Source Water Protection & Watershed Restoration in the Raritan Basin

NJ Water Supply Authority
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www.raritanbasin.org & www.njwsa/wpu
www.njriverfriendly.org  www.njriverfriendlyfarm.org

7th Annual Water Monitoring & Education Summit
November 18, 2009
NJ Water Supply Authority

• Manage Spruce Run, Round Valley & Manasquan Reservoirs, D&R Canal as water supply sources
• Raritan System provides water supply to public & private water utilities serving 1.3+ million people in Central NJ

• Management of water supply infrastructure
• Watershed management planning & implementation projects
• River-Friendly programs
• Open space preservation & management
• Stream assessment & restoration
• Stormwater management projects – planning & implementation
Raritan River Basin

- Largest river basin located entirely in the state of NJ
- ~1,100 mi², parts of 7 counties & 100 municipalities
- Surface water systems provide water to 1.5 million people
Why Source Water Protection?

Spruce Run and Round Valley Reservoirs provide 160 MGD to Central New Jersey (part of 225 MGD system)
Round Valley – pumped storage
Spruce Run – natural stream flow

Spruce Run Reservoir showing impacts of excessive nutrients and sediments

Tributary streams showing impacts of land uses and stormwater
Protecting Water Resources

What to Do?
Assess Current and Future Problems
Protect Critical Areas
Prevent Increased Pollutant Loads and Stormwater Flows
Remedy Existing Problems

How to do it?
• Stormwater improvements
• Riparian buffer improvements
• Stream restoration projects
• Land acquisition
• Municipal ordinance improvements
• Better land management by existing land uses
Raritan Basin Partners

• Watershed Associations
• Nonprofits – North Jersey RC&D, NJ Conservation Foundation, Hunterdon Land Trust Alliance, Land Trust of NJ
• Municipalities
• Counties
• Educational Institutions – Rutgers University, NJ Institute of Technology
• Utilities – Middlesex Water Company, New Jersey American Water Company, Stony Brook Regional Sewerage Authority, Middlesex County Utilities Authority, Morris County Municipal Utilities Authority, Somerset Raritan Valley Sewerage Authority
• State agencies – Delaware & Raritan Canal Commission, Highlands Council, NJDEP, NJ Department of Agriculture
• Federal Agencies – NRCS, US Department of Agriculture, USGS, USEPA
• County Soil Conservation Districts
• Americorps Watershed Ambassadors
• Consultants
……..and many more
• 1999 - Watershed Protection Unit formed
• 1999 - Raritan Basin Council formed to oversee C&A process
• 2001 - C&A completed, 7 technical reports + 3 background reports
• 2001 - WMA committees formed
• 2002 - Basin-wide Management Plan completed
• 2003 - Raritan Basin Watershed Alliance formed
• 2002 and Ongoing - Watershed Restoration Plans
• Ongoing - Implementation Projects
• Ongoing - Monitoring & Evaluation
Raritan Basin
Watershed Management Plan

• 2002, www.raritanbasin.org
• Identified six critical issues:
  • Surface Water Pollution
  • Loss of Riparian Areas
  • Biological Impairment of Streams
  • Loss of Ground Water Recharge
  • Water Supply Limitations
  • Stormwater Impacts
• 30% of historic riparian areas converted to urban and agricultural uses
• Nonpoint sources provide majority of pollutants
Raritan Basin Watershed Planning Efforts
Step 1.
Select a sub-watershed of interest

*Why do you want to do a plan?*
- Preservation
- Restoration
- Implement a TMDL
- Local interest
- Document baseline conditions

*What is the parameter(s) of concern?*
- Phosphorus?
- Sediment?
- Bacteria?

*Use existing models/guidance/data*
e.g. RBWA Riparian Health Assessment
RBWA
Riparian Health Assessment

• Level I: Used available geographic information system (GIS) data at riparian and watershed scale
• Characterization of HUC-14s – In need of restoration, Under stress, In good condition (focus on preservation)
• No field data acquisition
Step 2. Characterization & Assessment

Assemble existing data & compare current status to standards and desired conditions

- Raritan Project C&A Data – groundwater recharge, riparian areas (delineation and losses), water quality, septic system density…
- TMDLs – fecal coliform, phosphorus, temperature
- NJDEP/USGS water quality & flow monitoring
- NJDEP, non-profit, municipal biological monitoring
- GIS layers – parcels, streams, infrastructure, land use
- RBWA Road Crossing Inventory
- Variable source area hydrology – areas that generate the most runoff
- CCPI Model – best areas for BMP implementation
- Municipal information – ordinances, master plan
Open Space Criteria

1. Riparian Area
2. Primary Groundwater Recharge
3. Wellhead Protection Area
4. Critical Habitats

NJWSA Criteria (2009):
- Riparian Area
- Highly erodible soils
- Critical habitat (Landscape Project)
- Dense Forest
- Groundwater & Aquifer Recharge
- Isolated wetlands & buffers
Variable Source Area Hydrology & Critical Source Areas

VSA defined by soil, slope & topographic index

(Qiu, EM, 2009; Qiu et al, JSWC, 2009)
CCPI Model – Ag Buffer Plan

Prioritization of ag lands for restoration

- Soil Erodibility
  - USDA-NRCS Soil Erodibility Index (EI)

- Hydrologic Sensitivity/Runoff Potential
  - Modified Topographic Index (TI) from USDA-NRCS

- Wildlife Habitat
  - NJDEP Non-game and Endangered Species Program’s Landscape Project

- Impervious Surface
  - NJDEP Land Use/Land Cover Data
Step 3. Fill in the data gaps

• Think back to WHY a plan is needed
• What data are needed to determine what & where the problems are?
• What data are needed to identify potential pollutant sources?
• Design a monitoring program & data collection plan
  Water quality monitoring
  Stream assessment
  Infrastructure inventory
  Municipal data
Water Quality Assessment

• For regulatory compliance: measure concentration and flow
  – Caution: concentration alone can be masked by variations in flow volume, need to measure both
  – Analogy: Concentration = strength of lemonade after lemonade mix is added to a glass of water

• For determination of contaminant source(s) and levels of contribution: measure flow and concentration, and estimate load
  – Load = Concentration x Flow (unbiased from any variations in either concentration and/or flow)
  – Analogy: Load = amount of lemonade mix before it was added to the glass of water
Potential Pollutant Sources

**Roads** – total suspended solids, sediment, turbidity, conductivity (also metals and oil)

**Agriculture** – boron, ammonia, nitrate, total phosphorus, coliform bacteria, total suspended solids, turbidity, pH, conductivity, total Kjeldahl nitrogen, sediment

**Septic system and public wastewater discharge** – boron, nitrate, total phosphorus, coliform bacteria, conductivity, total Kjeldahl nitrogen, pH

**Geese and other wildlife** – total phosphorus, coliform bacteria, total suspended solids, turbidity, conductivity, total Kjeldahl nitrogen, ammonia, pH

**Lawn maintenance** – total phosphorus, nitrate, pH

**Streambank erosion** – total suspended solids, turbidity, total phosphorus, nitrate, total Kjeldahl nitrogen, pH, sediment
Stream Assessment
aka – Where are they going with those waders?

- USDA-NRCS Stream Visual Assessment Protocol (SVAP)
- Scores based on physical and biological indicators
- Assess overall stream health
- Identify potential restoration sites – where are the problems and what can we fix
- Completed for Spruce Run, Mulhockaway Creek, Neshanic River, modified protocol for Manalapan Brook
Infrastructure Inventory

Table 10: Stormwater Inventory Summary

<table>
<thead>
<tr>
<th>Feature Type</th>
<th>Description</th>
<th>Located Features</th>
<th>Photographs of Feature Types</th>
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</thead>
<tbody>
<tr>
<td>Stormdrains &amp; Stormwater Ditches</td>
<td>Channels greater than 1 meter in depth which convey concentrated stormwater flows</td>
<td>36</td>
<td>135</td>
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<tr>
<td>Storm Pipes</td>
<td>Structures which convey stormwater or in discharged from a piped conveyance system</td>
<td>45</td>
<td>73</td>
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<tr>
<td>Culverts</td>
<td>Structures through which convey permanent non-groundwater flow through floodplain modifications and other structures</td>
<td>16</td>
<td>135</td>
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<tr>
<td>Catch Basins</td>
<td>Basins through which surface stormwater enters a piped conveyance system</td>
<td>1078</td>
<td>22</td>
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<tr>
<td>Pipe Inlets</td>
<td>Inlet structures which convey stormwater flow under the piped conveyance system via existing or newly constructed pipes to the surface of a ground body</td>
<td>288</td>
<td>22</td>
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<tr>
<td>Detention Basins</td>
<td>Basins or basins areas designed to hold and detain peak stormwater flows caused by interactions surfaces</td>
<td>24</td>
<td>22</td>
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<tr>
<td>Permanent Basins Inlets</td>
<td>Piping which conveys water into a detention basin from a piped conveyance system</td>
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<tr>
<td>Permanent Basins</td>
<td>Pipes which convey water or is discharged from a detention basin</td>
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<td>14</td>
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<tr>
<td>Discharges</td>
<td>Structures which convey the flow of water from the interior of a detention basin to the receiving water body or conveyance in a receiving water body</td>
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<td>潦字管理</td>
<td>Structures created to in the improvement of wetland stand levels</td>
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<td>湖泊 &amp; 连锁</td>
<td>Structures and/or basins between designed to improve water or water bodies which impound water and regulate flow</td>
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<tr>
<td>水系管理</td>
<td>Locations which have known interaction with water or water bodies</td>
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<td>潮湿区</td>
<td>Locations of impacted or potential discharges to water</td>
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Municipal Assessment

Regional Analysis: Lockatong/Wickecheoke Watershed Plan

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<th>Key</th>
<th>No Provisions</th>
<th>Could be Improved</th>
<th>Very Good</th>
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Existing Conditions After Implementation

31 categories - 62 point maximum

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31 categories - 62 point maximum

59 of 62 = 95% 52 of 62 = 84% 58 of 62 = 93% 54 of 62 = 87%
Step 4.
Bringing it All Together: The Watershed Restoration/Protection Plan

• NJDEP – 9 minimum elements
• Identify sources of pollutants
• Recommend projects
• Estimate load reductions
• Timeline
• Figure out how to fund projects
Step 5.
The Fun Stuff-
Implementation
Simple projects and…
….not so simple
River Friendly Programs

- Golf Course
- Business
- Farm
- Resident
Stormwater Improvements

• Retrofit existing facilities- basins, etc.
• Disconnection of impervious surfaces
• Rain barrels/Rain gardens

Rain barrel

Rain garden at Ethicon, Inc.
Stream & Riparian Restoration
Agricultural BMP Implementation
Open Space Acquisition
Education
Municipal Implementation

• Master Plan Updates
  ✓ Environmental Resource Inventory
  ✓ Conservation Element & Open Space Plan
• Land Use and Development Regulations
  ✓ Zoning
    • Minimum lot sizes
    • Impervious surfaces
  ✓ Site Plan Review
    • Cluster / Lot averaging options
    • Protection of critical features
• Best Management Practices
  ✓ Reduction of NPS pollution
Master Plan & Ordinance Revisions

• Stormwater management
  – Regulatory compliance
  – Innovative site design
  – Best management practices

• Protect sensitive areas
  – Limit impervious cover
  – Stream corridor buffer
  – Protection of steep slopes
  – Protection of upland forests

• Design Guides
  – Protect community character
  – Low impact development
Step 6. Monitoring & Evaluation aka how do we know if it’s working (or not)

- Define indicators/criteria
- Define “success”
- Link physical restoration to water quality restoration goals
- Set measurable goals & objectives
- Identify when modifications are necessary

Stream Restoration Project
- Photo-monitoring
- Visual observation
- Macroinvertebrate sampling
- Fish sampling
- Habitat sampling
- Vegetation surveys
- Geomorphology surveys

Stormwater Improvement Project
- Photo-monitoring & visual observation
- Water quality monitoring
Monitoring the Hoffman Park & Crystal Springs Projects

_Pre-Construction:_
- Photomonitoring/Visual Observations – Frequent
- Macroinvertebrate Sampling - 3x/year
- Habitat Assessment – 1x/year
- Geomorphology Survey – once

_Post-Construction:_
- Photomonitoring/Visual observations – Frequent
- Macroinvertebrate Sampling – 3x/year to end of grant period, 1-2x/year thereafter
- Habitat Assessment – 1x/year
- Geomorphology Survey – 1x/year, additional if flows or visual observations indicated need
- Vegetation Monitoring – 1x/year at HP
Hoffman Park: Post-Construction Data
Monitoring & Evaluation (continued)

Estimating Load Reductions
- WQ monitoring is expensive!
- Modeling – simpler way to estimate load reductions
  - STEP-L model
  - WinSLAMM

Open Space
- Baseline evaluation
- Management plan

Adaptive Management
- Plan and budget for it
- Project plan should identify when it is needed, i.e.
  - WQ goals not met in 3 years, or
  - Vegetation survival target not met, or
  - Stream dimensions not achieved
Funding

Be creative!
• NJDEP 319(h) Nonpoint Source Grants
• NJDEP – Corporate Business Tax Funding
• Municipal stormwater mitigation plans
• In-kind services – counties & municipalities
• USDA-NRCS: WHIP, AWEP, EQIP
• Farm Service Agency (FSA): CREP, CRP
• US Fish & Wildlife: Partners for Fish & Wildlife
• US EPA: 5 Star Grant Program
• ANJEC municipal grants
• NOAA
Lessons Learned

- Effective watershed management addresses new and existing development
- Effective implementation requires detailed planning
- Effective projects require partnerships
- Utilize all your contacts/networks
- Be patient
- Adapt projects as needed
- Don’t give up!
NJWSA Source Water Protection Efforts

- Mulhockaway Creek Watershed Plan & Implementation
- D&R Canal Watershed Plan & Implementation
- Rockaway Creek- Protection of Critical Source Areas for Water Resource Protection through Community-based Land Use Planning & Ordinances
- Cedar Grove Brook Watershed Restoration Plan (NJIT lead)
- Manalapan Brook Watershed Restoration Plan (Middlesex County lead)
- Neshanic River Watershed Restoration Plan (NJIT lead)
- Sidney Brook Watershed Restoration Plan (Union Twp. Lead)
- Spruce Run/Rocky Run Stream Segment Management Plan
- River-Friendly Programs - Golf Course, Business, Resident, Farm
- Rain Garden/Rain Barrel Initiative (Peter’s Brook focus)
- Walnut Brook Stream Stabilization & Wetland Mitigation Project (NJRC&D lead)
- Riparian Restoration Plan for Agricultural Lands (NJRC&D lead)
- Lockatong/Wickecheoke Watershed Plan & Implementation
- Manasquan River NPS Plan
- Addressing Agricultural NPS Pollution in Priority Watersheds
- Open Space Preservation & Management
- Municipal Assessment
- Stream Assessment & Restoration
- ……..
Questions?

Thanks to:
NJWSA WPU: Rick Anthes, Heather Barrett, Todd Kratzer, Ken Klipstein, Jen Zhang
North Jersey RC&D: Christine Hall & Jen House
NJIT: Zeyuan Qiu

Native grass restoration area, NJWSA Administration Facility – Spruce Run Reservoir