Cawelo Water District Beneficial Reuse Program
Food Safety Expert Panel Meeting - January 12, 2016
Abby Auffant, Chevron Water Regulatory Coordinator
David Ansolabehere, Cawelo Water District General Manager
Agenda

- Introductions

- Chevron
  - Kern River Field / Heavy Oil Overview
  - Water Handling at Kern River Field

- Cawelo Water District
  - Valley Water Management Company
  - Water Handling and Distribution
Kern River Field Historical Overview
Kern River Operations
The Kern River Field
Kern River Operations
Discovery!

- Discovery well dug by hand to 75’ in May 1899
- Thick, gooey oil was struck at a depth of 43’
- By 1903, there were 800 wells and 400 companies in the Kern River Field

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Kern River Operations
Production and the Impact of Steam Flooding

Production
(thousands of barrels per day)

- Steam Flooding introduced - 1960’s
- Second peak oil event
- Recovery exceeding 60% of Original Oil in Place

Steam flood Phase
- 140 MBD peak production
- 2 billionth barrel in 2007

Discovery 1899
10% Recovery by 1960
Ultimate recovery = 15%

“Played out” after 60 years

Bottom hole heaters
Salvage Perforating

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Kern River Operations
Kern River Field Today

- 20 square miles
- 10,000 producing wells
- 67,000 barrels of OIL per day produced
- 783,000 barrels of WATER per day produced
- 250,000 barrels of STEAM per day injected
- 3rd largest oil field in California
- 10th largest oil field in United States
Kern River Field
Production System Overview

- Steaming Injectors: 600
- Producing Wells: 10,000
- Well Testing
- Water Treatment
  - Wemco
  - Filters
  - Softeners
- Oil Treatment
- Station 36
- Oil Sales: 67 MBOD
- Steam Injection: 250 MBSD
- Cawelo Reservoir
- Produced Water: 510 MBWD
Kern River Field
Station 36 Overview
Kern River Field
Station 36 Processing Facility

12:1 Water/Oil Ratio

Oil Production
67 MBOPD

Water Processing
Cawelo
510 MBWPD
Field Use
23 MBWPD
Steam
250 MBSPD
Kern River Field
Oil Treatment Process

*Note: Water from wash and shipping tanks is reintroduced at the beginning of the process.
Kern River Field
Production System Overview

Steam Injection
250 MBSD

Station 36

Oil Treatment

Water Treatment

Well Testing

Wemco

Filters

Softeners

Oil Sales
67 MBOD

Steam Generators

Produced Water
510 MBWD

Cawelo Reservoir

Producing Wells: 10,000

Steam Injectors: 600
Kern River Field
Water Treatment Process

Water Treatment

Water has less than 1 ppm Total Petroleum Hydrocarbons when it leaves Station 36

*Note: Skimming for Wemco and backwash from filters is reintroduced to the beginning of the process.

[Diagram showing the water treatment process with steps 1 to 5: Surge, Wemcos*, Raw Water Tank, Filters*, Softeners, Steam, Cawelo Reservoir.]

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Providing Produced Formation Water for Beneficial Use in Cawelo Water District
Providing Produced Formation Water for Beneficial Use in Cawelo Water District

Station 36 Water Treatment Plant

Valley Water Management Company (Non-Chevron)

8.5 mile pipeline

Polishing Pond

Cawelo “Reservoir B” Blending Reservoir

Fresh Water Sources

Fresh Water Wells

Cawelo Canal System

Farmer Use

Groundwater Banking Project
Cawelo Water District

- Beneficial reuse of produced water for local water district for over 20 years
- 500,000+ barrels of water per day pumped
- Solely for agricultural use
  - Benefits 90 farmers
  - Primarily “permanent” crops such as citrus, nuts, and grapes
Safeguards to Ensure Water Quality

- Continuous monitoring and alarm management of water in the Chevron facility

- Operator Routine Duties:
  - Test water quality entering the plant
  - Inspect water leaving the plant
  - Daily inspection at Cawelo facility

- Cawelo Facility:
  - Booms and skimmers
  - Weekly cleaning at polishing pond

- Monthly sampling (reported quarterly to Water Board)
Cawelo Water District
Beneficial Reuse Program

- Program has been permitted irrigating crops for over 20 years
- All Produced Waters discharged to Cawelo are sampled and tested monthly by a third party laboratory
- Cawelo’s Program has long history of compliance with standards set by CVRWQCB
- Providing irrigation to 34,000 acres of crops
- World Class crops include Citrus, Almonds, Pistachios, and Grapes
Cawelo Water District
Valley Water Management Operations

- Valley Water Management’s facility has been in operation since 1980
- Produced fluids enter gravity separation ponds
- Produced Water treated through Depurators (Wemcos) to remove any residual oil
- Produced Water pumped through 3.5 mile pipeline to Reservoir B
Cawelo Water District
Blending Facility

- Chevron Produced Water enters Polishing Pond (1)
- Chevron Produced Water enters Reservoir B (2)
- Valley Water Produced Water enters Reservoir B (3)
- Cawelo’s Imported Surface Water enters Reservoir B (4)
- Outflow to Distribution Canal (5)
- Pumped Groundwater enters Distribution Canal (6)
## Cawelo Water District
**Program Volumes**

### Average Volumes (Last ten years)

<table>
<thead>
<tr>
<th>Source</th>
<th>Acre-feet/ day</th>
<th>Annual Acre-feet</th>
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<tbody>
<tr>
<td>Chevron</td>
<td>500,000</td>
<td>23,500</td>
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<tr>
<td>Valley Water</td>
<td>100,000</td>
<td>4,800</td>
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<tr>
<td>Groundwater</td>
<td>168,000</td>
<td>7,900</td>
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<tr>
<td>Imported Surface Water</td>
<td>1,200,000</td>
<td>56,000</td>
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</tbody>
</table>

### Average Ratio

- **Imported/Groundwater to Produced Water**
  
  \[ 2.2 : 1 \]
Cawelo Water District Program Benefits

- Produced Water reduces Farmer’s reliance on groundwater and supports the sustainability of our groundwater basin

- Produced Water is a critical water resource for Farmers to continue operations due to issues in the Sacramento Delta

- The provision of Produced Water to Cawelo for irrigation purposes has been run appropriately for the benefit of California agriculture and in accordance with all regulatory requirements
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