



One Water LA calls for increased use of municipal recycled water at the Los Angeles (LA) Zoo to reduce reliance on potable water. Authors **Eliza Jane Whitman** of EW Consulting, Inc.; **Ali Poosti, Lenise Marrero**, and **Flor Burrola** of the City of Los Angeles, LA Sanitation; and **Darryl Pon** of the Los Angeles City Zoo explain some of the potential options under consideration at the LA Zoo.

Los Angeles Zoo plans drought-proof water strategy

In response to emerging challenges, such as increased water demand, new regulations, and threats of climate change, the City of Los Angeles, California, United States (US), is in the process of completing the One Water LA 2040 Plan. The Plan takes a holistic and collaborative approach to consider all water resources from surface water, groundwater, potable water, wastewater, recycled water, dry-weather runoff, and stormwater as “One Water.”

The planning effort was led by representatives from both LA Sanitation (LASAN) and the Los Angeles Department of Water and Power (LADWP) and shaped by input from other City departments, regional agencies, and local stakeholders. In efforts to improve water

quality as well as reduce the City of LA's potable water demand, One Water LA is working with the Los Angeles Zoo (LA Zoo) to identify the necessary steps to incorporate stormwater (SW) infiltration, capture, reuse, and treatment, and to increase the use of municipal recycled water (RW) at the LA Zoo.

An analysis completed by One Water LA recommends that the LA Zoo use RW from the Los Angeles-Glendale Water Reclamation Plant (LAGWRP) for operations that do not require potable water quality in order to save energy and money and decrease the consumption of potable water.

The One Water LA program provides a framework for city departments, regional entities, and stakeholders to work together

AN ESTIMATED 15,000 MP PER YEAR OF POTABLE WATER COULD BE OFFSET BY SWITCHING ALL LIFE SUPPORT SYSTEMS (LSS) – WATER TREATMENT SYSTEMS FOR WATER USED IN EXHIBITS – TO USE INFLUENT FROM POTABLE WATER TO RECYCLED WATER.

Above: Female elephants Tina and Jewel in their zoo habitat. Photo by Tad Motoyama/LA Zoo

collaboratively on the overall water picture, which includes water supply and demand, environmental needs, and long-term challenges and solutions. The Zoo is an example of this collaborative approach. Since early 2015, the One Water LA team has met with the LA Zoo to discuss opportunities for the expansion of recycled water use and stormwater capture at the zoo.

Through a series of meetings, One Water LA identified two currently ongoing collaborative opportunities for the Zoo and One Water LA:

- The LA Zoo Vision Plan 2028 and Beyond: The purpose is to facilitate, develop, and produce the Vision Plan for future capital improvement projects at the LA Zoo. As part of the collaboration

effort, the LA Zoo is open to involving the One Water LA group through collaborative meetings at the early stage of development so that water saving measures and other opportunities can be captured in the plan. Ideas already suggested and discussed with the Zoo include layouts and options for both stormwater and recycled water opportunities.

- New Children's Discovery Center Park Event Center: To address the expanding need and interest in providing opportunities for city residents, the LA Zoo will create a .69-hectare (ha) event space to accommodate numerous activities and events.

Recycled water opportunities for, and barriers to, expanding the use of RW at the LA Zoo were identified as top on the list to investigate. Stormwater opportunities were also identified as important to explore, especially since both the Vision Plan and the Event Center planning efforts have begun.

Early investigation
Research and investigation of water quality allowance at zoos was carried out in order to determine the possibilities and opportunities for reuse at the LA Zoo. The regulatory agency, the United States Department of Agriculture (USDA), was contacted to obtain information on animal species and animal classes, which was critical to understanding water quality parameters in the waters where they lived. In addition, a survey of those zoos that were already using RW was conducted, including zoos in Denver, Colorado, and Santa Barbara, California. Specific to the LA Zoo, the One Water LA team performed field visits and reviewed the following:

- Number and location of water treatment facilities by exhibit
- Type and components of treatment facilities

- Use of potable water in each exhibit
- Number and size of pools, moats, and tanks
- Frequency of discharging water and re-filling with potable water
- Irrigation demands
- Existing RW lines near the Zoo and potential connection points
- Cleaning and maintenance activities and frequency, such as washdown.

During discussions, the Zoo's chief veterinarian had concerns regarding the water quality of RW, and specifically asked about the micro-biomes in the water. The One Water LA team stated that they did not know, but they would determine if that was something that the City's water labs tested for when measuring water quality. Currently, the One Water LA team is comparing the water quality of RW with potable water for those constituents that are tested by both laboratories. It was noted that there are a few constituents that are tested in potable water, but not in RW. To make a complete comparison, Los Angeles Sanitation Department (LASAN) is testing for those constituents. The LA Zoo is willing to consider RW for the animals and is very interested in capturing more SW. Its Vision Plan will include re development of the entire zoo over the next 20 years.

Regulatory compliance
The USDA's Animal and Plant Health Inspection Service (APHIS) regulates all zoos in the US. USDA regulations that are relevant to zoo animals are the following:

- Sec. 3.83 – Drinking water source of an animal must be of potable water quality
- Sec. 3.106 – States specific water quality parameters for marine mammals.

However, the regulations are not specific to the use of recycled

water; USDA regulations require only that the water meets the water quality parameters for marine mammals and the health of animals.

Research, field visits
An extensive literature review and field visits were completed to determine the feasibility of increasing recycled water use in the Zoo. The review resulted in understanding where recycled water is currently being used in the US for animals and by whom, as well as the benefits and lessons learned since implementation. The WateReuse Research Study titled *Recycled Water Use in Zoo and Wildlife Facility Settings, 2013* included useful information related to the experience of other zoos using municipal recycled water at their premises.

The One Water LA team has had follow-up discussions with zoos nationwide, such as in Denver, Colorado, and Santa Barbara, California, to identify any changes, hurdles, and/or the progress that has been made since the publication of the WateReuse study. Both the Denver and Santa Barbara zoos are pleased with the implementation of RW use for their operations and are continuing to look for expanding its use as new improvement projects become available. The only challenge with the use of RW that was mentioned was that it may be adversely affecting coniferous plants. However, this possibility is still being studied.

The LA Zoo currently receives RW from the Los Angeles-Glendale Water Reclamation Plant (LAGWRP) for the landscape irrigation at its parking lot. Future connections will also supply RW from the City's LAGWRP to the zoo.

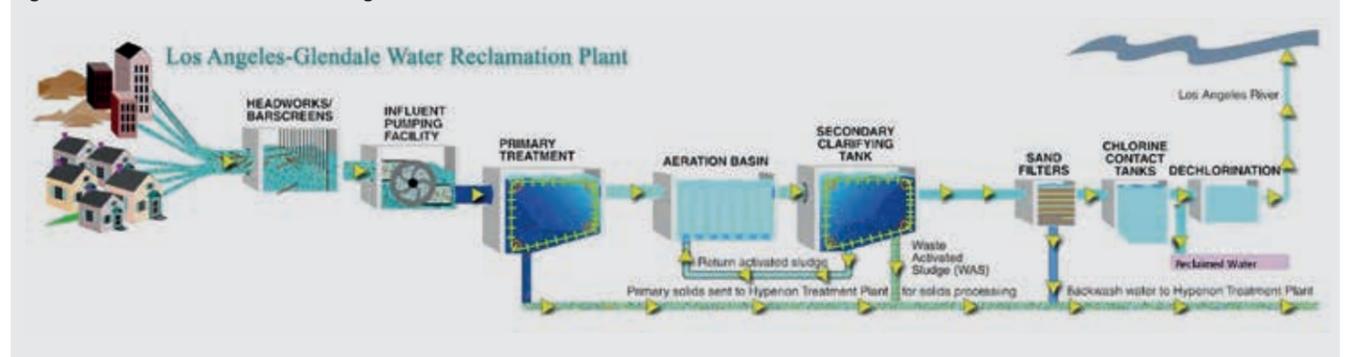
LAGWRP is located in the Eastern side of the San Fernando Valley and has a water capacity of 75.7 million liters per day (ML/d). The treatment plant currently treats an average of 60.6 ML/d,

with 33 percent of the treated wastewater becoming RW. The WateReuse Study helped to identify which species are sensitive to RW and which are not. It is understood that US zoos currently using RW do not use it in fish and reptile exhibits due to the animals' sensitivity to chlorine. LAGWRP's RW is chlorinated before it is distributed in to the RW distribution system. It is anticipated that the RW would potentially need to be dechlorinated before it is used as part of these animals' natural environments such as the filling of ponds and pools. As mentioned earlier, the LA Zoo's chief veterinarian expressed some concerns regarding the water quality of RW. Therefore, the City of LA performed an additional study to compare the water quality of the City's potable water with its municipal recycled water.



Photo by Jamie Pham/LA Zoo

Figure 1. Treatment Process for the Los Angeles-Glendale Water Reclamation Plant



The supply source for activities requiring RW will be the LAGWRP's RW effluent. Using RW for operations that do not require potable water quality can save both energy and money while reducing dependence on potable water supplies. RW has been used to irrigate surrounding areas of the LA Zoo, such as Griffith Park, for many years. The One Water LA team reached out to the Department of Recreation and Parks and the LADWP to identify the current RW 76.2-centimeter (cm) (30-inch) main pipeline nearest to the Zoo.

Existing stormwater management

Currently, the LA Zoo stormwater collection tank and system captures the pond drainage and most of the Zoo's stormwater runoff – approximately 49 ha – and discharges to the LAGWRP. The remaining amount – 4 ha – will be captured in the main parking lot, which includes permeable pavement, bioretention, and pervious concrete.

Constructed in 1994, the LA Zoo stormwater system eliminates and prevents water pollution and maintains water quality in the Los Angeles River by pumping the Zoo's animal wastewater to the North Outfall Sewer (NOS) and LAGWRP for treatment. The facility meets federal water quality standards, complies with the NPDES permits, and provides relief of local sewers in surrounding areas.

The LA Zoo stormwater collection facility includes storm drain, pond drain, junction box, inlet structure, pumping station, force main, wastewater retention basin, and a grit removal facility. The LA Zoo system's grit removal facility removes the storm drainage grit and debris while the pond drainage bypasses the grit removal facility and enters the tank after the grit chambers. The LA Zoo tank captures nearly 112,700 cubic meters per year, which equates to an average flow rate of 0.22 cubic meters per minute.

The LA Zoo has implemented the following best management practice (BMP) measures to help manage stormwater runoff based on the results of a 2000 study that identified the best potential BMPs to reduce the quantity and/or improve runoff:

- Non-structural BMPs: Schedule regular pickup and disposal of garbage, green waste, and animal waste; use indoor feeding during rainfall, a practice which keeps more manure under roofs and away from runoff;

RECYCLED WATER OPPORTUNITIES FOR, AND BARRIERS TO, EXPANDING THE USE OF RW AT THE LA ZOO WERE IDENTIFIED AS TOP ON THE LIST TO INVESTIGATE.

routinely inspect conditions of waste containers and trucks; look for signs of leaks and leaching; and cover waste containers

- Structural BMPs: Pervious paved parking lot (includes: RW irrigation, bioretention cells, and permeable paving); Zoo drive bioswale with a capacity of 454 cubic meters (m³) (120,000 gallons).

It is important to note that new structural BMPs have been developed since the study was done 16 years ago. Additionally, the option of reusing captured stormwater was not initially considered because the City was not going through a drought during the time of the study. In 2011, the City improved water quality by retrofitting its main parking lot to include

bioretention, drought-tolerant plants, and permeable pavement. The LA Zoo parking lot's stormwater BMPs are sized and designed to capture pollutants, trash, and other debris and significantly reduce runoff that would otherwise flow directly into the Los Angeles River.

The LA Zoo parking lot project encompasses the entire 13.35-ha parking area and the implementation of BMPs for the 4-ha main parking area. Enhancements to mitigate stormwater runoff include various types of permeable pavement, grassy swales, native trees, and other vegetation. A bioswale on the site retains 454 to 568 m³ (120,000 to 150,000 gallons) of stormwater for percolation after a storm event. The parking lot also includes RW use for landscape irrigation.



Sumatran Tiger. Photo by Jamie Pham/LA Zoo

Reuse opportunities

One Water LA recommends a variety of integrated solutions to reduce the volume of imported, purchased water supply, and increase local supplies by using municipal recycled water for LA Zoo operations and incorporating stormwater capture methods on Zoo property.

One Water LA also looks to improve stormwater quality by implementing the Low Impact Development (LID) Ordinance, which requires the following stormwater management techniques:

- Capture and infiltrate
- Capture and use
- Capture, treat, and release (treated through high removal efficiency biofiltration).

The stormwater quality improvement and recycled water use recommendations are described in further detail below.

Potable water offset

Through a series of meetings, the Zoo's current water-related activities and use have been identified. The potential uses for recycled water for various LA Zoo operations include washdown of animal holding areas, irrigation, exhibits (treatment systems, ponds, aesthetics), power washers, and restrooms (toilets) in addition to the use of captured stormwater for landscape and planter irrigation. An estimated 244,000 cubic meters of potable water per year could be offset if these modifications proposed by the One Water LA team are included in the Vision Plan and Event Center design for these purposes.

Water reuse for exhibits

An estimated 15,000 cubic meters per year of potable water could be offset by switching all Life Support Systems (LSS) – water treatment systems for water used in exhibits – to use influent from potable water to recycled water. The One Water LA team is working with the LA Zoo to determine the feasibility of using recycled water for its water treatment systems (LSS). The team, however, would need to verify if the treatment system is sufficient to meet the animals' needs if recycled water is to be used instead of potable water.

The team visited the Zoo to examine its 15 LSS, which currently receive influent from LADWP's potable water source. Depending on the animal exhibit's need, the LSS treatment processes vary. The water quality testing frequency for each exhibit also varies. Testing for pH, chlorine, ammonia, nitrate, and nitrite is conducted for certain exhibits.

Most LSS are recirculating systems, which may only discharge wastewater once per month. However, the drain and fill frequency for each exhibit varies: some exhibits have large volumes and are drained frequently; some have small volumes but are drained frequently; and others have large volumes but are drained infrequently.

Stormwater opportunities

The City of Los Angeles Stormwater updated the LID Ordinance in May 2016 – an action that opens up opportunities to capture more stormwater. As a result, various stormwater management techniques are required to be



Grevy zebras at the Los Angeles Zoo. Photo by Tad Motoyama/LA Zoo

evaluated in the following order in priority: capture and infiltrate; capture and use; and capture, treat, and release. The latter option involves treatment through high removal efficiency biofiltration.

The type of BMP selected will depend on the site and criteria such as surrounding soil type, depth to groundwater, usable area, and other conditions. The purpose of LID is to mitigate stormwater runoff by capturing and infiltrating rainwater before runoff is generated. Examples of LID practices include rain barrels, permeable pavement, storage tanks, and infiltration swales. The City's 2016 *LID Handbook* presents sample design calculations for stormwater BMPs.

Incorporation of LID in development and redevelopment projects to the maximum extent practical is a critical component in improving the City's water quality and attaining regulatory compliance. LASAN and the LA Zoo will coordinate to ensure LID standards are incorporated at the design stage of the master plan and the event center. The permeable and impermeable areas in the LA Zoo create significant opportunities to capture stormwater.

Next steps

Zoos provide an opportunity to improve water quality by capturing, infiltrating, reusing, and treating stormwater. Typically, they consume large quantities of water, so it is crucial to determine whether the supply source for certain water-related activities could be changed from potable water to recycled water. The study conducted by One Water LA and LA Zoo determined that recycled water from the Los Angeles-Glendale Water Reclamation Plant will be used for Zoo operations that do not require potable water quality – a strategy that will result in savings in energy, water, and public funds

A BIOSWALE ON THE SITE RETAINS UP TO 568 M³ (150,000 GALLONS) OF STORMWATER FOR PERCOLATION AFTER A STORM EVENT.

while also reduce dependence on potable water supplies.

Currently, RW is currently being used in the LA Zoo main parking lot. The LA Zoo Vision Plan is in the design stage for incorporating and increasing the use of RW and stormwater capture.

Authors' Note

Eliza Jane Whitman is founder and president of EW Consulting, Inc., based in Altadena, California. Division Manager Ali Poosti, Assistant Division Manager Lenise Marrero, and Civil Engineering Associate Flor Burrola work for the City of Los Angeles' LA Sanitation. Darryl Pon is the planning and development director of the Los Angeles Zoo.

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