Introduction and Overview of Wetbud

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http://www.landrehab.org/WETBUD
Who’s doing what?

Zach Agioutantis, Univ. of Kentucky -- Programmer & MODFLOW
W. Lee Daniels, Virginia Tech -- Program coordinator & gadfly
Ben Hiza, Old Dominion University – Julie Metz models / groundwater
Stephen Stone, Old Dominion University – Huntley Meadows models
Tess Thompson, Virginia Tech – Surface water & ET estimators
Rich Whittecar, Old Dominion University – Groundwater & MODFLOW

Previous Graduate Students: Kerby Dobbs, Matt Gloe, John McCleod, Eric Neuhaus, O. Waverly Parks, Candice Piercy, Tracy Thornton, Cal Smith

Research Associates/Specialists: Dan Evans, Katie Haering, Sara Klopf and Laura Lehman.
One version of the “water budget” from a popular text.

Note missing direct ppt input to wetland and no overbank inflow.
Created Wetland Water Budgeting

- Wide variation in water budgeting approaches among agencies and consultants.

- Many agencies follow and/or recommend variations of the “Pierce Approach” whereby ground water flux is presumed minimal, ET is estimated via Thornthwaite, runoff additions are estimated via SCS/NRCS Runoff Curve Number Method, water is presumed to be detained over the site via a berm, and water level is controlled via an outlet, etc.
A “simple” way to create a mitigation wetland is to create a perched system. Can work on hilltops with low permeability compacted subsoils.
Wetland creation site in mineral flat or pocosin type landform. Here, designers presumed that excess rainfall vs. ET + minimal infiltration losses would drive the annual water budget. Before adjustments were made, this site was “too dry” in summer, but very wet in the winter.
Surface soil from the same wetland.

Note massive structure in surface breaking to firm plates at about 20 cm. This is the “traffic pan” that was designed to perch the water table, but also led to extremely dry summer conditions.
Water Budget Model Issues

- “Bath Tub” vs. Sloped Systems
- Vegetative Flow Resistance
- Groundwater Inputs vs. data?
- Overbank Flow Contribution
- Which Precipitation Data?
- Variations in ET Estimators
- Complex topography
Fort Lee Water Budget Studied by USGS & Virginia Tech in late 1990’s.

> 20 wells/piezometers monitored for > 2 years along with direct measurements of all water budget components.
Ft. Lee Wetland

May 1, 1998 to April 30, 1999

Net Loss of 0.01 in (0.30 cm)

Surface In
4.08 in (10.36 cm)

Surface Out
32.14 in (81.64 cm)

Precipitation
35.43 in (89.99 cm)

Evapotranspiration
38.32 in (97.36 cm)

Net Groundwater In
52.24 in (132.69 cm)

Net Groundwater Out
21.29 in (54.08 cm)

Runoff In
10 cm of
90 cm of rain In (dry year)

Runoff Out
80 cm of

98 cm of ET Out

GW In
132 cm of
g

GW Out
55 cm of
Growing Season

Hydroperiod for one zone in Fort Lee wetland (7-4) vs. adjacent natural wetland (REF3A). How do we pick a design target? Here it was just lucky.

Less than 20% of this site exhibited a hydroperiod similar to well 7-4. Around 40% was much drier and the rest was much, much wetter.
Piedmont Wetlands: the interface between uplands, groundwater, and surface water. Primary original focus of research funds; Wetbud works just fine for the Coastal Plain!
Wetbud Basic Version

Wetbud is a design tool for wetland creation

GW flux modeled via Darcy flow approach assuming uphill head data available
Wetbud Advanced Version

Allows for 3-D modeling including multiple water/soil/substrate layers, slopes, variable wetland topography, etc.

Incorporates more rigorous groundwater flux modeling via MODFLOW (basic model uses a simplified Darcy approach)
WetBud – Advanced Version

- **SW\textsubscript{in}**
- **GW\textsubscript{in}**
- **Ppt**
- **ET**
- **GW\textsubscript{out}**
- **Stream**
Model and Component Validation & Calibration

Huntley Meadows – Fairfax
(*detailed ET x 4 and GW studies*)

Northfork Bank – Haymarket
(*basic model + overbank flow*)

Cedar Run 3 – W. of Quantico

Others at Julie Metz, Bender Farms, Pocahontas, etc.
Design Standards Development

**Precipitation**
- Statistically based analysis for wet, normal, and dry rainfall years
- Recommended weather stations for VA/MD
- Tools for auto download of any USA station

**Evapotranspiration**
- Calculates both Penman and Thornthwaite
- For W-N-D years selected by precipitation
- Options for input of pan data, Bowen Ratio, etc.

**Groundwater**
- Measurement protocol recommendations
- Wem: Projection of long term hydroperiod
- Soils data import for Ksat for all VA map units

**Hydroperiod “Library”**
- Developing VA and MD Regional Collection of “typical hydroperiods”
- What is targeted design Hydroperiod for PFO, PSS, PEM?