



Data Collection, Modeling, and Cumulative Impacts in Water Supply Planning

Using water supply plan alternatives to determine optimal long-term water availability, reliability, storage, and drought response



Virginia Water Supply Modeling

Cumulative Impacts Model for entire state

- Basic Meta-Modeling details
- Implementing all permit rules, storage capacities, withdrawals, discharges
- Impacts to all beneficial uses: off-stream (perm./ex./gf), in-stream (aquatic life, WQ)

Water Supply Plans

Modeling scenarios of interest

Commitment to open standards for data sharing and interoperability

Three Inflow Models and a Meta-Model

USGS "Baseline"

Flows + WD - PS

Process Based:

- VAHydro: USGS/CBP Model with Enhanced WD Rules
- 1-hour time step

Probabilistic:

- Flow models from USGS partial & ungaged streams

• **Meta-Model:**

- Operations & Meta-model linkages
- Web-based, multi-user interface

The screenshot displays the USGS 'Baseline' web interface in Mozilla Firefox. The browser address bar shows the URL: <http://...php>. The page title is 'Clearing model element cache'. The main content area is divided into several sections:

- Project Information:** Project Type: Off-Stream Storage. Description: Pumped storage project, from Rapidan-return flowz go to Rapidan.
- Project Access Control:** Group: VWP Permit Writer. Public Perms: Read-Only.
- Current VWP?** False. VWP ID: 11-1068.
- Current VPDES?** False. VPDES Outfall No.: [Field].
- Current VWUDS?** False. VWUDS MP ID: [Field].
- Withdrawal Details:** Annual Limit (MG): 1277.5. Single Monthly Limit (MG): 200. Single Day Limit (MG): 11. Source Stream: Rapidan River. Flow By: (Direct withdrawals & Pump Storage). Select Type: Simple.
- Simple Flow-By:** Description: 10% of instantaneous flow may be diverted. cfs. Index Variable: Month.
- Estimated Use Data:** Table with columns: month_num, pct_of_annual. Rows 1-10.
- Reservoir Storage Info (if applicable):** Has on-site storage? False. Latitude: 38.26991. Longitude: -78.370792. Maximum Storage (ac-ft): 2762.0. Initial Storage (ac-ft): 2762.0. Unusable Storage (ac-ft): 100. Drainage Area (sq. mi.): 0.3. Reservoir Refill Limit (MG/year): [Field]. Reservoir Geometry: storage, stage, surface_area.

A map on the right side shows the 'Intake Drainage Area' with a red outline and a green dot for the 'Rapidan River' intake location. The map includes a legend and a 'Map' button.



Water Supply Plans

- ◆ **Inventory of Users:**
 - **Community Water Systems**
 - **"Self-Supplied Users" > 300k g/mo**
 - **"Self-Supplied Users" < 300k g/mo**
 - **Agricultural Users**
- ◆ **Predicted Change in Demand**
- ◆ **Alternatives for un-met demand**
- ◆ **Users that are not in our database (SSU < 300k)**
 - **A single 0.01/0.03 MGD user is not significant, but 100 are**
- ◆ **Plans going into Web-Based CMS for update by localities beginning in 2013/2014**

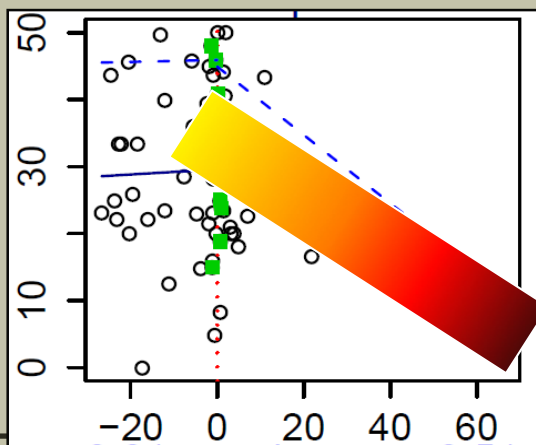
Flow Ecology Modeling

Expand & Solidify Scientific Basis for Instream Flow Recs

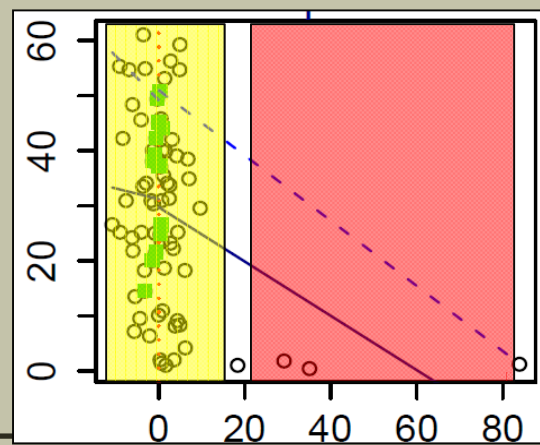
Provide basin specific impact estimation and resource valuation.

A “3-tiered” approach to developing flow ecology relationships

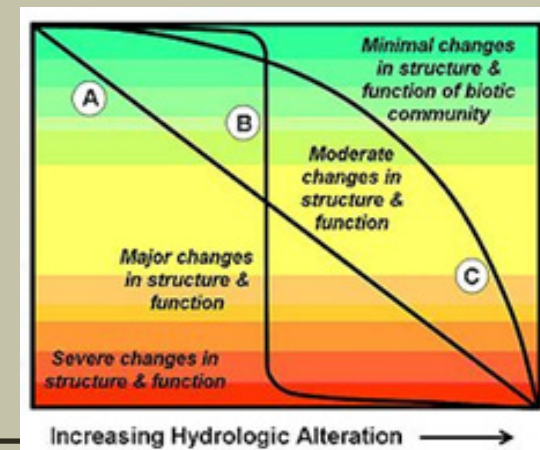
- **Tier 1** – Continuous curves describing the incremental relationship between biological health and flow alteration
- **Tier 2** – Binary curves, dividing the alteration spectrum along the line after which substantial degradation would be expected to occur.
- **Tier 3** – Best professional judgment, and non-site specific model curves. May be binary or continuous.



Tier 1: $E = f(h)$



Tier 2: Binary



Tier 3: Best Prof. Judge.



Current/Historical Data/Modeling Scenarios

Historical Time Series

- Daily withdrawal rates, from monthly reported withdrawal (1986 to present)
- Point Source Discharges (VPDES)

Current Time Series

- Average demands from most recent 5-year period as reported to VWUDS/VPDES
- Withdrawal rates vary by month
- Raw monthly values, or permit rule influenced
 - ◆ Dams/withdrawals modeled releases/flow-bys where known



Future Scenarios

“Permit Term”

- Likely demands over current permitted term (ending 15 years hence)
- Monthly Varying/Daily Time Series

“Safe Yield” or “Full Allocation”

- All grandfathered, exempt and permitted pulling at maximum allowable

30-50 Year Planning Horizon

- Demands and sources from planning submittals
- Multiple scenarios based on alternatives from plans and optimization runs



Web-Based Data Sharing Methods

XML/CSV Feeds:

- Lat/Lon Based Monthly Historic & Current scenarios now available
- Future Modeling Scenario feeds available soon

Real-time Feeds:

- Time series flows submitted to server via POST command
- Server returns withdrawal time series



Status of Tools / CIA


State-wide baseline flows and “current” water budget modeling completed

VWP Permit rules ~30% completed

Meta-Model architecture integration of multiple models (HSPF, IFIM, etc.)

Future use (“safe yield”) model framework draft completed and tested

First Cumulative Impact models completed for permitting activities in late 2011



Ongoing Modeling & Interstate Collaboration

Future Data Feeds:

- “Permit Term”, “Safe Yield”, and “Planning Horizon” – begin Fall 2012
- Groundwater Pumping Impacts begin ~2014

We Support Using this Joint Model for planning purposes for the work of the Roanoke River Bi-state Commission