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WATER RECLAMTION AND REUSE: AN OVERVIEW OF THREE MUNICIPAL PROJECTS IN ARIZONA

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- David Hollinger, City of Glendale, AZ
  Engineering Project Manager
- Janet Martin, Town of Queen Creek, AZ
  Public Works Manager

PRESENTATION OBJECTIVES

- **Arizona Water Management Overview**
- **Recharge Technology Overview**
- **Representative Project Overviews:**
  - Scottsdale Water Campus
  - Surprise Reuse and Vadose Zone Wells
  - Glendale Recharge Facility Expansion
  - Queen Creek Reuse and Feasibility Study

ARIZONA WATER SUPPLIES

- **Surface Water - all supplies allocated**
  - Salt River Project (SRP)
  - Central Arizona Project (CAP)
- **Groundwater – statutory safe yield goal**
- **Reclaimed Water – final piece of portfolio**
  - Direct reuse: irrigation and other uses
  - Indirect reuse: stored and recovered

OVERVIEW OF REUSE & RECHARGE IN ARIZONA

Regulatory and Permitting Framework:

- Arizona Groundwater Management Act (1980)
- Arizona Environmental Quality Act (1986)
- Assured and Adequate Water Supply Rule (1995)
- Underground Storage Facility Rule and Act (2000)
- Constructed and Managed Recharge

Recharge Technology:

- Basins & Infiltration Galleries
- Wells
  - Vadose Zone
  - Injection
  - Aquifer Storage and Recovery

Representative Projects:

- Scottsdale Water Campus
- Surprise Vadose Zone Wells - Phase 1
- Glendale Recharge Facility Expansion
- Queen Creek Reuse and Recharge Feasibility Study

SCOTTSDALE WATER CAMPUS OBJECTIVES

- Integrated Water Resources Management approach
- Optimize reclaimed water supply (RWDS and Well Recharge)
- Produce potable quality source water (MF and RO)
- Meet Assured Water Supply (AWS) Designation
- Achieve safe yield goal and sustainable supplies
- Pioneered vadose zone well design

SCOTTSDALE WATER CAMPUS

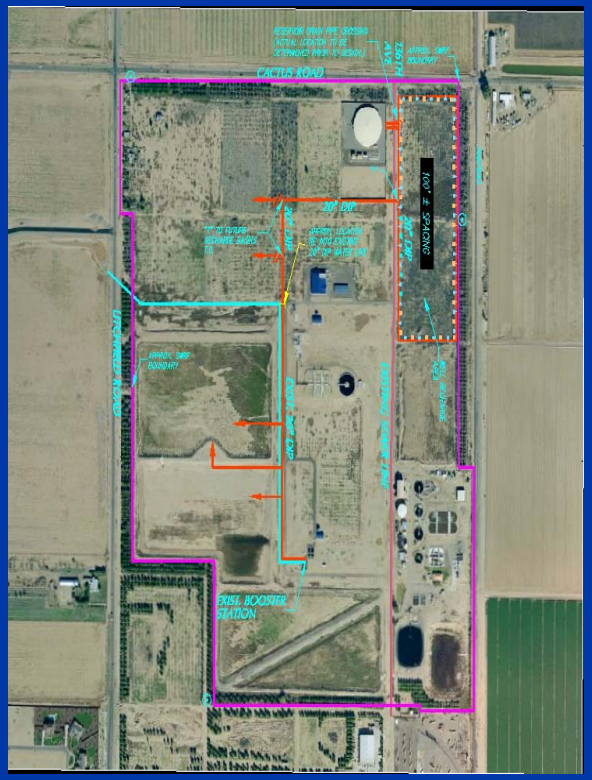
SURPRISE REUSE-RECHARGE FACILITY

- Resource management vs irrigation disposal
- Master plan, design, construction new facility
- Total recharge for long-term disposal compliance and supply management

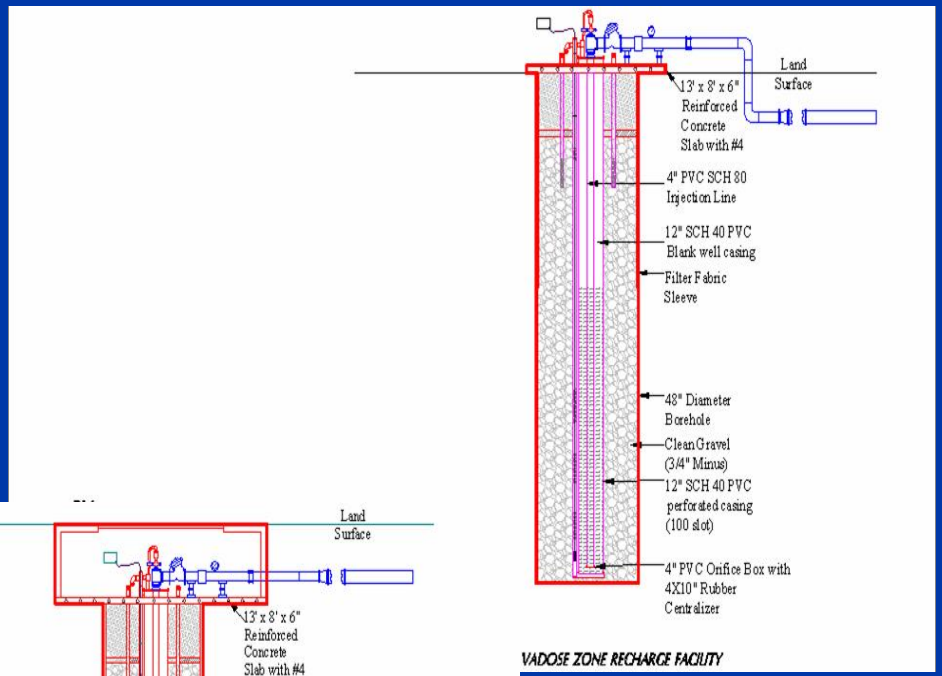
PROJECT CHALLENGES AND ISSUES

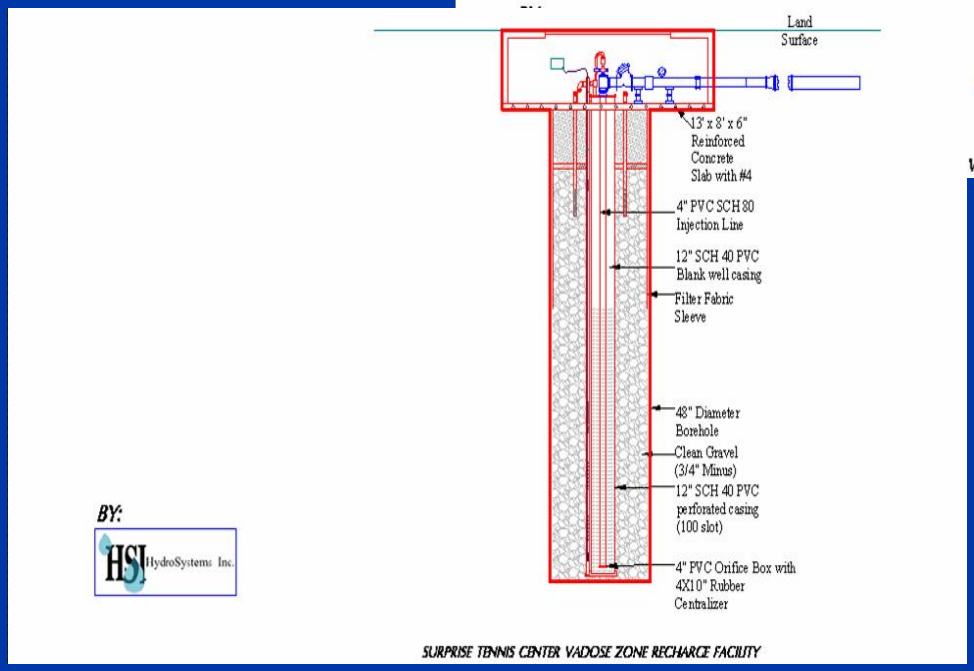
- Permitting challenges – available aquifer “space” and modeling
- Reclaimed water quality (open storage) and enhanced filtration
- Incorporating system construction into ongoing treatment plant expansion

SURPRISE REUSE-RECHARGE SYSTEM



TYPICAL VADOSE ZONE WELLS





Public Works Article

Surprise Project Success Recognized in January 2008 issue of *Public Works* Magazine

Reclaimed Water Supplies Stored for Future Water Source Also Solving Disposal Compliance Issue

Mission: increase contribution to aquifers

Owner: City of Surprise, Ariz., Water Services Department

Project management, planning, civil engineering, filtration design: Lockwood, Andrews & Newnam Inc., Phoenix

Vadose well design and permitting: HydroSystems Inc., Phoenix

Electrical design and integration: DLT&V Systems Engineering Inc., Phoenix

face a plethora of challenges beyond financing. The state Department of Water Resources, for example, places strict limits on how much groundwater utilities can draw, while the Department of Environmental Quality requires any water that's discharged back into aquifers to be Class B quality or better.

After assessing existing and possible future water sources in light of these regulations, as well as growth projections, the city's Water Services Department identified treated wastewater effluent as its primary source of renewable water. The department projects that, by 2020, almost half of the city's effluent—a total of 36,787 acre-feet/year—can be used for irrigation or to replenish groundwater supplies.

To generate that much effluent, the department is more than doubling its wastewater treatment plant's capacity, from 7.2 to 16.3 mgd, and building a network of wells, pipes, booster pumps, and filtration stations to treat and recharge the additional effluent. In anticipation of this $9.5 million upgrade, managers have been shoring up their capital-improvement budget with permitting and other revenues generated by the city's booming economy.

MAKING HIGH QUALITY AFFORDABLE

Until now, the department has stored much of the plant's excess effluent in recharge infiltration basins. Given the price of land around Surprise and the basins' relatively low infiltration rates, the result of soil plugging due to total suspended solids composed mainly of organic materials, building more basins was not the most cost-effective option for storing and treating the expanded plant's excess effluent.

Local consultants proposed using vadose zone recharge wells instead. These wells treat effluent to higher quality levels than surface infiltration basins (for an explanation, see the sidebar below) and are so small that an entire cluster of the wells uses less space than the average recharge basin.

Since its development by the Scottsdale Water Resources Department more than a decade ago, other Arizona cities—including Glendale, Mesa, and Gilbert—are deploying vadose zone recharge well technology.

"By increasing the amount of high-quality reclaimed water that they deposit back into the aquifer, city utilities accrue 'water credits' they can 'spend,' to draw groundwater during system emergencies or supply shortages or as demand rises with population, much like a bank account for water," says Floyd Marsh, water resources manager and practice leader for the Phoenix office of Lockwood, Andrews & Newnam Inc.

"This is the most effective way to recharge underground system," senior project manager Services Department.

CONNECTING TREAT TO FILTRATION

Surprise is installi in conjunction with t expansion so the am treated water matche ment's discharge cap and 2011, a cluster o with pipelines, filtrati pump station modifici tical instrumentation integrated with the plan system—will provide a capacity of 10 mgd.

Each well will b imeter and drilled to 18 water lies 300 to 500 face, water from the through more than 12 gravel, and silt—a pro polishing—before it r

"Permitting agenc advantage because of ment that the water und

To maximize spa placed in a rectangu each located 100 feet configuration that allow to be constructed in b dividual well fails to

The closed-loop reclaimed wastewater

- Diverting it into age basins with a cor 15 million gallons
- Sending the rec set of pipelines using
- Filtering out se solids, and organic ma system connected to t
- Injecting the filt vadose zone recharge
- Discharging the r from the filter system line, where it will be r for recycling.

FUTURE STEPS

The department's to build a second rec

Sorting out solids

The proper filter extends the life of vadose zone recharge wells

A vadose zone recharge well works like a condensed drainage pit.

Adapted from the concept of dry wells that collect and disperse stormwater runoff in parking lots and other large paved areas to the underground, vadose zone recharge wells are dug in the unsaturated zone of sand and gravel material above the groundwater table, commonly known as the vadose zone. From there, reclaimed water percolates through clay, sand, gravel, and silt layers laterally and vertically into the groundwater aquifer (see drawing).

"While they require less space and are more cost-effective than surface infiltration basins, the wells can't be rehabilitated like other recharge technologies," says Floyd Marsh, water resources manager and practice leader for the Phoenix office of Lockwood, Andrews & Newnam Inc. Well lifespan is estimated at five to 10 years.

Therefore, the water that's injected into the wells must be treated to very high levels—preferably Class A+ quality—to prevent clogging from particulates such as total suspended solids and total organic carbons. In addition to slowing infiltration, these materials lessen the well's effective life.

"The reclaimed water has a high nutrient load, which allows bacteria already in the soil to flourish," says Gary Small of Phoenix-based HydroSystems Inc., which specializes in developing recharge solutions. "Disinfecting and filtrating at the surface helps to ensure that the water injected into these wells is of a very high quality."

To achieve this objective, the project team recommended a filter that has 98% particle removal efficiency and provides a cost-effective solution with a small footprint.

Instead of a membrane, the AFR Series-8 internal backflushing filter from Eaton Filtration of Portage, Mich., uses a stainless steel wire mesh screen to filter suspended solids and micro-organisms down to 2 microns. Filters used in Surprise, Ariz.'s project will remove 5-micron particles at a removal efficiency of 98.6%.

Typical design for a vadose zone recharge well in Surprise, Ariz.

Source: HydroSystems Inc.

Web extra: To see how the Water Services Department of

Water reclamation

Drought busters

A desert city ensures long-term water supply with small-footprint recharging technology.

Ever sunny and warm, Arizona continues to be one of the nation's fastest-growing states. But while the influx of aging baby boomers and new business is good for the economy, it requires water providers to be increasingly innovative to ensure supply meets demand. In a state that's mostly desert, this means going beyond asking residents to use brooms to sweep sidewalks and driveways, water early in the morning or evening, and make sure that sprinklers aren't spilling water into the street.

Located about 30 miles outside of Phoenix, Surprise, Ariz., is the second fastest-growing suburb of the state's largest city. Like much of the West, what was once a small farming town now encompasses almost 70 square miles of residential and commercial development. A new home was built in Surprise every three hours in 2005, and, at that rate, population is expected to increase 72% by 2020.

In Arizona, water managers tasked with ensuring supplies meet future demand

This storage basin holds millions of gallons of high-quality reclaimed water treated at the wastewater treatment plant operated by the Surprise, Ariz., Water Services Department. Before it's recharged into the city's vadose zone wells, the water is filtered to remove suspended solids and organic material down to five microns. Removing this material extends well life by minimizing plugging. Photo: Lockwood, Andrews & Newnam Inc.

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GLENDALE RECHARGE EXPANSION

- Subsequent phase under existing permit
- Expansion (4 wells) and rehabilitation of initial well (8 wells) system
- Six month recharge season plus redundancy to effluent recovery distribution system (ERDS)
- Design, test wells and filtration testing
- CMAR delivery method

GLENDALE RECHARGE FACILITY EXPANSION

PROJECT CHALLENGES AND ISSUES

- Ineffective performance of existing recharge system
- Filtration of reclaimed source water
- Integration of system operation with existing reuse system and recharge wells
- Dedication of booster capacity among existing wells, new wells and effluent recovery distribution system

QUEEN CREEK FEASIBILITY STUDY

- Maximize direct reuse and recharge for resource management
- Achieve water supply sustainability
- Comprehensive reclaimed system tied to multi-party IGA
- Pre-design through 3 implementation phases
- Implement through Design-Build-Finance

PROJECT CHALLENGES AND ISSUES

- Feasibility stage to pre-design (maximize direct reuse or recharge)
- Route alignment
- Recharge siting and permitting
- High capital costs
- Funding and implementation challenges

QUEEN CREEK REUSE/RECHARGE FEASIBILITY

SUMMARY

- Reclaimed water = renewable and sustainable supply
- Both direct reuse and recharge for storage are complementary management options
- Recharge well is effective technology
- Project design is site specific

Thank You!

Questions?

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