Hydrology Monitoring in New Jersey Pinelands and Coastal Wetlands: Methods and Applications

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Disclaimer – I am an NOT a hydrologist (but I do hydro monitoring with a lot of help)!
1. Why monitor hydrology?
2. What do you need to know? Be specific.
3. The importance of geomorphology and soils
4. Hydrology, geochemistry and wetland dynamics
5. Duration and frequency of sampling
6. Approaches to monitoring hydrology
7. Hydrology monitoring equipment options
8. Data & interpretation
9. Application of findings
10. Hydrology resources
1. Why monitor hydrology?

✓ Driver of soil characteristics and vegetation patterns
✓ To determine HGM characterization
✓ To detect changes over time
✓ Hydroperiod and relationship to vegetation zonation
✓ Determine dominant source(s) of water
  ▪ Groundwater (shallow, deep) – vertical vs horizontal
  ▪ Surface water – source and direction of flow
  ▪ Precipitation and timing of response in wetland
  ▪ Tides (freshwater, brackish or saline)
✓ Restoration & Mitigation
2. What do you need to know? Be specific.

- Climate change driven changes in hydroperiod and its effect on vegetation (*e.g.* sea level rise and tidal/salinity influence)?
- Long-term hydrologic trends for a particular wetland type (*e.g.* intermittent pond, marl seep)?
- Changes in source of water due to human influence (*e.g.* regional well water withdrawal)?
- Discharge/Recharge function of a wetland complex (*seasonal shift due to drought*)?
- Restoration success/failure – why?
Be sure to frame your questions well so that you will get relevant answers ...

Then

ASK A HYDROLOGIST FOR HELP!!

(who will inspire more questions and refine your framework to make it more realistic ... )
3. The importance of geomorphology and soils

- Geologic history and geomorphology influence hydrodynamics
- Bedrock and surficial geology play a huge role in how water moves
  - Karst (*conduit system*)
  - Sand aquifer (*porous*)
  - Periglacial landforms (*legacy*)
  - Clay lens perched WT
- LEGACY: Hydrological–Geomorphic–Biogeochemical
- *(thanks Dave Goehrman!)*
Identify your study site(s) and geologic setting ...

Then

ASK A GEOLOGIST FOR HELP!!

... who will inspire more questions ...
4. Hydrology, geochemistry and wetland dynamics

• Look at maps and imagery (particularly historic) to better understand landforms and landscape dynamics
• Use all GIS resources available – Land Use, Hydrography, LiDAR, SURGO, etc
• Find all relevant hydrology and geochemistry data for the site
• Visit the site (if you haven’t already done so) and observe hydrology
5. Duration and frequency of sampling

- Long-term multi-year monitoring?
- Short-term seasonal study (*snapshot*)?
- When to start - what time of year?
- Sampling frequency – Once a month? Hourly?
  
  *A hydrologist or hydrogeologist can make recommendations.*

- Adaptive monitoring – be ready to change strategy if necessary (based on prelim data or necessary modifications to design).
6. How to conduct hydrological monitoring

- **Up-front effort is time and resource intensive**, but makes follow through easier and the data more likely to answer the questions posed.
- Simple monitoring – e.g. seasonal hand measurement of water depth at set location
- Moderate effort monitoring – e.g. CPIP monthly over years
- Intensive monitoring effort – automated hourly water level measurements (SLF, CPIP) with multiple wells/piezometers
- Triangulation of well geometry (horizontal movement) plus shallow/deep paired wells (vertical movement)
7. Hydrology Monitoring Equipment Options

• Gauge and binoculars
• Metric tape, Rebar, Meter Stick, Compass
• Piezometer (PVC) and M-scope
• Piezometer (Galvanized with locked cover) and automated water level data logger equipment (In-Situ, Hobo, Solinst)
• Precipitation gauge
Tools for measuring water level
8. Hydrology Data Interpretation

• Simple hydrograph (water depth x date)
• Multiple well data interpolation
• Influence of groundwater, surface water, precipitation
• Tidal influence (often need WQ data)
• Modeling options
9. Applications of hydrology data

• Determining hydroperiod and vegetation dynamics for condition assessment targets
• Long-term trend analysis (*CPIP and rare plant monitoring*)
• Best management practices (*SLF OMWM*)
• Modeling of site dynamics and vegetation patterns (*Pinelands Commission – KC study*)
• Restoration – integrated and adaptive management
Hydrology characterization (seasonal water level fluctuations, hydroperiod by veg zone) for rare calcareous sinkhole pond study in karst landscape in NJ.
Pine Barren Riverside Savanna geomorphology, paleoecology, and hydrology monitoring
Surficial geology – geomorphology transects and piezometer locations in hydrology monitoring at PB Savanna
Long-term hourly WL monitoring at CPIP (2007-2016)
Hydrology monitoring used to understand the influence of groundwater and tidal flooding at a rare sea level fen pre- and post-OMWM treatment on adjacent salt marsh in NJ. Data used to update best management practices (NOAA funded study).
A network of 23 groundwater piezometers and 3 surface water gauges placed in sea level fen and adjacent freshwater swamp. Sampled for 11 months (April ‘05–March ‘06)

7 Regional groundwater wells (to determine direction of flow)
OMWM Pond Site:
8 piezometers: 7 shallow (3 ft) + 1 deep (12 ft)
2 surface water gauges (tidal ditch, OMWM pond)
Control Site
8 piezometers: 7 shallow (3 ft) + 1 deep (12 ft)
1 surface water gauge (tidal ditch)

Elevation surveys (NAVD88) of all wells were completed to have true tidal and ground water elevation data.

Continuous water level monitoring probes were installed in various sets of wells and moved periodically to determine water source, regional groundwater patterns and site specific responses to precipitation and tidal events.
Water-level data can be used to construct vegetation-hydrology models that describe the probability of finding the forest communities at various water levels. These models can be used to estimate changes in area occupied by wetland-forest communities in response to declines in groundwater level.
Application: Changes in pond-vegetation communities can be estimated under various water-depth reduction scenarios.
10. Resources

USGS – surface and groundwater well data
http://waterdata.usgs.gov/nj/nwis/gw/
http://nj.usgs.gov/infodata/groundwater.html

State Geological Survey – Bedrock and surficial geology
Maps and digital geodata ambient groundwater network
http://www.nj.gov/dep/njgs/

Office of the State Climatologist – precipitation data
http://climate.rutgers.edu/stateclim/

ASWM Hydric Soils Training Series Webinars (1-4)
http://www.aswm.org/wetland-science/soils
(particularly #3 Landforms and Landscapes)
Hydrology Monitoring Take Home Messages

ASK FOR HELP!
(from a professional hydrologist)

- Build into grant funding the capacity to hire a hydrologist and a geologist to help design and implement your hydrology monitoring study.
- Design hydrology monitoring carefully to get good and meaningful data.
- Choose appropriate equipment for chosen level of monitoring intensity.
- Adaptive monitoring – be ready to change strategy if necessary
Thank you!

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