The Payoff of Recycling Nursery Water

Creative sourcing and responsible treatment helps Altman Specialty Plants realize savings in recycling its irrigation runoff water.

By Bruno J. L. Pitton, Lorence R. Oki, Darren L. Haver and Grant E. Johnson

Is there potential for interruption in your water supply that will delay or reduce crop production? Is your water supply becoming more expensive? Are regulations on the water discharged from your operation becoming more difficult to meet? Or do you see water as a precious resource leaving your operation, and would like to capture it for reuse? Altman Specialty Plants was concerned about interruption in the supply and the increasing cost of the municipal water they relied on, so an irrigation runoff capturing system was built to address these concerns.

Altman Specialty Plants (ASP) grows at seven nurseries in the United States, including three in California. One container nursery site is located in Lake Mathews, within the "Inland Empire" of Southern California, where a favorable plant production climate allowed the citrus industry to flourish during the last century. However, water is scarce in this area, where the 30-year average precipitation is about 12 inches per year and during the recent four-year drought, average precipitation was approximately 6 inches per year at nearby University of California, Riverside. The majority of precipitation occurs in the winter months with the bulk of the 50 inches of yearly evapotranspiration occurring in summer. ASP in Lake Mathews grows color, seasonal products, and woody and herbaceous ornamentals, including the drought-tolerant Smart Planet™ line, on 157 acres of indoor and outdoor space.

All images courtesy of Bruno J. L. Pitton

Supply and demand

The nursery's water supply is untreated municipal water provided by the Western Municipal Water District (Western) via the Metropolitan Water Board of Southern California (Metropolitan). The water provided by Western is predominantly from the terminus of the Colorado River Aqueduct with a smaller portion from groundwater. The water chemistry can vary, but typically has an electrical conductivity near 1 dS/m and is alkaline (see Table 1). The nursery has no alternative water source (wells, irrigation district, and so on), and an interruption in Western water could cause serious production problems.

In water years (October 1 to September 30) 2013 and 2014, the nursery used 984 and 1,031 acre feet (ac-ft), respectively, amounting to approximately 3.7 percent of the total volume of water provided to customers by Western. During WY2013-2014, water cost between $706 to $825 per ac-ft with fixed monthly charges between $122 to $175. The total water bill for WY2013-2014 combined was $1.6 million. Needless to say, water is a large cost for container plant production at ASP in Lake Mathews.

In 2011, before the most recent drought in California, ASP began looking into a water recycling system to both save money and prevent delays or reduced production if the water supply from Western was interrupted for a short period of time (less than 1 week). Initially, ASP looked at the overall design of the nursery to ensure that existing and future development would facilitate capturing and recycling runoff.

In 2012, ASP began discussions with the National Resource Conservation Service (NRCS) about designing and engineering the runoff and recycling ponds at the nursery and potential grant funding. The design included two ponds and a runoff channel for water capture and storage. The original estimated costs of the recycled water system totaled $750,000, and ASP turned to the water providers for rebates to help offset the cost. Metropolitan and Western authorized a maximum of $358,000 and $100,000, respectively, based on amount of water saved and a percentage of the infrastructure costs, to be paid out over several years through Metropolitan's Water Savings Incentive Program. ASP anticipated reusing 230 ac-ft (75 million gallons) in the first year. The NRCS Environmental Quality Incentives Program provided $195,000 in grants for infrastructure costs (see Table 2).

How it's structured

Two lined ponds were installed at the nursery: A 10 ac-ft lower pond (see Figure 1) captured irrigation runoff, and a 27 ac-ft upper pond served as the major reservoir. Water from the lower pond is pumped at 1,000 gallons/minute to the upper pond via two 40-hp pumps. Water is pumped from the upper pond for irrigation via two 125-hp variable frequency drive pumps with a max flow rate of 5,500 gpm. A remnant pond, into which growing areas originally drained, was saved to slow water flow and increase sedimentation. A half-mile-long channel designed by the NRCS to handle a 25-year flood event was built to connect the remnant pond to the lower pond. This trapezoidal runoff channel was built with a 1-in-3 slope on the sides to eliminate the need for fencing along its length.

The drainage channels are lined with polyethylene sheeting to prevent infiltration water losses and covered with polypropylene weed barrier to delay UV degradation and physical protection of the polyethylene. All growing areas are covered in weed barrier, and half of those areas have polyethylene sheet below to maximize irrigation runoff capture.

Figure 1. Map of Altman Specialty Plants and locations of water runoff capturing system features. Poly-lined growing areas maximize runoff capture. The remnant pond captures sediments and the channel directs runoff to the lower pond. Water is then pumped to the upper storage pond. For scale, the runoff channel from the remnant pond to the lower pond is approximately a half-mile long.
Figure 2. (Opposite page) A growing bed covered with weed barrier. The bed is sloped so irrigation water flows to the center and runs into the channel (foreground).

Table 1. pH and Electrical Conductivity from 12 field measurements of district and recycled irrigation water from 8/6/2015 to 5/20/2016.

	Electrical Conductivity (dS/m)			pH		
	Average	Min	Max	Average	Min	Max
Western	1.18	0.81	1.87	8.00	6.65	9.24
Recycled	1.75	1.46	2.07	7.97	6.10	9.10

Table 2. Costs and rebates for recycled irrigation runoff water system at Altman Specialty Plants.

Recycled Water System Costs	
Pond Liner	$89,000
125- and 40-hp pumps (2 ea.)	$155,000
PVC Pipe between ponds	$30,000
Polyethylene sheeting	$112,000
Polypropylene Weed Barrier	$271,000
Labor and Misc. supplies	$243,000
Rapid Sand Filters	$30,000
Total Cost	$930,000

Grant and Rebates	
NRCS	$195,000
Metropolitan	$358,000
Western	$100,000
Total	$653,000

Benefits (Recycled water used)	
WY2015	429 ac-ft
WY2016	593 ac-ft
Total saved	$809,200

Figure 3. The majority of nursery area flows into the remnant pond that was present when the property was purchased. The concrete walled sediment trap allows for a front loader to be used for cleaning.

Figure 4. The NRCS-designed runoff channel lined with polyethylene sheeting and covered with weed barrier to transport irrigation runoff water to the lower collection pond. The channel is a half-mile long, 1 foot wide at the bottom, and was built with a 1:3 slope so the entire length doesn't need to be fenced in. It was designed to handle a 25-year rainstorm; irrigation runoff utilizes a very small part of it (left of photo).

Figure 5. The irrigation runoff water flows over cemented rocks into a 10 ac-ft lower collection pond.

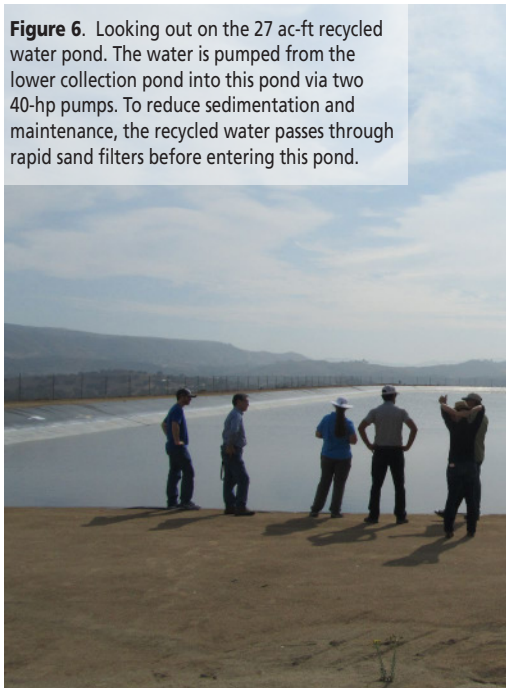

Figure 6. Looking out on the 27 ac-ft recycled water pond. The water is pumped from the lower collection pond into this pond via two 40-hp pumps. To reduce sedimentation and maintenance, the recycled water passes through rapid sand filters before entering this pond.

Costs — and savings

The final cost for the whole project totaled $930,000 (see Table 2), including one 27 ac-ft pond liner ($89,000), pumps for moving water from the lower pond to the upper pond and for irrigation ($155,000), polyethylene sheeting ($112,000) and weed barrier ($271,000) to cover beds and channels, PVC pipe between lower and upper ponds ($30,000), rapid sand filters ($30,000), and all labor involved. Construction costs exceeded the estimated $750,000 because design improvements were made and some very large boulders that obstructed the runoff channel and ponds needed to be moved. To control plant pathogens in recycled water, the nursery leases a chlorine dioxide injection system costing $82,800 per year and includes chemical costs.

The system came online in September 2014, four months before water prices increased to $944 per ac-ft and fixed charges of $210 per month. In the first 12 months (WY2015), the Lake Mathews nursery reused 140 million gallons or about 429 ac-ft, accounting for 37 percent of total nursery water use. Twice the amount of water was reused than anticipated by ASP in the first year, far exceeding goals. Reusing 429 ac-ft of irrigation runoff resulted in direct savings of $330,500, as this was water that did not need to be purchased from Western. In WY2016, the nursery reused 593 ac-ft resulting in savings of $478,700.

After a couple of years, ASP received the entire available rebate from both Metropolitan and Western totaling $458,000. With rebates from the water providers, the NRCS grant, and the savings from reduced water usage, the return on investment was less than one year and continues to pay dividends. Another benefit of pond construction is that the nursery now has a backup water supply, of approximately one week or longer, if Western infrastructure problems were to occur and water could not be delivered.

Figure 7. Two 125-hp variable frequency drive pumps for irrigating with recycled water. The max flow rate is 5,500 gpm and the VFD pumps adjust flow rate to meet real-time irrigation demand.

The quality of recycled water at ASP is lower than the water provided by Western (see Table 1), but they are still able to grow high-quality plants with this lower quality water. If source water for your operation has better quality, recycled water is unlikely to be as low in quality as ASP experiences in Lake Mathews (see Table 1).

As water becomes scarcer and more expensive, using recycled irrigation runoff water is a good option to reduce costs and ensure production is not impacted. Container plant producers are able to grow high-quality plants with it, despite the fact that recycled water may be of lower quality than other sources. Although your nursery or greenhouse operation may not realize as much savings on water costs as Altman Specialty Plants, this example highlights the benefits of recycling water for plant production.

Bruno J. L. Pitton is Staff Research Associate in the Department of Plant Sciences at the University of California, Davis; he can be reached at *bjpitton@ucdavis.edu*. Lorence R. Oki is Cooperative Extension Specialist in Landscape Horticulture and Co-Director of the UC Nursery and Floriculture Alliance at the University of California, Davis; he can be reached at *lroki@ucdavis.edu*. Darren L. Haver is Water Quality and Resources Advisor with Orange County Cooperative Extension, University of California, Irvine; he can be reached at *dlhaver@ucanr.edu*. Grant E. Johnson is Staff Research Associate with Orange County Cooperative Extension, University of California, Irvine; he can be reached at *gejohnson@ucanr.edu*.