Water Storage Ponds

Kabul, Afghanistan
February 2011

This watershed rehabilitation and restoration training was prepared by the U.S. Department of Agriculture (USDA) team of Jon Fripp (Civil Engineer – USDA/NRCS), Melvin Westbrook (Director USDA-NRCS/IPD), Otto Gonzalez (International Agricultural Development Specialist - USDA Foreign Agricultural Service), Clark Fleege, (Nursery Manager, USDA Forest Service, and George Hernandez (Forester - USDA Forest Service), Rich Weber (Civil Engineer – USDA/NRCS) in consultation with Lief Christenson, (USA CJTF101 Water Resources Coordinator, Afghanistan). Contact Jon Fripp at jon.fripp@ftw.usda.gov or Otto Gonzalez at Otto.Gonzalez@fas.usda.gov for more information on this workshop.
Module Topics:
• Purpose of Ponds
• Types of Ponds
• Pond Design Issues
• Field Exercise
Purpose of Ponds

• Provide Source of Drinking Water for Livestock
  • Improves Grazing Distribution
  • Increases Health of Grass
  • Increases Animal Production
• Grass Health Increases
  • Infiltration of Rainfall and Snowmelt
  • Soil Health
• Grass Health Decreases
  • Erosion and Sediment Deposition
  • Downstream Peak Discharges in Streams
Three Types of Ponds

Embankment Ponds

Pit Ponds – Surface Runoff

Pit Ponds – Groundwater Source
Pit Ponds

• Pond is Excavated
• Excavation is Placed as “Spoil”

• Water Comes From –
  • Surface Runoff
  • Bottom of Pond is Below Groundwater Table
Embankment Ponds

Installed on Streams to Capture Surface Flow

• Subject to Failure
• Risk Downstream Due to Breach
• Design Requires Knowledge of Watershed Hydrology, Soils, Drainage Area, etc.
Considerations:

- Embankment Ponds are Complex
- Embankment Ponds Require Maintenance
- Embankment Ponds can Fail

- Pit Ponds are Simple
- Pit Ponds Only Fail by Silting up
- Pit Ponds Cannot Create a Downstream Hazard

- ALL Ponds are for supplying LIVESTOCK water
- Should not be relied to supply safe drinking Water for human consumption
Pit Ponds
Pit Ponds

Watershed Boundary

Pond Inflow

Spoil

Pond Outflow
What Can Possibly Go Wrong With This?

Sediment Inflow

Leakage Through Bottom
Avoiding “Silting Up”

Site pond adjacent to the direct inflow. High velocity flows and sediment will bypass the pond, but backwater can still get in.
Preventing Leakage

Soil Investigation
• Clays will hold water
• Sands and Gravels Will Leak
Groundwater Ponds

• Leakage is not an issue
• We want groundwater to “leak” in
• Look for Floodplain Sites in the Transition Zone
• Look for wet sites on the Collection Zone
• Look for High Groundwater Table
• Usually Associated with Sandy, Gravelly Soils
• Site Pond Well Away From Direct Stream Flow
Groundwater Pond Sites

Here?

Here?
Groundwater Pond Sites

Here?

- If there is a high groundwater table

Maybe-
Groundwater Pond Sites

Why put a pond here?
Soil Types

Surface Runoff Pond
• Clays and Silts

Groundwater Pond
• Sands and Gravels
Handy forms are available
We need to make decisions about –
• How long
• How wide
• How deep
• How much earth to move
### Design Layout

<table>
<thead>
<tr>
<th>BM</th>
<th>Backset (FS)</th>
<th>Height of Instrument (FS)</th>
<th>Foresight (FS) or Grade Rod</th>
<th>Elevation or Plumb Elevation</th>
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<tbody>
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#### BM
- Top of Dam
- ASW
- PSW
- Design Bottom

#### Auxiliary Spillway (ASW), Principal Spillway (PSW)

#### Excavation Volume Computations

- Total of Top Lengths (L) = 266.1 feet
- Total of Top Widths (W) = 177.2 feet

Top Area = (Average Top L) x (Average Top W) = \( \frac{133.05 + 193.1 + 193.1 + 133.05}{4} \) x (Average Top W) = 11,788 sq ft

Bottom Area = (Average Bottom L) x (Average Bottom W) = 60.0 x 40.0 = 2,400 sq ft

4 x Median Area = (Avg. Top L + Avg. Bottom L) x (Avg. Top W + Avg. Bottom W) = 24,826 sq ft

Average Depth = 8.1 foot

Excavation Volume = Average Depth x Sum of Areas = 316,017 cubic yards
# Toe Staking

<table>
<thead>
<tr>
<th>Toe Stake Pit Pond</th>
<th></th>
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<td>BM</td>
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<tr>
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<tr>
<td>Right Toe</td>
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</tr>
<tr>
<td>Right Toe</td>
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<tr>
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</tr>
<tr>
<td>End Toe</td>
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</tr>
<tr>
<td>End Toe</td>
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</tr>
<tr>
<td>Ramp Toe</td>
<td>4.3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ramp Toe</td>
<td>4.4</td>
<td></td>
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</table>

Toe Distances are from bottom flags at corners

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**Date:** 5/1/2011  
**Survey Party:** Spc Bailey, MSGt. Snorkel  
**Weather:** Hot, Dusty

**Painted Boulder NW of Pond**

**Planned Bottom Elevation**

- C 8.4 @ 25.4 (3:1)
- C 7.9 @ 23.7 (3:1)
- C 7.1 @ 21.3 (3:1)
- C 7.2 @ 21.6 (3:1)
- C 8.5 @ 25.5 (3:1)
- C 8.6 @ 25.8 (3:1)
- C 6.9 @ 41.4 (6:1)
- C 6.8 @ 20.4 (6:1)
Considerations

• Depth – A practical limit is 8 feet
• Shape – They don’t have to be square, but you can stake out and measure a square one easier
• Size – Site limitations may dictate size more than the volume of water needed
• Construction – Local hand labor. Need to get local estimates for cubic yards per day per laboror
• Slopes – 6:1 for watering access slopes for cattle, 3:1 on remainder of slopes.
Field Exercise