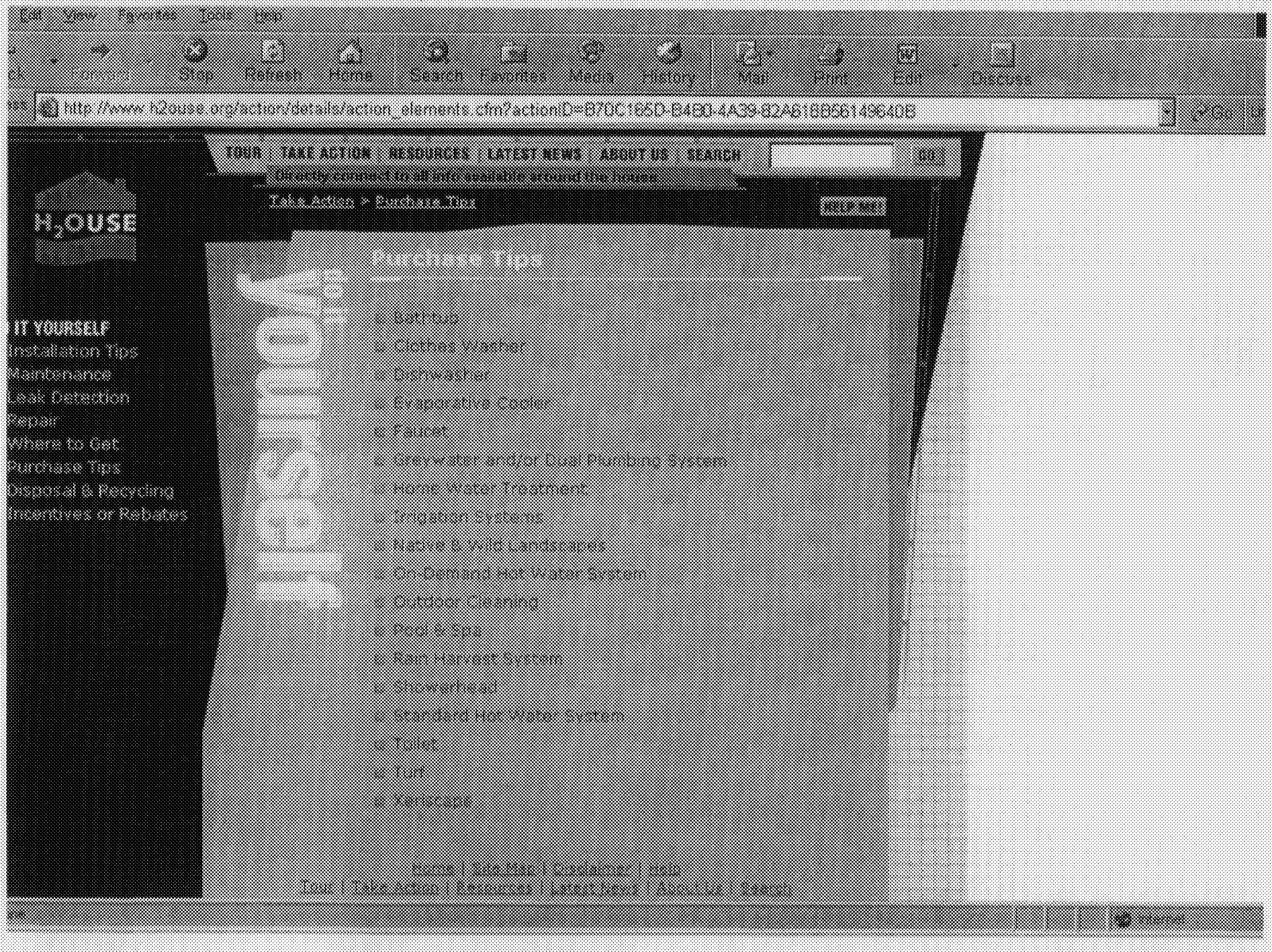
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Clothes Washer
Dishwasher
Evaporative Cooler
Faucet
Greywater and/or Dual Plumbing System
Home Water Treatment
Irrigation Systems
Native & Wild Landscapes
On-Demand Hot Water System
Outdoor Cleaning
Pool & Spa
Rain Harvest System
Showerhead
Standard Hot Water System
Toilet
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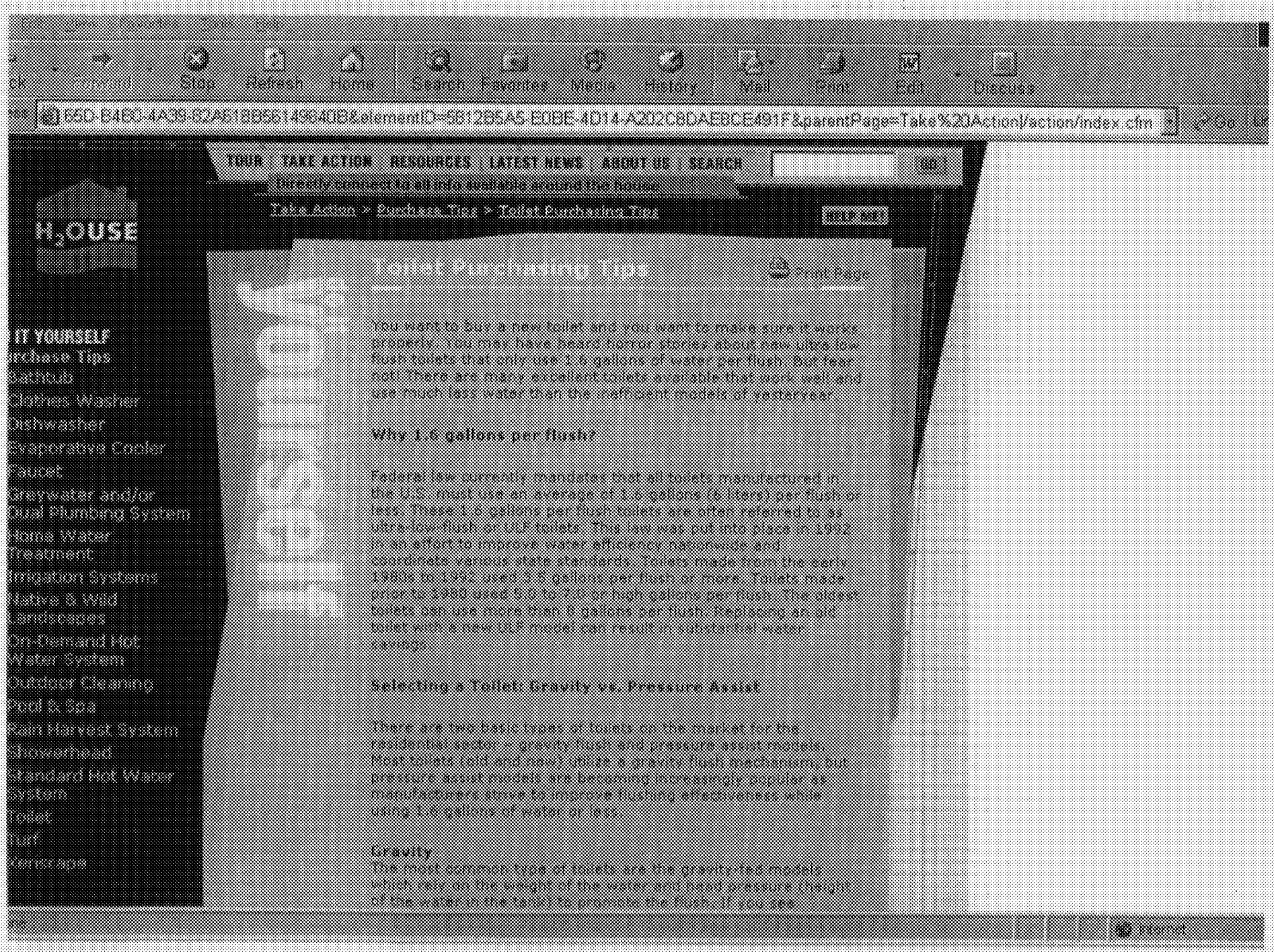
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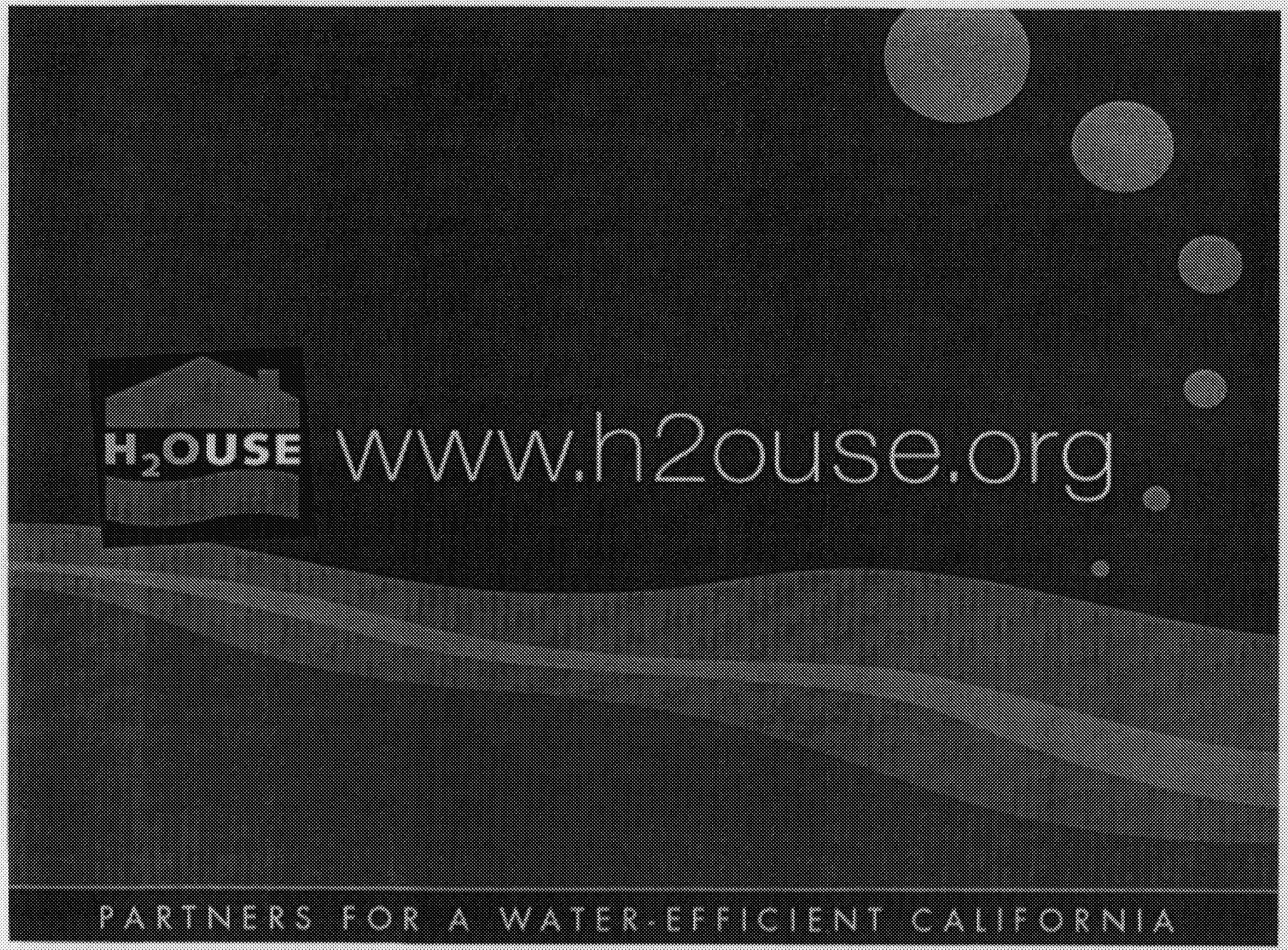
Faucet
Greywater and/or Dual Plumbing System
Home Water Treatment
Irrigation Systems
Native & Wild Landscapes
On-Demand Hot Water System
Outdoor Cleaning
Pool & Spa
Rain Harvest System
Showerhead
Standard Hot Water System
Toilet
Turf
Xeriscape
Toilet Purchasing Tips
Print Page
You want to buy a new toilet and you want to make sure it works properly. You may have heard horror stories about new ultra low flush toilets that only use 1.6 gallons of water per flush. But fear not! There are many excellent toilets available that work well and use much less water than the inefficient models of yesteryear.
Why 1.6 gallons per flush?
Federal law currently mandates that all toilets manufactured in the U.S. must use an average of 1.6 gallons (6 liters) per flush or less. These 1.6 gallons per flush toilets are often referred to as ultra-low-flush or ULF toilets. This law was put into place in 1992 in an effort to improve water efficiency nationwide and coordinate various state standards. Toilets made from the early 1980s to 1992 used 3.5 gallons per flush or more. Toilets made prior to 1980 used 5.0 to 7.0 or high gallons per flush. The oldest toilets can use more than 8 gallons per flush. Replacing an old toilet with a new ULF model can result in substantial water savings.
Selecting a Toilet: Gravity vs. Pressure Assist
There are two basic types of toilets on the market for the residential sector – gravity flush and pressure assist models. Most toilets (old and new) utilize a gravity flush mechanism, but pressure assist models are becoming increasingly popular as manufacturers strive to improve flushing effectiveness while using 1.6 gallons of water or less.
Gravity
The most common type of toilets are the gravity-fed models which rely on the weight of the water and head pressure (height of the water in the tank) to promote the flush. If you see
Internet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# Why Water Conservation?

## Its Multiple Benefits for Jordan

Mary Ann Dickinson
Executive Director
California Urban Water Conservation Council

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# Common Perceptions About Water Conservation

- It doesn't work
- It may work, but it's too expensive
- It may work and may be cheaper than buying other water, but it's not reliable
- It may work, may be cheaper, may be reliable, but it's not popular with our customers

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# The Reality

- Major new products and appliances
- Efficiency laws and regulations on Federal, State, and local levels
- Incentive funding from wholesalers and regulatory agencies
- Strong community support
- Technical assistance available everywhere

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# Conservation's Many Faces

- Drought Tool: short-term relief
- Planning Tool: lessen gap between demand and available supply
- Economic Tool: defer capital facilities for drinking water and wastewater treatment
  - e.g. US will spend a quarter trillion dollars by the year 2020

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# Federal Incentives

- 1992 Energy Policy Act plumbing efficiency standards

| Fixture | U.S. Standard | Metric Equivalent |
|---|---|---|
| Water Closets (Toilets) | 1.6 gallons per flush | 6 liters per flush |
| Showerheads | 2.5 gallons per min | 9.5 liters per min |
| Faucets | 2.2 gallons per min | 8.3 liters per min |
| Urinals | 1 gallon per flush | 3.8 liters per flush |

- Drinking Water and Wastewater SRF Funds

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# National Activity

- Over 15 State Conservation Programs
  - Planning Requirements and Permit Hooks
  - Implementation of specific programs
- Arizona; California; Colorado; Connecticut; Florida; Kansas; New Jersey; New Mexico; Oregon; Texas; and Washington State
- Seattle, Boston, New York City, Los Angeles, San Diego and Las Vegas

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# How Much Can Be Saved?

- 1998 AWWARF Study of residential end uses in 1300 homes in twelve cities using data-loggers
- *Without conservation*, the household used on average 64.6 gallons per capita per day
- *With conservation*, the per capita per day figure is reduced to 44.7 gallons, or 30% savings



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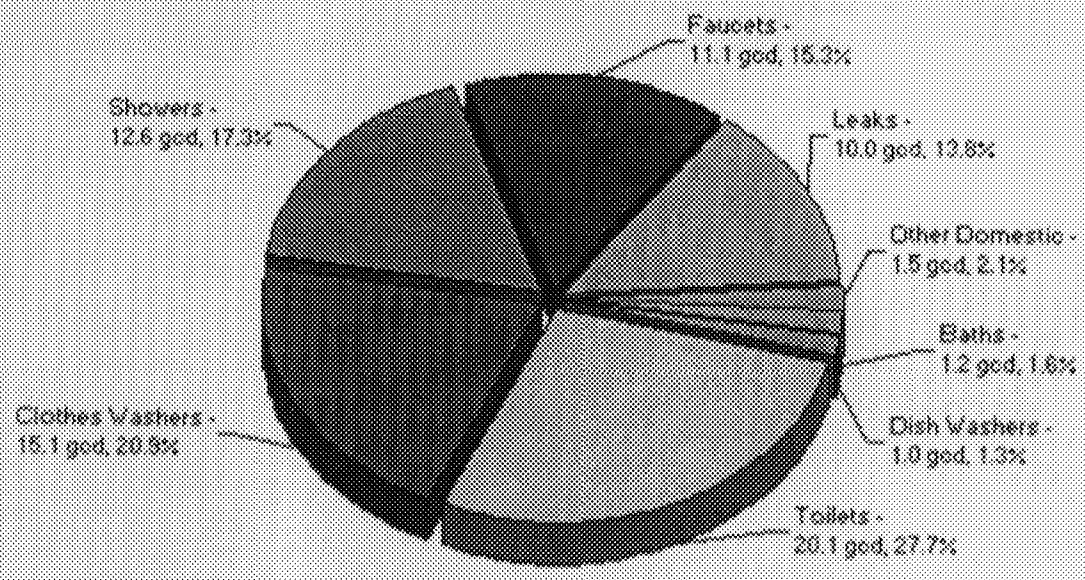
# Without Efficiency Measures

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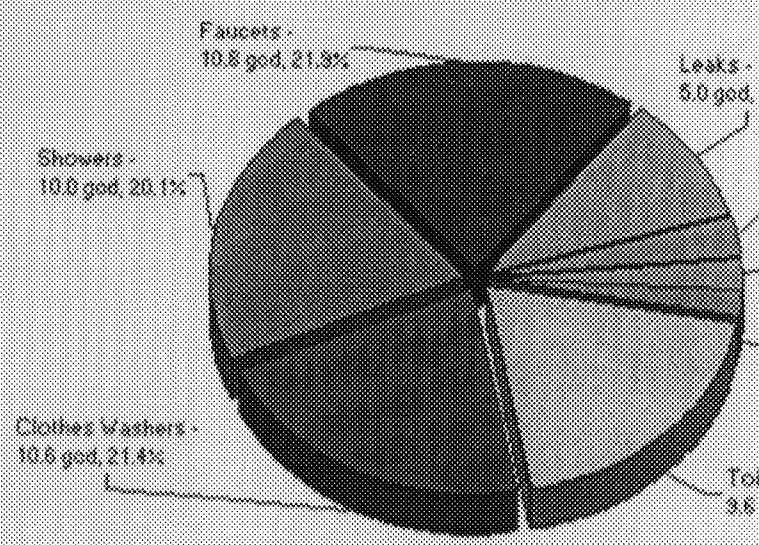
# With Efficiency Measures: 30% savings

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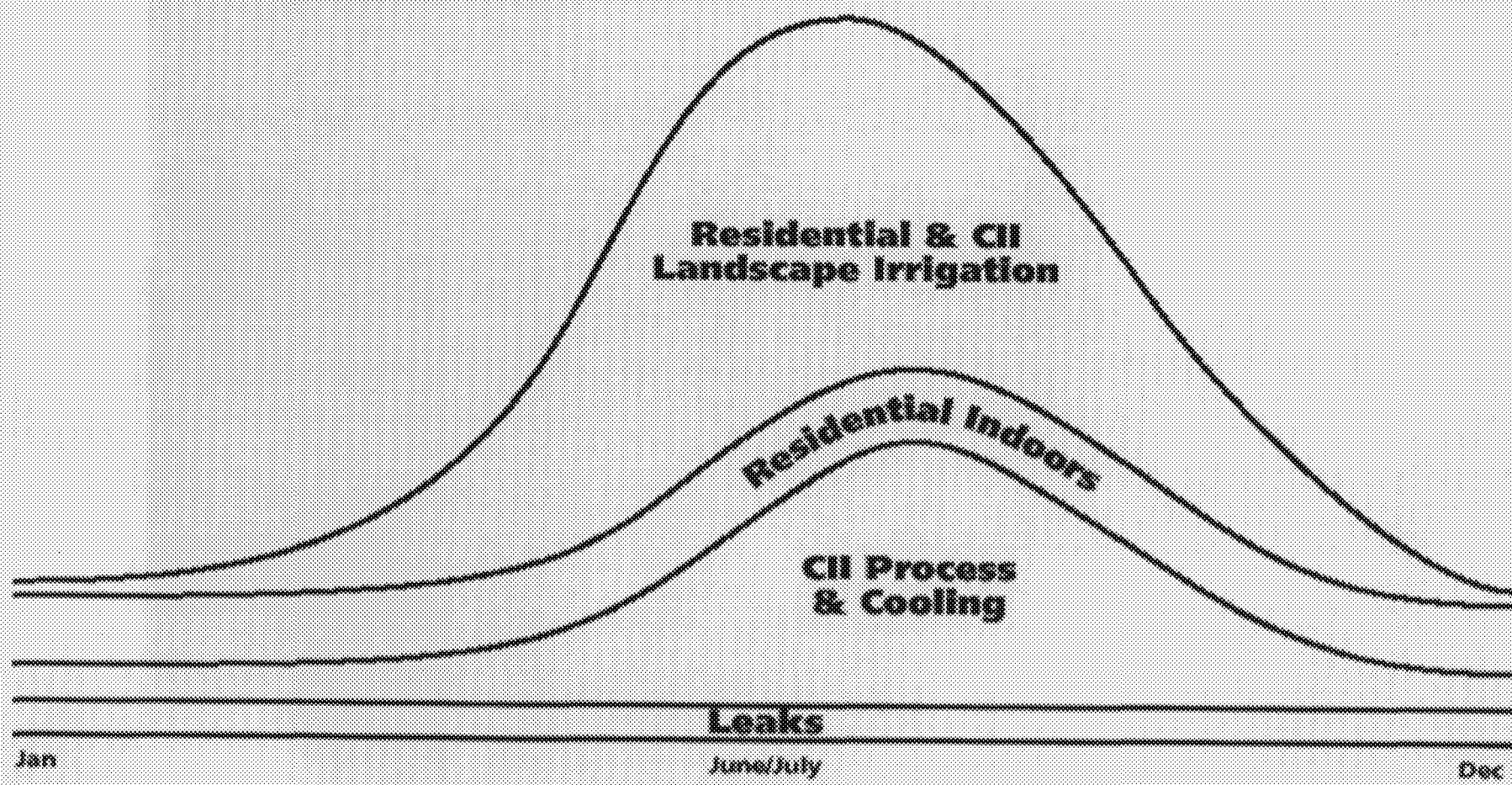
# Uses for Water Savings

PROVIDING UTILITY SYSTEM VALUE

- Flattening the demand peak to reduce the need for water supply and treatment investment to meet an artificially high peak
- Satisfying the demands of new growth without needing additional capital investment for supply and treatment

# Water Demand Curve



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# Uses for Water Savings

## RESTORING ENVIRONMENTAL VALUES

- Maintaining the habitat along rivers and streams and restoring fisheries with increased flows
- Protecting groundwater supplies from excessive depletion from overpumping or contamination from excessive landscape irrigation runoff



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# More Uses for Water Savings

- Reducing the volume of wastewater discharges to rivers and streams
- Reducing excessive runoff of urban contaminants now regulated under TMDLs
- Restoring the natural values and functions of wetlands and estuaries impacted by excessive water supply withdrawals
- Reducing green waste from landscaped areas

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# California's "BMPs"

- State of the art conservation programs defined as "Best Management Practices"
- California's list is typical of water conservation programs typically being implemented around the country
- Standardizes the "bottom line" for all water utilities
- Now voluntary, soon to be mandatory

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# So Where Do You Start?

- Analyze your system needs and pinpoint where you most need your savings targeted
- Evaluate your water users
- Determine a baseline set of data
- Draw up a conservation plan and budget
- Justify the economics
- Plan for long-term savings evaluation that is comprehensive and statistically defensible

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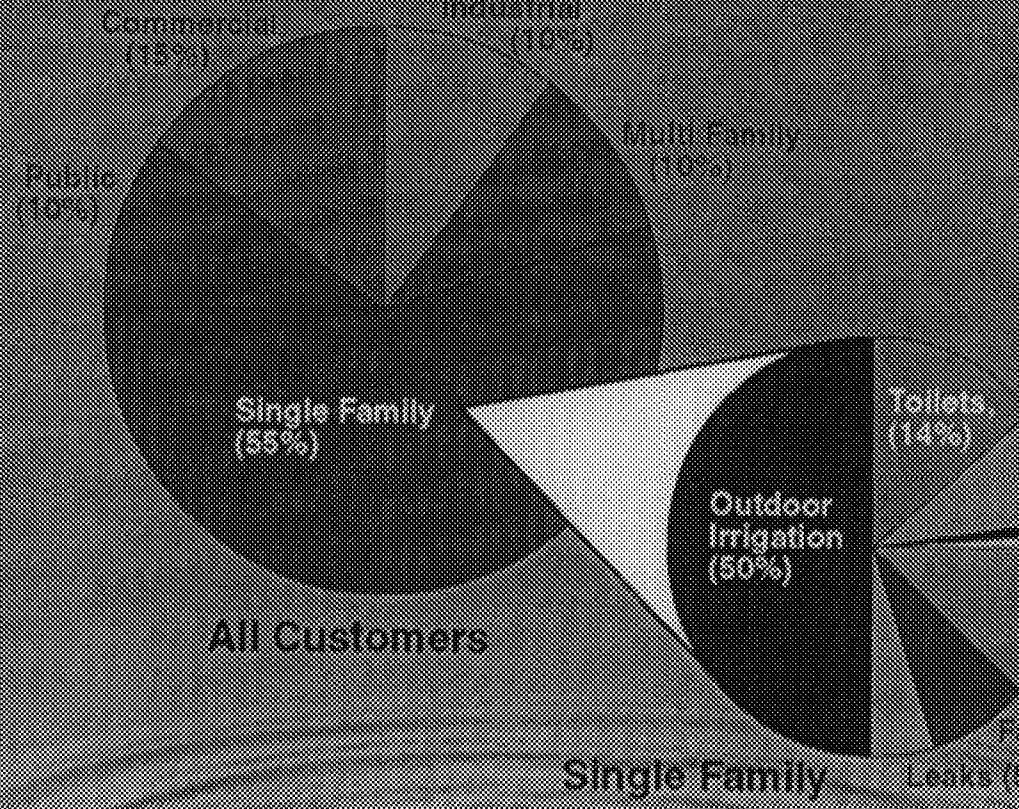
# Urban Water Uses
## An Example

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# First Steps Are Free

## Designate A Conservation Coordinator

- Designate responsibility within agency to an individual identifiable to the public

## Prohibit Obvious Water Wastage with Simple Ordinances

- Enact and enforce local ordinances prohibiting gutter flooding, single-pass cooling, non-recirculating systems in car washes and commercial laundries, non-recycling decorative fountains

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# Educate the Public

## Public Information Programs

Provide speakers, advertising, and other information to promote water conservation

## School Education Programs

Work with school districts by providing materials for water conservation instruction

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# Next Steps

## Audit Your Water System and Repair Leaks

- Conduct system audit when sum of sales divided by gross water production is less than 90%
- Monitor water delivery system for leaks and make cost-effective repairs

## Meter With Commodity Rate

- Meter all new connections and bill by volume
- Retrofit unmetered connections
- Consider installing dedicated landscape meters

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# Next Steps

## Explore Conservation Rate Pricing

- Adopt water rates that provide an incentive to customers to reduce average or peak use
- If utility provides both water and sewer service, apply conservation pricing to both

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# Typical Residential Programs

## Conduct Residential Audits

- Offer residential customers water-use surveys which include checking for leak, flow rates, irrigation systems and schedules. Try contacting 20% of your customers each year to offer surveys. Offer incentives and devices.

## Retrofit Residential Plumbing

- Best when tied to the audit program.
- Provide 2.5 gallon-per-minute showerheads and aerators and toilet displacement devices.

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# More Residential Programs

## Replace Old Toilets with ULFTs

- Implement a program to replace high-water using toilets with 1.6 gallon per flush models

## Retrofit High-Efficiency Washers

- Provide rebate to encourage purchase of high-efficiency clothes washing machines
- New national standard taking effect in 2007

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# Large User Programs

## Examine the Commercial, Industrial, Institutional Accounts

- Identify and rank customers in each customer class
- Retrofit high-water using toilets and clothes washers
- Look at high water using processes for possible efficiency improvements (cooling towers, one-through cooling, etc.)

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# More Commercial &Industrial

## Examine Large Landscape Accounts

- Encourage dedicated landscape meters; assign a yearly or adjusted monthly water budget of ~100% ETo
- Tie water budgets into rates for penalties
- Explore new irrigation technologies
- Offer incentives to minimize irrigation needs
- For mixed-use meters; offer surveys to 20% of customers

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# And Lastly....

## Wholesale Agency Assistance

- Provide financial incentives
- Provide technical support

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# Is Conservation Affordable?

- Conservation Programs typically cost between $0.40 and $1.40 per 1,000 gallons, depending upon the program
- Most utilities facing paying more than $1.40 per 1,000 gallons to develop new supply
- Conservation should be automatic for the utility where the utility's avoided cost of water is HIGHER than the cost per unit of the conservation program (or where B/C ratio is 1 or greater)
- Conservation should be capitalized like supply to reduce rate impacts

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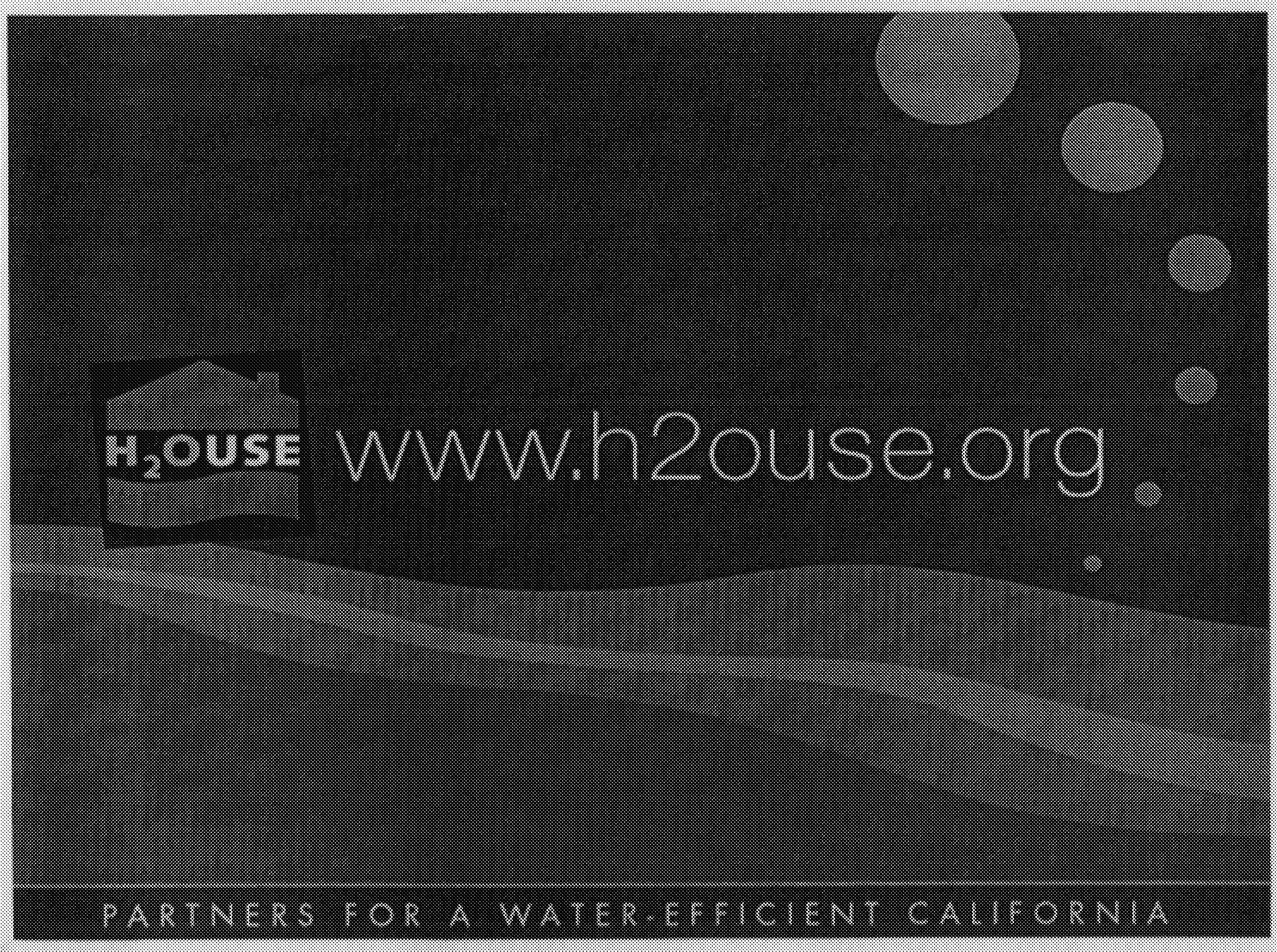
# Final Messages

- Conservation is a positive program
- Every dollar spent on water efficiency yields multiple benefits statewide
- It will ALWAYS be the cheapest new water you can buy if you consider the full acquisition costs
- Consider capitalizing your conservation programs to reduce rate shock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