The Role Hydrogeology Will Play in Stabilizing Afghanistan

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OUTLINE

• Afghanistan overview
• Military water requirements
• Local population water requirements
• Military initiatives
• USGS initiatives
• Conclusions
AFGHANISTAN OVERVIEW

• Mountainous terrain
• Arid to semi-arid climate
• Limited surface water
• Population: 30.5 million (estimated)
KABUL BASIN

Sparse precipitation
Melting glacier
Evapotranspiration
River
Water table

Not to scale

Sediments
- $0.24$ ac Fan alluvium
- $0.10$ Loess
- $0.2a$ Conglomerate
- $0.1a$ Alluvium

EXPLANATION
Bedrock
- Sandstones
- Limestones
- Metamorphics
- Intrusives
- Irrigation system
- Homes
MILITARY REQUIREMENTS

- Large bases and smaller Forward Operating Bases
- Fluctuating troop levels
  - 40,000+ in 2006
  - 100,000+ in 2010
  - 10,000+ in 2015
- Water usage: 50-120 liters per Soldier per day
- Impact on local water supplies?
• Primary water supply for most locations
• Larger base wells
  – Treatment prior to use: Filtration, RO, Disinfection
  – Full time contractors operate water points
• FOB wells
  – Treatment: typically disinfection
  – No full time water system operator
  – Coliform bacteria most common contaminant
    • Chlorination reduces risk
DRINKING WATER TREATMENT
NEW FOB WELL

“Modern Drilling Machine”
2001: 13% had access to safe, potable water

2012: increased to 46%
  - Rural: 25%

Water consumption: 20-40 liters/day

Infrastructure

Water quality

Reliance on drilled wells
Since at least the time of Alexander the Great several millennia ago, Afghans have been using *karez* systems for irrigation and water transportation purposes. They dig a well in an alluvial fan, then dig out gently sloping tunnels that can travel thousands of kilometers before surfacing.
MILITARY INITIATIVES

- U.S. Army Public Health Command
- Drinking Water Surveillance (annual)
  - Treated and raw (untreated) water
  - Health risk management
  - Central database
MILITARY INITIATIVES

• U.S. Army Corps of Engineers (USACE)
• Several projects coordinated with USGS
• Afghanistan Watershed Assessment project
  – Identify and evaluate small to medium scale water resource projects
  – Mostly via remote sensing
• Groundwater studies
USGS INITIATIVES

• Kabul Basin
• Helmand Basin
• Capacity building
• Hands-on training
• Support to Afghan Geological Survey
WATER QUALITY

- Groundwater contaminants at military sites
  - Magnesium
  - Sodium
  - Sulfate
  - Nitrate
  - Turbidity
  - Boron
WATER QUALITY

- Groundwater contaminants in Kabul Basin
  - E. coli
  - Nitrate
  - Boron
  - Chloride
  - Sulfate
  - Total dissolved solids
CHALLENGES

• Outdated groundwater laws
  – Growing number of new wells
  – Overpumped aquifers
• Lack of hydrogeologic knowledge in remote areas
• Controlling sources of contamination
• Climate change
  – Reduced recharge
  – Melting glaciers
CONCLUSIONS

• Afghanistan presents many hydrogeological challenges

• Access to safe, potable water is a key concern for both military forces and local population

• High risk of depleting groundwater supplies in near future

• Water will play a large role in bringing long term stability to Afghanistan
QUESTIONS?