Water Well Drilling
Applications

Municipal Water Supply

Agriculture-Irrigation Wells

Mine Water Supply

Mine Dewatering

Beverage Water Supply
The role Hydro Resources plays in the water crisis

- Hydro Resources drills to provide water to drink and to grow food.
- 60% of available water to the public comes from groundwater.
- 40% of California’s water is used for agricultural purposes, most of this is groundwater as well depending on the grower. Ground water is utilized for many reasons such as water availability, farmers may not have convenient access to water from municipalities, water districts, and it is costly to purchase and pipe in water from municipalities.

  - [http://www.watereducation.org/](http://www.watereducation.org/)
Steps to Producing Water

Sub-Surface Imaging
Pilot Hole
Geophysical Log
Ream Production Hole
Drill fluids
Set Casing
Gravel Pack
Sanitary Seal
Develop Hole
Remove Solids from Hole
Stimulate
Set Pump
Test Pump for Gal/minute yield
How is our process different than that of Oil and Gas?

- Size of the operation (foot print)
- Diameter of borehole
- Skillset of the personnel
Flooded Reverse Circulation Drilling

- The Flooded Reverse Circulation method is normally employed in drilling large diameter wells in unconsolidated formations.

- As the drill string and drill bit rotates, cuttings are returned to the surface through the drill pipe, rather than the annulus. Water from a supply pit near the rig circulates to the open drilled hole. This water serves to raise the water level in the drill hole to pit level so that hydrostatic pressure is applied against the wall of the open hole to prevent caving.

- The fluid level must be maintained at or near surface to maintain borehole integrity.

- The fluid moves downward in the annulus at low velocity, and is returned with the cuttings inside the drill pipe, at a high velocity.
Flooded Reverse Circulation Drilling Circulation Methods

- Air assist
  - Shallow, Large Diameter Application
Dual Wall Flooded Reverse

- Consolidated Formation
- Top Head Drive
Water Well Drilling Safety Considerations

- Large footprint that contributes to tight working quarters
- Leading edges
- Noisy environment
- Rigging and lifting
- Rotating equipment
- Overhead obstructions (power lines)
- Heavy equipment
- Repetitive motion
- High pressure hoses
- Chemical exposure
Features

- Drilling Fluid Control
- Sampling Quality-Cuttings Return Flow Path and Speed
  - No Mixing of Cuttings or Washouts due to path and low annular velocity
- Formation Contamination Control
  - Low Pressure on Formation
  - Not Circulating cuttings in fluid up annulus
- Deviation Control
  - Large Diameter Tooling and BHA to apply weight directly to drill bit
Advantages

Lighter Weight Drilling Fluids
  Polymer Base
  Less Formation Pressure

Sample Collection
  Rapid Return of Cuttings to Surface
  Less Mixing

Well Development
  Easy to Break Down Fluid
  Wall Cake is very thin

Lost Circulation
Circulation Systems

- Containerized Mud System
- Solids Control
- Earthen Pits
Tooling

- 6” to 8” Inside Diameter Drill Pipe used in Air Assist Flooded Reverse
- 7 x 4, 8 5/8 inch x 4 and larger dual wall RC Flooded Reverse Drill Pipe
- Large Diameter Drill Collars to apply weight directly to bit
Tooling

- Drag Bits
- PDC
- Tricone
  - Mill Tooth
  - Button Bits

Reamers/Hole Openers
Stabilizers
Roller Reamers
Well Development

- Bailing
- Jetting
- Dual Swab Airlift
- Pump/Surge
Lost Circulation

- Dual Wall RC is very good in lost circulation environment

- Reverse Mud Rotary is good in lost circulation environment only if borehole is competent and static water level is high enough to allow for effective circulation with the interior airline.
Projects

- Municipal Well

- Deep Agricultural Well using Air Assist Flooded Reverse
Summary

- Choose the Drilling Method to Meet the Project Goals and Geologic Conditions

- Flooded Reverse Circulation is a very good method for drilling of large diameter, high volume production wells.

- Proven in Mine Dewatering process as the most effective drilling method.

- Drilling Fluid Control is a very important factor in any drilling method.

- Well Development is critical to the life of the well. Do not step over dollars to pick up a dime.

- Your friendly drilling contractor is a great source of information as you design your well.
Questions?