

The Basics of a Groundwater Banking Study

An Introduction of the Technical Aspects

by

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Who is John?

- Born in Atchison, KS, and raised in Atchison Co.
- BS & MS Degrees in Civil Engineering from Kansas State University
- Career includes
 - 17.5 yrs Black & Veatch
 - 2 yrs GEI/Bookman-Edmonston
 - 1 yr County of San Luis Obispo (Nacimiento Project Manager)
- Came to CA in June 1994. Reside in Atascadero, CA (Go Greyhounds!)



Basic Success Factors

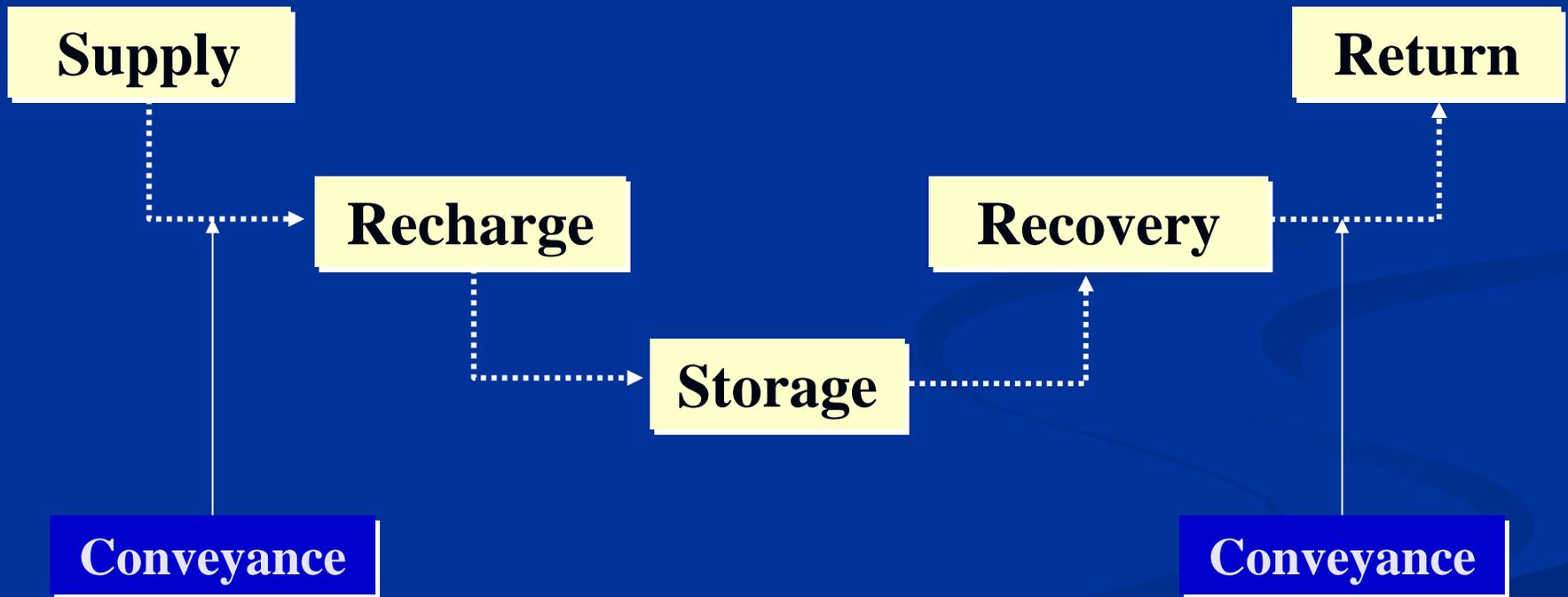
- The single most important success factor in a Conjunctive Use Project is Trust
- Public involvement and education
- The program is beneficial to the Local Community, the District and the Banking Partners.
- Pre-delivered water raises groundwater levels, which reduces pumping lift of local wells.
- Maintain flexibility with the infrastructure

Three Steps of Groundwater Banking Studies

- Step 1 – Data Collection & Hydrogeology Study
- Step 2 – Physical Facilities Analysis and Layout
- Step 3 – Institutional and Financial Phase
- Other steps follow if implementation is desired.

Today's Presentation will focus on a portion of
Step 2 – Method of Banking Water in the Ground

Water Banking Elements

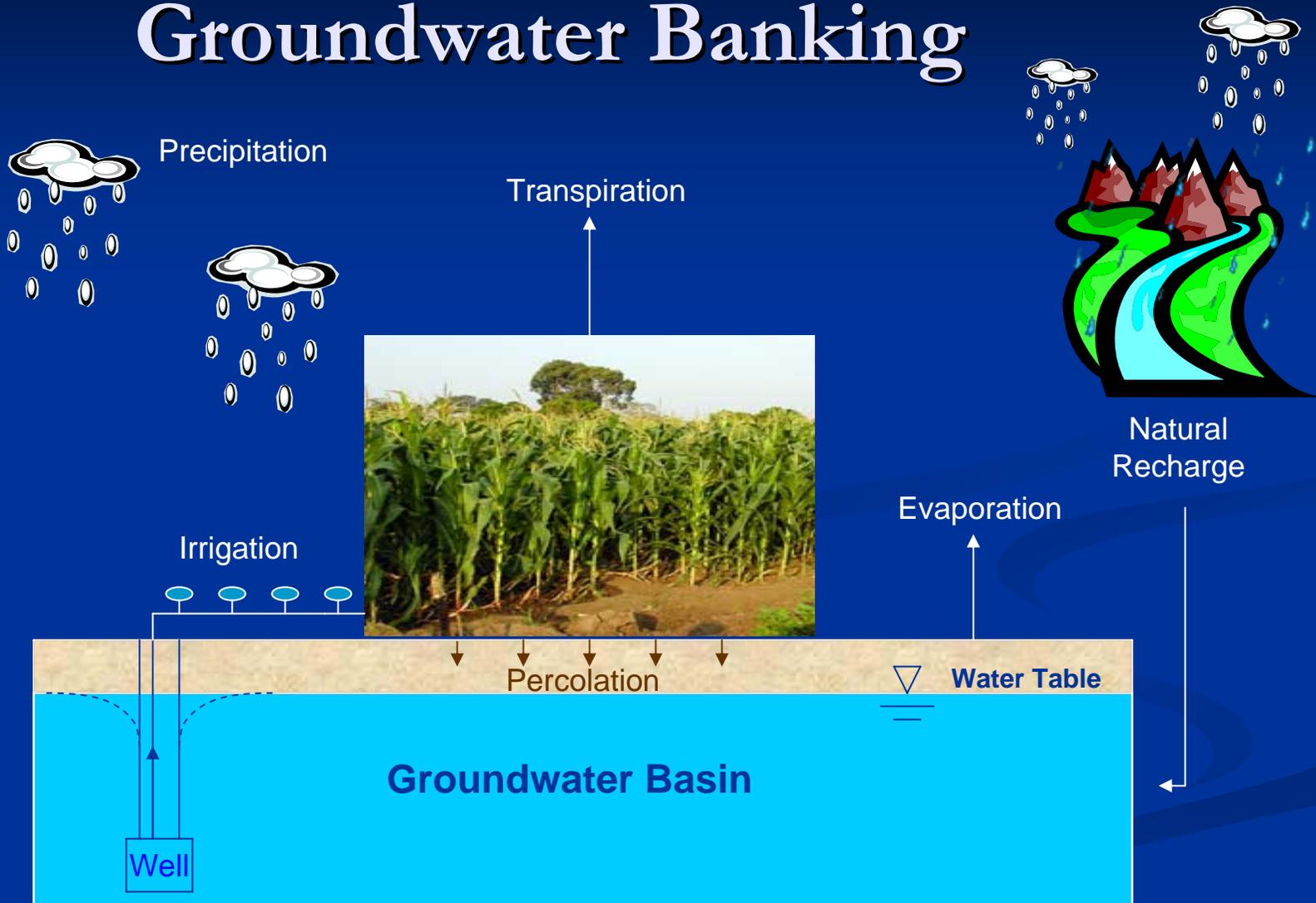


Methods to Bank Water in the Ground

- In-Lieu Recharge
- Direct Recharge
- Injection Wells



The Hydrologic Cycle Without Groundwater Banking



Modes of Banking

Monetary Bank

- Deposit – “Put” Money In
- Withdrawal – “Take” Money Out
- Fees = Put - Take

Groundwater Bank

- Deposit – “Put” Water In
- Withdrawal – “Take” Water Out
- Losses = Put - Take

Subtle Differences Between Monetary and Groundwater Banking

Monetary Banking

- If it's your money in, then it's your money out (less fee)
- If it's OPM in, then it's OPM out (less fee)

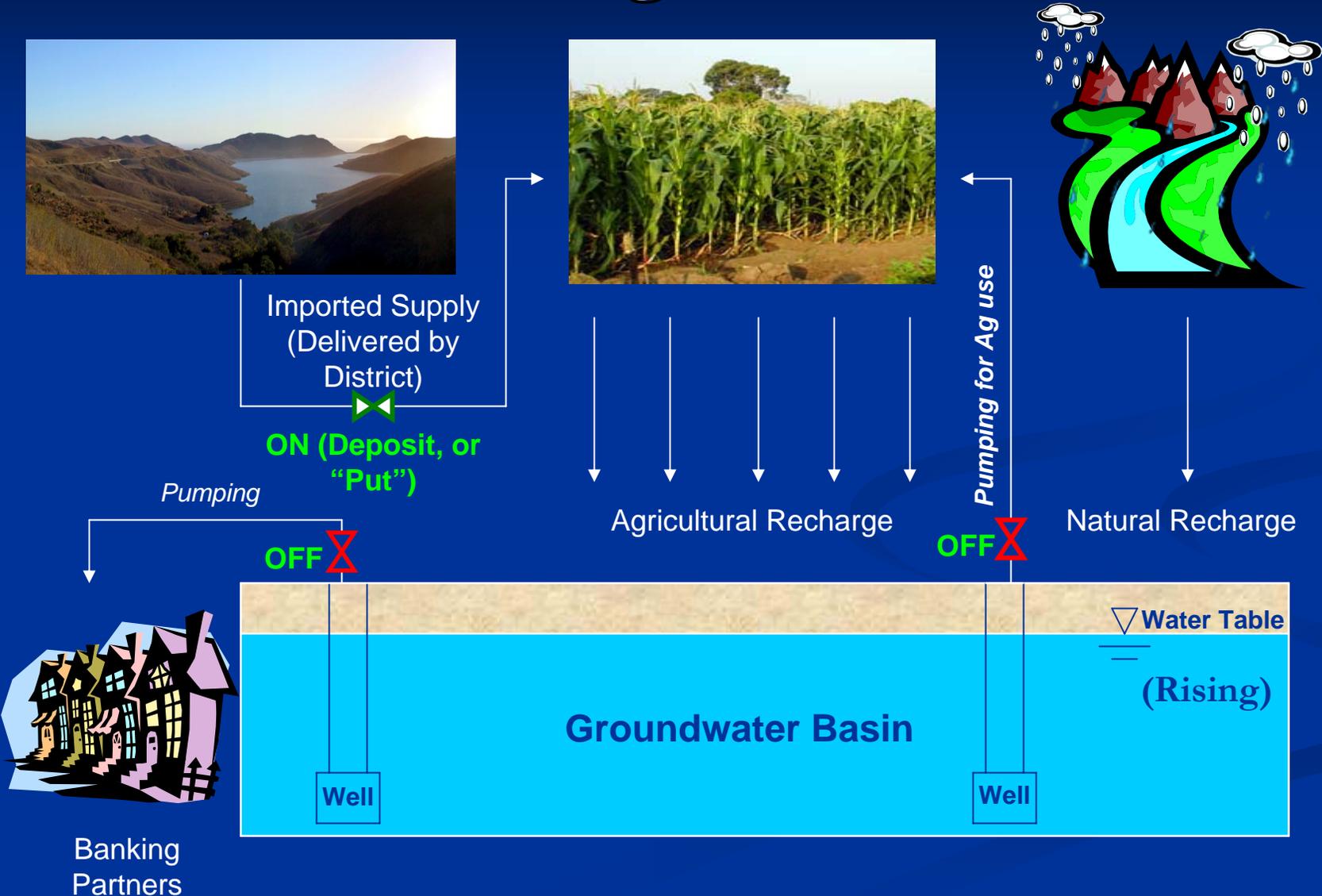
Groundwater Banking

- If it's your water in, then it's your water out (You get to keep the losses!)
- If it's OPW in, then it's OPW out (You get to keep their losses too!)

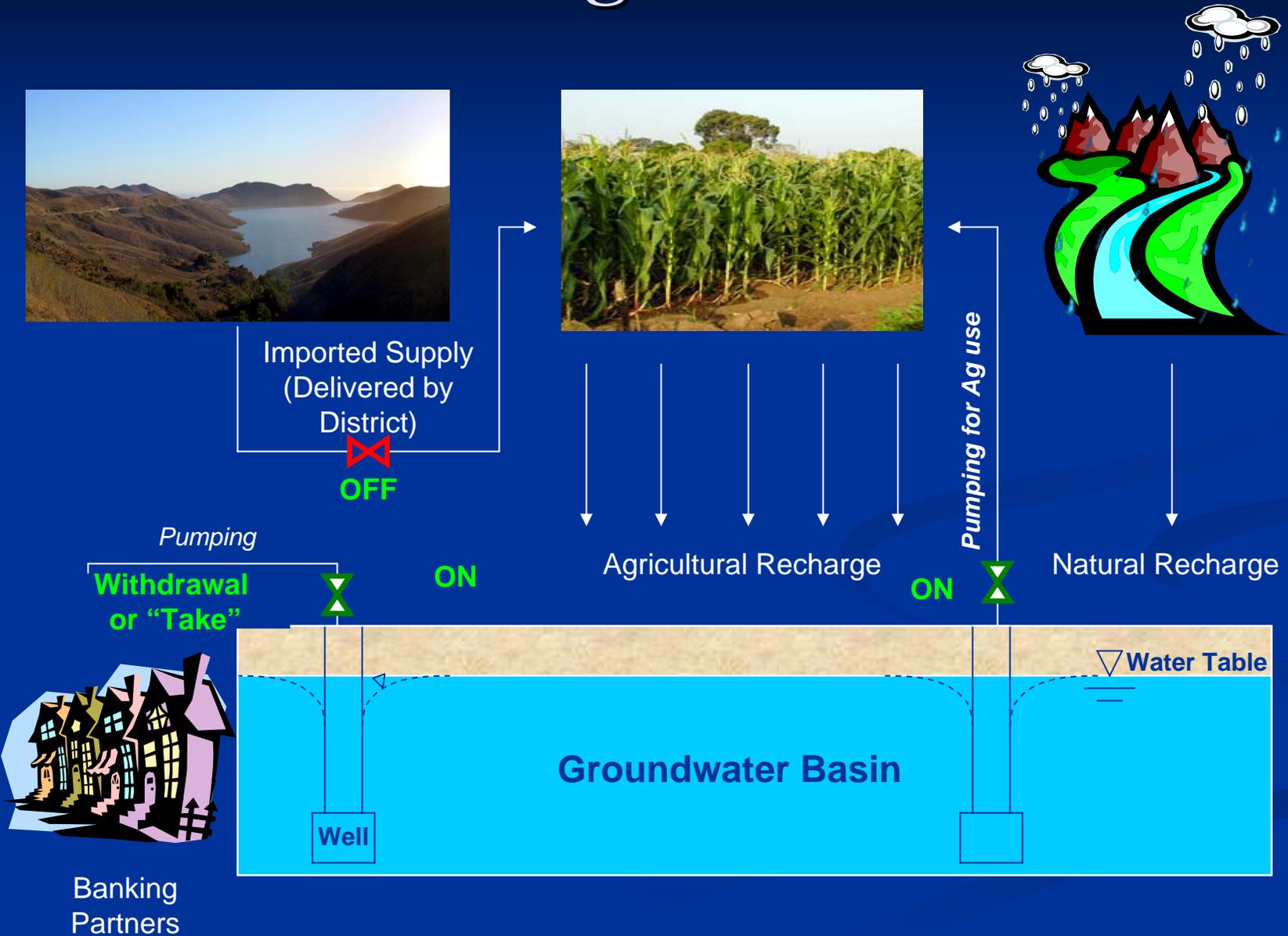
In-Lieu Recharge

- Providing imported supply to growers “in-lieu” of them pumping directly from the Groundwater Basin
- Amount banked equal to imported supply delivered
- Recharge Sources: Natural Sources (rain, run-off, etc.) and water from irrigation

In-Lieu Recharge – The “Put” Mode



In-Lieu Recharge – The “Take” Mode



Example of In-Lieu Recharge

■ Semitropic Water Storage District (Kern Co.)

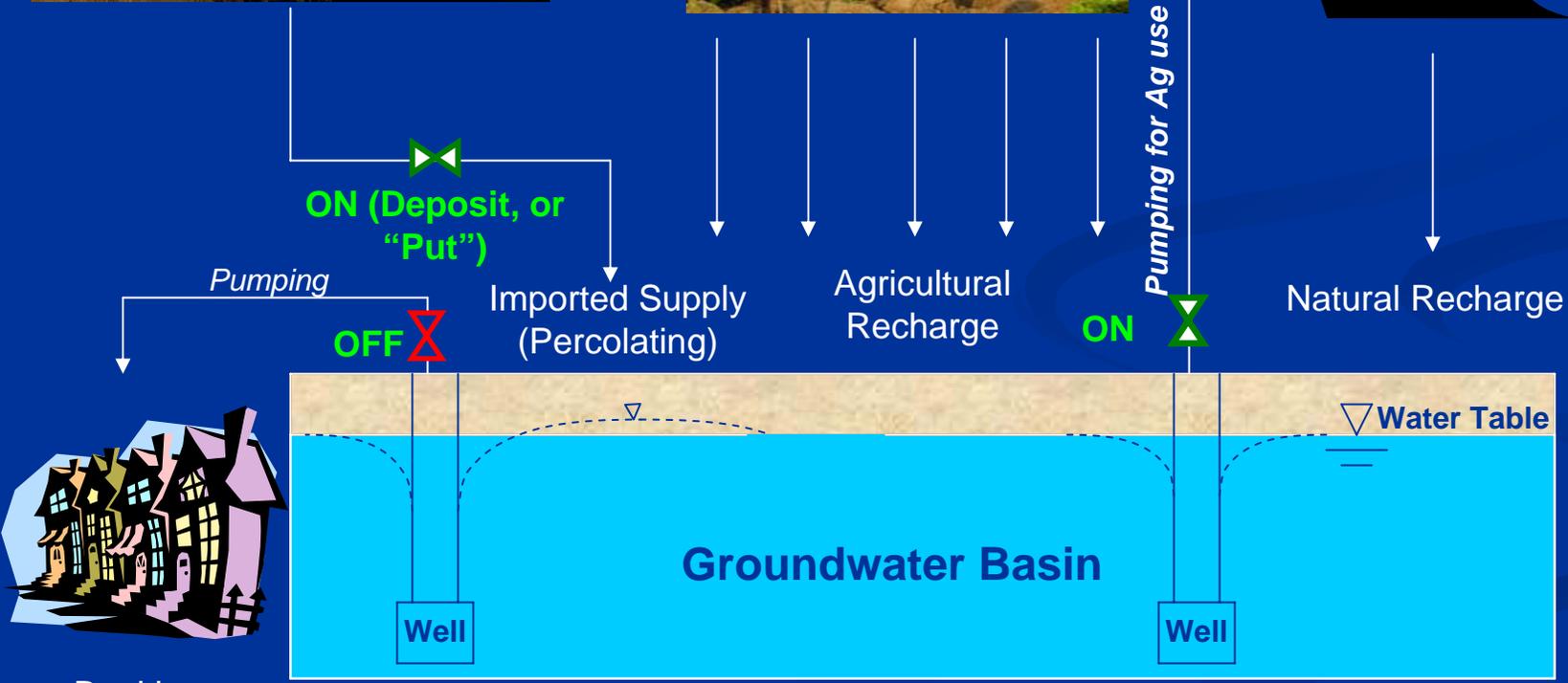
- Presently 1MAF of storage with 7 Banking Partners.
- New Program Under Construction for additional 0.65MAF of storage
- Water from the SWP is delivered to growers during the “put” (deposit) phase
- During the “take” (withdrawal) phase, water can be direct returned through grower’s wells, or through entitlement exchange to the Banking Partners



Direct Recharge

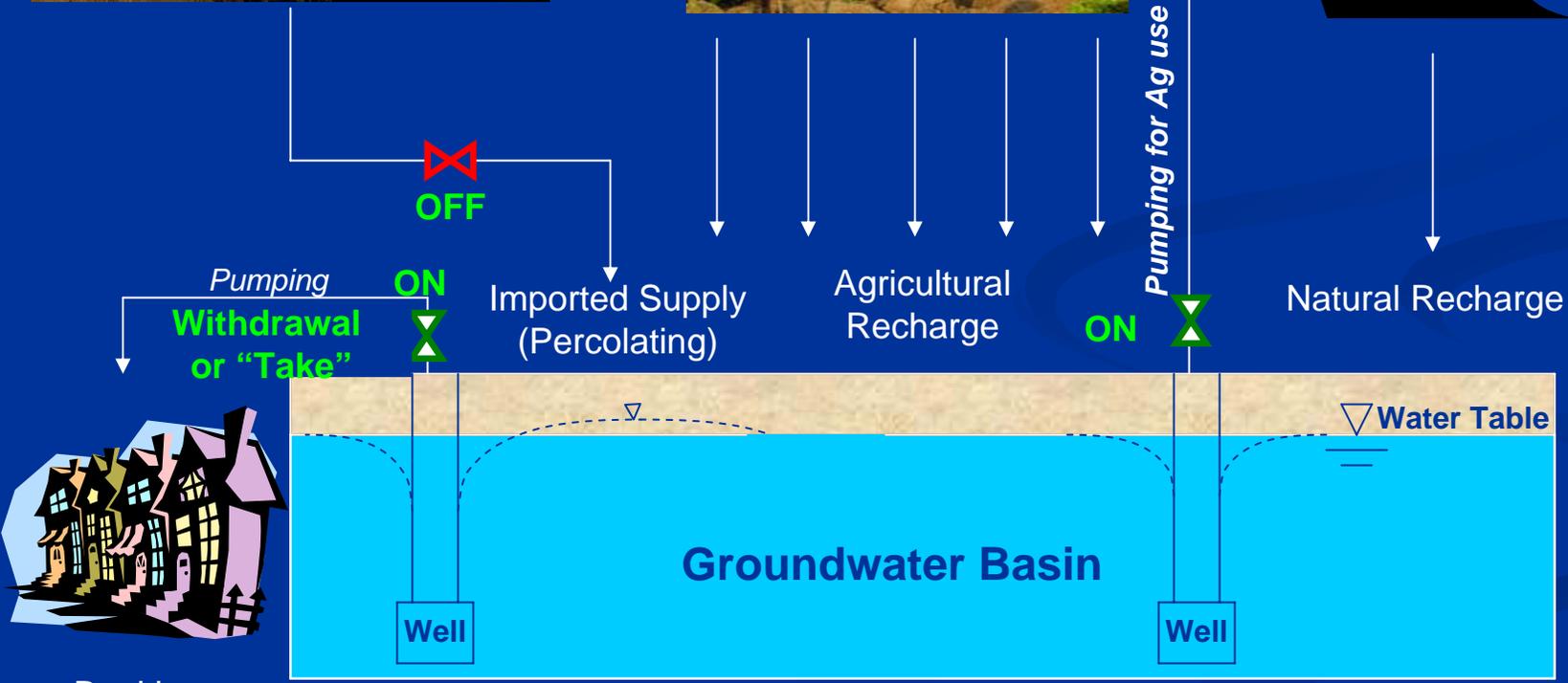
- Storing water by allowing it to percolate into the Groundwater Basin
- Recharge Sources: Natural Sources (rain, runoff, etc.), water from irrigation, and imported supply

Direct Recharge – The “Put” Mode



Banking Partners

Direct Recharge – The “Take” Mode



Banking Partners

Example of Direct Recharge

- Arvin-Edison Water Storage District (Kern Co.)
 - Presently 250,000 AF of storage with MWD
 - Water from the SWP is delivered to spreading ponds (percolation ponds) during the “put” (deposit) phase
 - During the “take” (withdrawal) phase, water can be direct returned to the SWP via a pipeline

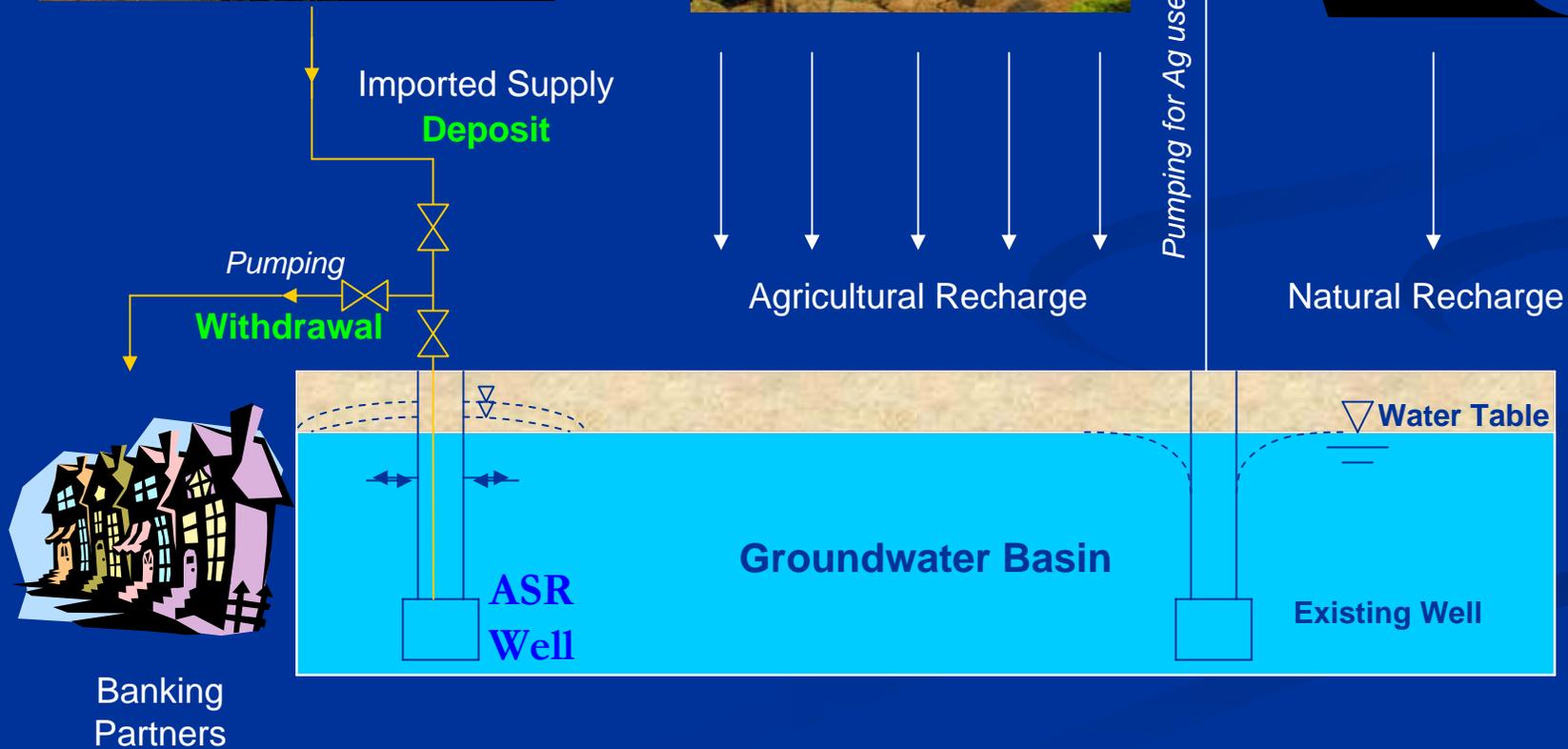


Injection Wells

- This Method is often called Aquifer Storage & Recovery (ASR), and the wells are often called ASR Wells
- Groundwater Basin is recharged by first treating the water to potable water levels, then inject into the water table through ASR Wells.
- Recharge Sources: Natural Sources (rain, run-off, etc.), water from irrigation, and imported supply

ASR Wells

“Takt” Model

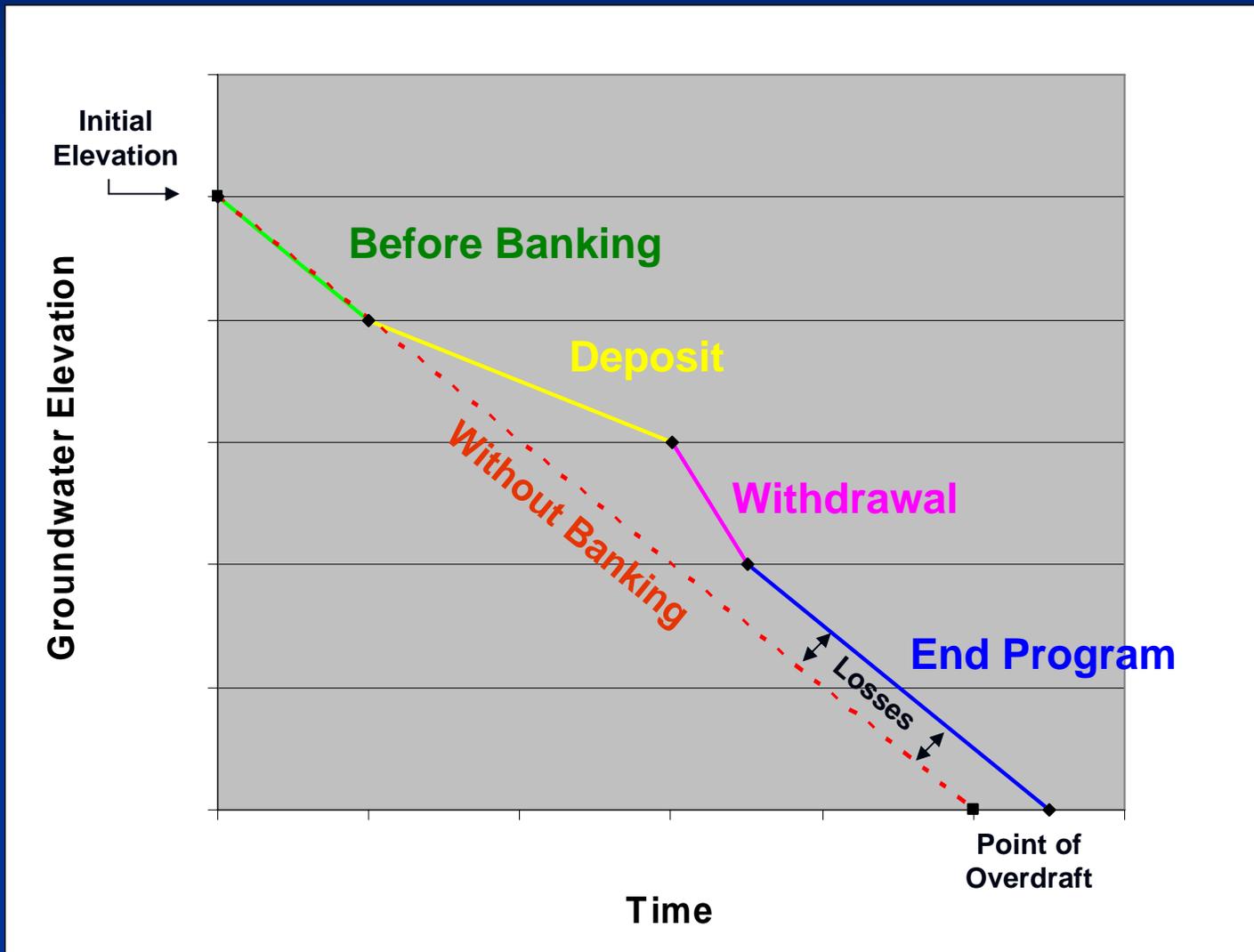


Example of ASR Recharge

- Calleguas MWD's Las Posas Basin (Ventura Co.)
 - Presently 300,000 AF of storage with MWD
 - Water from the SWP treated at the Jensen WTP, and is delivered to ASR wells during the “put” (deposit) phase
 - During the “take” (withdrawal) phase, the ASR wells pump the water out and deliver it directly to the local distribution system

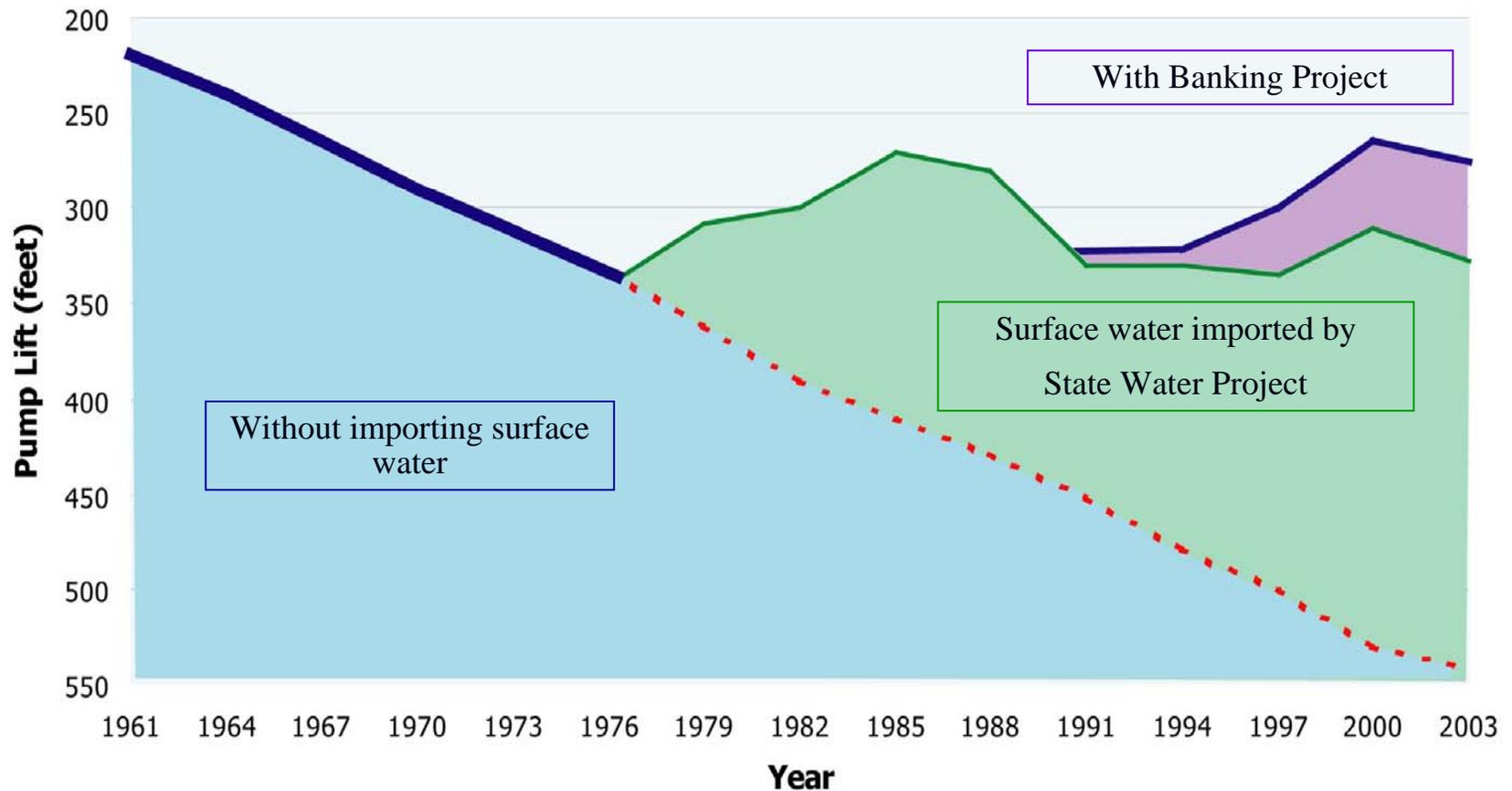


Effect of Banking on Declining Groundwater Levels



Semitropic Water Storage District

Pump Lift History



Effect of Banking on Declining Groundwater Levels

- The basic effect and benefit of a banking program is a lengthened time for groundwater levels to decline due to the introduction of imported water supplies.

Thank You!

- www.SLOCountyWater.org
- Contact: Courtney Howard, 781-1016
- Panel Discussion
 - Paavo Ogren, SLO County
 - John Hollenbeck, SLO County
 - Paul Sorensen, Fugro
 - Ron Eid, Bookman-Edmonston/GEI

Paul A. Sorensen

CA Professional Geologist

CA Certified Hydrogeologist

- BS Degree-Geology, Univ of Washington
- MS Degree-Geology, UC Santa Barbara
- Lived in Creston for 21 years
- Career includes
 - 7 yrs Charlton/Sorensen Intl., Missoula, MT
 - 5 yrs Earth Sciences Assoc, Palo Alto/SLO
 - 10 yrs Fugro West, San Luis Obispo

Paul A. Sorensen (cont)

■ Career Highlights

■ Basin Analyses

- Paso Robles Groundwater Basin
- Kaweah-Delta
- Cummings Basin (Tehachapi)
- Bear Valley Basin (Tehachapi)
- Goleta Basin

■ Active Recharge Projects

- Santa Clara Valley Water District
- East Bay Municipal Water District

■ Drilled more than 400 water wells

Ronald J. Eid

- Raised in southern California
- Attended UC Riverside and UC Davis
- BS degree in Civil Engineering (1977)
- Registered Civil Engineer in CA and AZ
- Joined *Bookman-Edmonston Engineering (Specialists in Water Resources)* upon graduation
- Resided and worked in Bakersfield office for last 28 years

Ron Eid ...

- Experience (Planning)
 - Surface water hydrology
 - Water supply
 - Flood control
 - Groundwater hydrology
 - Open-channel hydraulics
 - Water rights
 - Groundwater management
 - Conjunctive use

Thank You!

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