



Evaluation of Potential Best Management Practices - X-Ray Film Processor Recycling Units

Prepared for

The California Urban Water Conservation Council

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V. X-Ray Film Processor Recycling Units

1. Background

Processing Film

Large-scale X-ray film processing (developing) with current technologies uses large amounts of water to rinse chemicals from the film and to cool the processing equipment²⁰. X-ray film processing in medical applications represents a significant opportunity for new technologies to reduce or eliminate water use. One of those technologies is the application of water recycling to the process equipment.

Medical Applications

X-ray film processors are used throughout the medical industry by doctors, hospitals, imaging centers, health and medical clinics, chiropractors and veterinarians. Processing equipment comes in a variety of sizes to suit the individual needs of the practitioners.

The largest user of processors is hospitals. Most hospitals in the U.S. have a number of medical x-ray film processors operating 24 hours per day, 365 days per year. The larger hospitals may possess over a dozen of these units. Processors generally use a constant flow of water to cool the machine and develop the film. Published flow rates for this equipment range from as little as 0.25 to as high as 2.5-gallons per minute (gpm)²¹ of fresh water, all of which is directed to drain.

Most smaller facilities (such as those found in doctors' offices) use processors that do not operate in a constant flow mode, use very small amounts of water, and are not considered within this analysis.

In the mid-1990s, C&A X-Ray developed a water recycling process and system that captured the water in the larger processors and recirculated it back through the unit. Consisting of a small reservoir, a pump, and an algicide dispenser, the Water Saver/Plus™ (patented by C&A X-Ray) is being marketed entirely to the medical sector, although other industrial x-ray applications do exist.

Conversion to Digital Technology

The use of film processors in the medical sector is gradually declining, as new digital imaging technology for radiography becomes cost-effective and gains presence in the market. Digital technology will eventually provide better images at lower cost than X-ray films.

²⁰ Irvine Ranch Water District, Dale Lessick, *Converting X-Ray Machines from Water Pass-Through to Recirculating*, no date.

²¹ C&A X-Ray, *Published Water Flow Rates for Medical X-Ray Processors, Revised December 8, 2000*, found on the website: www.caxray.com/flow_rates.html

The investment required to convert to the newer digital technology is significant and comes at a time when the entire medical sector is experiencing severe constraints on capital and operating costs. Furthermore, new seismic requirements in California are forcing a large number of hospitals to perform major facility retrofits or abandon their existing facilities and construct new ones. Seismic retrofits and new hospital construction are allowing hospitals to install the necessary wireless and other systems that enable the use of digital technology. This may speed the elimination of conventional film processing in many hospitals.

Within 10 years, many expect that digital imaging will prevail in all of the larger medical facilities in California, potentially meaning that the Water Saver/ Plus™ and similar technologies will have a shrinking customer base.

Other Non-Medical Film Processing Applications

Other possible applications for the recycling units, such as Water Saver/ Plus™, include industries of metal plating, fabrication and assembly; defense and aerospace manufacturing; medical and scientific research; electronics; commercial graphics operations; and other similar sectors employing film processors for their work.

Useful Life

Authoritative data does not currently exist on the expected useful life of the Water Saver/ Plus™ unit, although the water agencies currently underwriting incentives for this equipment have assumed lifetimes of between 5 and 20 years. With the conversion of facilities to digital radiography, however, the real economic life (and the accrued water savings) should probably be limited to a maximum of five years.

2. Water Savings Estimates and Projections

Over a period of approximately three years, water agencies have conducted a number of independent analyses of the water-saving benefit of the Water Saver/ Plus™ technology. In particular, three separate sets of investigation reveal valuable information:

Metropolitan Water District (MWD) Innovative Conservation Program (ICP)

The ICP included the field measurement of water use at eight Water Saver/ Plus™ installations in three hospitals in the region. The savings measured over the study period for these installations were as follows²²:

²² Metropolitan Water District of Southern California, *Innovative Conservation Program, Water Saver/Plus™ Recycling System, Final Report*, September 18, 2001.

Hospital/Medical Facility	No. of Film Processing Units Metered & Retrofitted	No. of Licensed Beds²³	Metered Savings/Unit (per week)	Estimated Annual Savings/Unit (acre-feet)
Pacific Alliance Medical Center, Los Angeles	3	138	20,175 gallons	3.22
California Hospital Medical Center, Los Angeles	4	313	21,085 gallons	3.36
Irvine Regional Medical Center, Irvine	1	176	19,270 gallons	3.07

The result of the ICP study of X-ray film processing installations resulted in MWD offering a \$2,000 rebate within its regionwide commercial-institutional program for retrofits in larger hospitals.

Los Angeles Department of Water and Power (LADWP)

The LADWP has encouraged the installation of the water-saving technology in a large number of installations in the city; to date, 70 Water Saver/ Plus™ units have been incented in the City of Los Angeles. In some cases, LADWP has added additional incentives to the \$2,000 MWD rebate for specific retrofit installations where water savings are high. Following are those 30 installations (out of the total of 70) within the City of Los Angeles where actual water use data was gathered by LADWP²⁴.

Hospital/Medical Facility	No. of Film Processing Units Metered & Retrofitted	No. of Licensed Beds²³	Metered Savings/Unit (per week)	Estimated Annual Savings/Unit (acre-feet)
Good Samaritan Hospital	14	408	14,658	2.34
Encino-Tarzana Regional Medical Center	2	387	30,947	4.94
Los Angeles County USC Medical Center	14	1,417	10,207	1.63

²³ Office of Statewide Health Planning and Development (OSHPD), *Summary of Hospital Seismic Performance Ratings*, April 2001.

²⁴ Notes supplied by Mark Gentili, LADWP.

Irvine Ranch Water District, East Bay Municipal Utility District (EBMUD), and Upper San Gabriel Valley Municipal Water District

The three agencies jointly conducted a CalFed study in 2001 and 2002 that encompassed the measurement of water use at seven installations in northern and southern California²⁵. Results reported by Irvine Ranch Water District (the lead agency) were as follows:

Hospital/Medical Facility	No. of Film Processing Units Metered & Retrofitted	No. of Licensed Beds²³	Metered Savings/ Unit (per week)	Estimated Annual Savings/ Unit (acre-feet)
Eden Township Hospital, Castro Valley	1	214	20,042	3.20
Childrens Hospital Medical Center, Oakland	1	205	15,289	2.44
San Leandro Hospital	1	122	20,861	3.33
Irvine Regional Medical Center ²⁶	1	176	14,996	2.39
Greater El Monte Community Hospital	1	117	31,426	5.01
San Gabriel Valley Medical Center, San Gabriel	1	274	25,780	4.11
Queen of the Valley Hospital, West Covina	1	Not avail	23,514	3.75

The overall weighted average for all 45 hospital installations in the preceding three tables was 2.57 acre-feet of annual savings for each metered retrofit.

Metering projects to date have been focused entirely on larger hospitals with high film processing throughput. It is these facility categories that represent the largest opportunities for water efficiency. Other opportunities may exist at smaller, less-active medical establishments, such as emergency care facilities, medical clinics, doctors' offices, and the like. However, no studies of film processor retrofits at these facilities have yet surfaced.

Most of the film processing units that are being retrofitted with the Water Saver/ Plus™ already contain automatic shut-offs that would terminate the flow of water when the unit is not operating. However, these shut-off switches rarely work due to age or lack of proper maintenance, thereby creating the retrofit opportunity for the Water Saver/ Plus™. As such, properly maintained film processors would normally function at lesser flow rates than those experienced in the metering projects itemized above. Consequently, water savings would be less than that shown.²⁷

Finally, the Water Saver/ Plus™ manufacturer calls for certain periodic maintenance of the system over and above that normally required for the film processor itself. It is critical that operators rigorously follow the periodic maintenance schedule in order to assure that the water

²⁵ Irvine Ranch Water District (lead agency), *Quarterly Progress Report #3, Contract No. 460000-1587*, dated July 2002 (Note: This report was deemed to be the final report by the other participating water agencies.)

²⁶ This is the second of two units installed at the Irvine Regional Medical Center, the first being under the MWD Innovative Conservation Program.

²⁷ Personal communication, Mark Gentili, LADWP.

savings are sustained throughout the unit's assumed economic life. That schedule requires cleaning the unit every two weeks, which includes replacement of the algaecide within the holding tank. Without maintenance, the unit will likely fail. With declining staff at many hospitals, maintenance priorities can change and, as a result, the maintenance of the Water Saver/ Plus™ could suffer.

3. Product and Program Cost

The Water Saver/ Plus™ costs from \$4,000 to \$5,000, including tax and installation. As reported in the Council's Cost and Savings Update Draft²⁸, costs to operate and maintain the unit are approximately \$1,300 per year²⁹. Maintenance is a service offered by C&A X-Ray.

Program costs to reach end-users³⁰ vary according to the incentives offered and the type of program undertaken. Individualized outreach to hospital facilities administrator (or the radiography department) by the vendor, when in partnership with water agency personnel and their associated financial incentives, has proven successful for some of the larger water agencies such as LADWP, EBMUD, and MWD.

4. Cost Effectiveness

With an estimated water savings in large medical facilities of approximately 2.57 acre-feet of water per year and a physical (useful) life of 10 years, aggregated savings would amount to about 25 acre-feet per installed unit. However, with the likely replacement of existing high volume film processors with digital radiography, an economic life of no more than 5 years should be assumed. Accrued savings over 5 years, then, would average around 13 acre-feet. At an assumed program cost of \$2,500 per retrofit (typical of the MWD regionwide program³¹), water savings can be expected to be achieved by the water agency at a cost of about \$195 per acre-foot, generally below the cost of new supply.

From the viewpoint of the end-user, the water savings achieved through the installation of the Water Saver/ Plus™ in a large medical facility potentially yields two significant benefits: reduced water consumption and reduced flows to the sanitary sewer. Depending upon the frequency and timing of film processor use, peak flows could be reduced as well.

Because water and sewer rates vary significantly throughout the state, the economic benefits would likewise vary. Over a range of rates, however, the assumed costs of retrofit (\$2,500) could reasonably be shown to be recovered within one year, as seen in Figure 2.

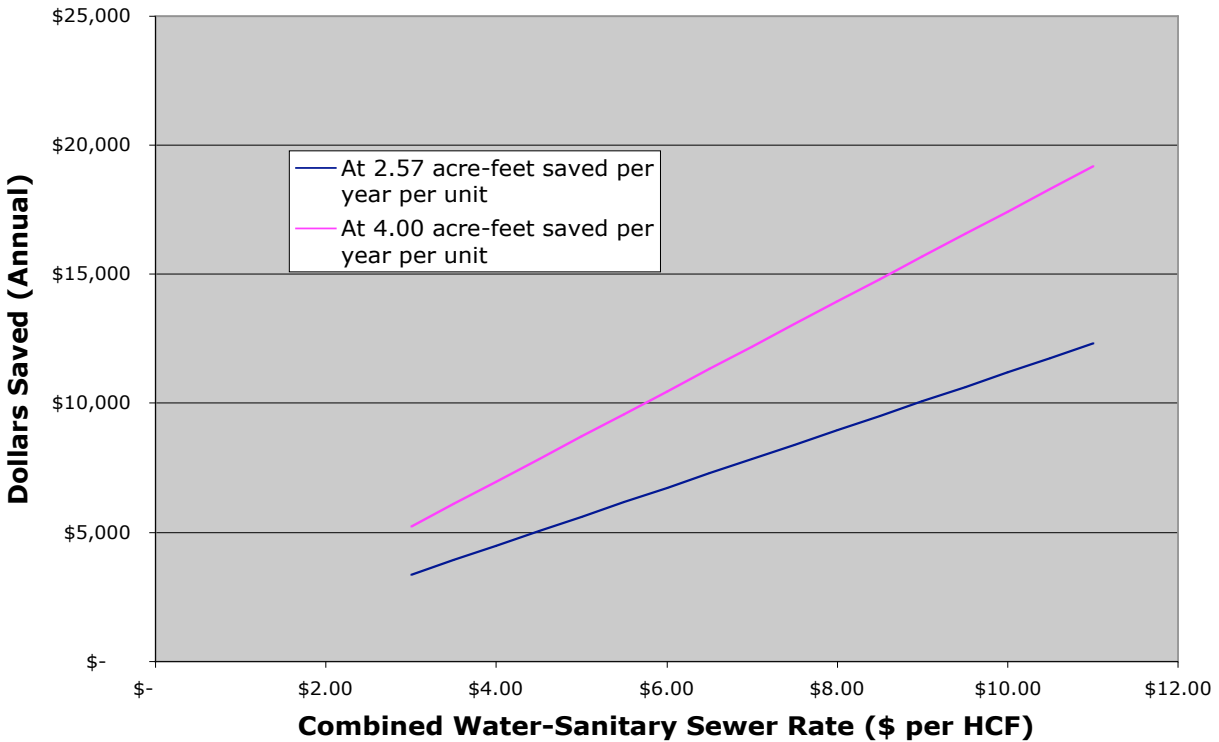
²⁸ Draft of December 2003.

²⁹ These costs are in addition to the normal maintenance costs associated with the film processor itself.

³⁰ In reality, the end-users, and frequently the decision-makers in the medical facility, are the managers of the radiology operations, not necessarily the hospital facility administrator. Because of the very specialized interests of this group, program outreach can be somewhat more difficult and less effective.

³¹ Personal communication, Bill McDonnell, Metropolitan Water District.

Figure 2. Customer's Water-Related Utilities Cost Savings from Water Saver/Plus at Various Combined Water-Sewer Rates



5. California Potential

The distributor of the Water Saver/ Plus™, C&A X-Ray, has prepared very rough estimates of the number of film processors that would represent retrofit candidates. For example, 14 California hospitals³² under the auspices of Catholic Healthcare were identified by C&A as having a total of 70 heavily used processors that could yield water savings averaging 2.42 acre-feet per year per retrofit³³.

California's OSHPD licenses slightly in excess of 2,500 hospitals in the state; those hospitals contain approximately 90,000 licensed beds²³. Assuming that the distribution of film processors in California is generally proportionate to licensed bed count, and that the distribution found in the 14 Catholic Healthcare facilities is representative, the total number of film processors as candidates for retrofit in California would approximate 1,400.

Completion of these 1,400 retrofits could be expected to yield about 3,500 acre-feet of water savings annually³⁴.

³² The 14 hospitals were situated throughout the state and ranged in licensed capacity from 76 beds (one installed film processor) to 531 beds (9 installed film processors). Total licensed capacity for all 14 facilities was 4,438 beds. These inventory of installed processors includes only those that were retrofit candidates. Of the 70 processors, 28 had already been installed at the time of the assessment.

³³ C&A X-Ray, *Grand Totals – Projected Annual Water and Cost Savings, Catholic Healthcare*, August 14, 2003.

³⁴ Based upon the range of 2.42 to 2.57 acre-feet of water savings per retrofit.

It must be noted that these water savings are achievable only if the Water Saver/ Plus™ unit is rigorously maintained. In addition, the reluctance of some radiology departments to invest in a disappearing technology (i.e., film processors), coupled with space limitations in the typical radiology facility, may make the achievement of these water savings somewhat unrealistic.

In conclusion, the short “opportunity window” of five to 10 years before a water-efficient technology takes over makes X-ray film processor retrofits an unlikely candidate for full BMP status. As such, we do not recommend that they be included within the PBMP list.