YOUR WATER. YOUR FUTURE.

Irrigation Efficiency: Building Bridges Through Conservation and Drought Resilience

ORESTES MORFÍN – SENIOR ANALYST, COLORADO RIVER PROGRAMS

July 11, 2022
Why now?
Colorado River Water Supply Report
System Contents: 18.08 MAF
As of July 10, 2022
Last Year System Contents: ~24.79 MAF

* With respect to May 24, 2022

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Current</th>
<th>Change*</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>Lake Mead</td>
<td>7.12</td>
<td>-0.54</td>
<td>25.90</td>
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<tr>
<td>Lake Powell</td>
<td>6.41</td>
<td>+0.28</td>
<td>24.30</td>
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<tr>
<td>Flaming Gorge Reservoir</td>
<td>2.78</td>
<td>-0.07</td>
<td>3.75</td>
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<tr>
<td>Fontenelle Reservoir</td>
<td>0.32</td>
<td>+0.17</td>
<td>0.34</td>
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<td>Navajo Reservoir</td>
<td>0.93</td>
<td>-0.02</td>
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<td>Blue Mesa Reservoir</td>
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<td>+0.08</td>
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<td>Morrow Point Reservoir</td>
<td>0.11</td>
<td>0.00</td>
<td>0.12</td>
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<td>Crystal Reservoir</td>
<td>0.02</td>
<td>0.00</td>
<td>0.03</td>
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</table>

Reservoir Capacities (MAF)

* With respect to May 24, 2022
US Bureau of Reclamation - June 14th Announcement

- Investments in Drought Response Actions
  - Additional $38M in Drought Resiliency Projects
  - Additional $17.3M in Water and Energy Efficiency grants in 11 Western states
- Water reuse/recycling
  - $1B tbd over 2022-2024 period
- Bipartisan Infrastructure Law
  - Funding available to accelerate project development for “new water supplies”
  - Recycling, storage, desalination, drought contingency plans
- Added Essentials
  - Acknowledgment of additional 2-4 MAF needed to prop up system
  - Commitment to “protect the system (infrastructure)”
  - “Equitable” distribution of reductions
Options

• Conservation
  • Municipal & Industrial
  • Agricultural Fallowing
• Weather augmentation
• Transfers of entitlement
• Intentionally Created Surplus incentives
• Desalination
  • Seawater
  • Brackish groundwater
• Water reuse/recycling
• Agricultural efficiency
  • Irrigation efficiency
  • Canal lining
  • Piping
N-Drip™: Promising Technology Against Climate Change

The water crisis in Southwest USA is accelerating.

Sustainable supply chain is a core concern.

GHG emissions from flood-irrigated rice are equal to emissions from more than 135M cars.

Colorado River, US

Potatoes, India

Rice paddy, India
Furrow (Flood) Irrigation

In Arizona:
• 70% of Colorado River allotment is used for Ag
• 70% of all Ag in AZ is flood-irrigated

…~50% of AZ allotment is used for flood
N-Drip System Components

Saves Water
up to 60 percent of the water used for flood irrigation

Reduces Fertilizer Use
Saves up to 50 percent of total fertilizer costs, and reduces algal blooms and groundwater contamination

Up to 80% reduction in CO₂ + CH₄ emissions

Maximizes Yield Potential
30 percent greater than a comparable flood irrigated field
Proprietary Emitter

N-Drip

- Water inlet
- Water flows in the ring between dripper-body and rod
- Dripper Rod

Water outlet

Traditional

- Water inlet
- Clogging points

- Water outlet

✓ Uses existing infrastructure
✓ No pumping station (no energy)
✓ No pressure-based filters

✗ Massive infrastructure
✗ Energy intensive
✗ Heavy filtration
Partnership Details

• Applying N-Drip technology, developed in Israel, on CRIT fields to test water savings and agricultural productivity
• The gravity-powered, micro-irrigation system was tested against traditional flood irrigation
• This innovative technology is cost-effective and easy to implement – no need for new infrastructure or power requirements
• Partners include:
  • CRIT – field and farming experience
  • CAP – funding and interest in saving Colorado River water
  • N-Drip – gravity-powered, micro-irrigation and real-time soil monitoring
  • UA – data gathering and research

N-Drip/CRIT On-Farm Team:
Miguel Gonzalez (CRIT Farms),
Buddy Moore (CRIT Farms Manager), Uri Segev (N-Drip)
Conservation Partner: Colorado River Indian Tribes (CRIT)

- Colorado River Indian Tribes (CRIT)
  - Sovereign Indian tribe with a first-priority Colorado River water right
  - Served by outdated, poorly maintained irrigation project in need of extensive renovation

- CRIT provides --
  - Farming expertise
    - Stewards of Colorado River water who have farmed the region for millennia
  - Fields
    - Testing N-Drip technology under challenging climatic circumstances in the remote environment near Parker, Arizona
    - 40 acres of sorghum in 2020, 100 acres of sorghum, 40 of cotton, and 100 of alfalfa in 2021, 286 acres of sorghum and 300 acres of cotton in 2022
Conservation Partner: Central Arizona Project (CAP)

- CRIT and CAP worked together to develop alternatives to traditional fallowing with the aim of saving Colorado River water and sustaining irrigated agricultural productivity.
- CAP is looking for solutions to preserve the Colorado River and balance the future water needs of Tribes, cities and agriculture.
- CAP provides –
  - Funding for conservation technology and research.
  - Facilitation to broaden the application of innovative water conservation technology for future implementation.
Conservation Partner: N-Drip

Proprietary (IP protected) dripper:
- Multi-dimensional flow, anti-clogging
- Designed to provide efficient drip irrigation with only 50 cm (20 inches) of pressure
- Resilient to unfiltered water

N-Drip’s Benefits:

- **Cost effective**
  Lowest conversion & operational costs

- **Energy saving**
  Powered by gravity alone

- **Highly efficient**
  Increase yields using less water

- **Eco-friendly**
  100% recyclable, reduces greenhouse gas emissions

- **Modular**
  Easy to install and uninstall, seasonal and flexible

Here's how N-Drip works
Conservation Partner: University of Arizona (UA)

- The related research being developed from this pilot project includes analysis and monitoring for:
  - Water quantity
  - Water quality
  - Soil health
  - Crop health
  - Crop productivity
  - System performance
- Direct comparison of N-Drip fields to flood-irrigated fields
Field Application – CRIT
Field Application – Yuma Mesa IDD

Flood

N-Drip
Field Application – Bard Irrigation District

High-Pressure Drip
Equipment: filters, pumps, valves

N-Drip
Equipment: water tank, valves
Field Application – Harquahala Vy. AZ

- Arizona
- October 2021
- Alfalfa
- 43-acre
- Sandy loam

Images of field application activities in Arizona, October 2021, focusing on alfalfa grown on a 43-acre sandy loam field.
Real-Time Data

<table>
<thead>
<tr>
<th>Monitor</th>
<th>Act</th>
<th>Optimize</th>
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</thead>
<tbody>
<tr>
<td>Water status, nitrogen</td>
<td>When and how much to irrigate</td>
<td>Yield, water, harvest-time, emissions,</td>
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<tr>
<td>levels, vegetative</td>
<td>and fertigate</td>
<td>contamination</td>
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<tr>
<td>index, field viability</td>
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</tr>
</tbody>
</table>
Proven Results - Arizona

- 2020
  - CRIT
    - Sorghum: 40 ac., 52% savings
- 2021
  - CRIT
    - Sorghum: 106 ac., 47% savings
    - Alfalfa: 100 ac., 50% savings (based on first cutting)
    - Cotton: 44 ac., 40% savings
  - Tonopah/Harquahala
    - Cotton: 40 ac., 30% savings
    - Alfalfa: 100 ac., 50% savings (based on first cutting)
2022 – 2023 Projects to Program Level

**2022**
- **Project**
  - CRIT Farm-scale Project
  - Yuma Mesa Irrigation and Drainage District
  - Harquahala Valley Irrigation District
  - CRIT Farms
  - Seeking CAP Tribal partners (GRIC, TON)
- **Scale**
  - ~300 acres
  - ~270 acres
  - ~100 acres
  - ~100 acres
  - ~100 acres
- **Crop**
  - Milo
  - Citrus
  - Alfalfa
  - Alfalfa
  - TBD
- **Notes**
  - Expansion to Farm scale demonstration
  - Pilot-scale Demonstration multi-year
  - Multi-year alfalfa Demonstration (’22 – ’23) – “Big 5 Funders”
  - Multi-year alfalfa Demonstration (’22 – ’23) – “Big 5 Funders”
  - Pilot-scale Demonstration

**2023**
- **Project**
  - CRIT Farm-scale continued
  - YMIDD Farm Scale
  - Mexicali Valley Pilot
  - CAP Tribal Partners continued
- **Scale**
  - TBD
  - TBD
  - ~400 acres (5 x 80 acres)
  - TBD
- **Crop**
  - TBD
  - TBD
  - TBD
  - TBD
- **Notes**
  - TBD
  - Binational Demonstration and capacity-building – Binational Funder
  - Demonstration and capacity-building

**2023 – 2026 Develop and Implement Colorado River Conservation Subscription Program**

- Assuming continued demonstration of success and cost competitive with other alternatives
2022 – 2023 Projects to Program Level

Central Utah Project

Southern Nevada Water Authority

Denver Water

Central Arizona Project
KNOW YOUR WATER

Thank you