Lockatong and Wickecheoke Creek Watersheds Stormwater-Control Program

Automated Stormwater Monitoring and Sampling

New Jersey Water Supply Authority

Background

- The Watershed Protection Programs Division of the NJ Water Supply Authority was awarded a 319(h) grant by the NJDEP to implement innovative stormwater control projects at selected sites within the Lockatong and Wickecheoke Creek Watersheds, Hunterdon County, NJ
- Funded projects were recommended in the "Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan"
- Techniques to reduce storm runoff volume and pollutant loadings from roadside-drainage and a public recreation area are being developed and will be implemented as State demonstration projects in partner municipalities: Kingwood, Raritan, Franklin, and Delaware Townships
- To determine the effectiveness of stormwater controls, assessments of runoff volume and quality are being conducted prior to, and following the installations using automated storm-runoff samplers

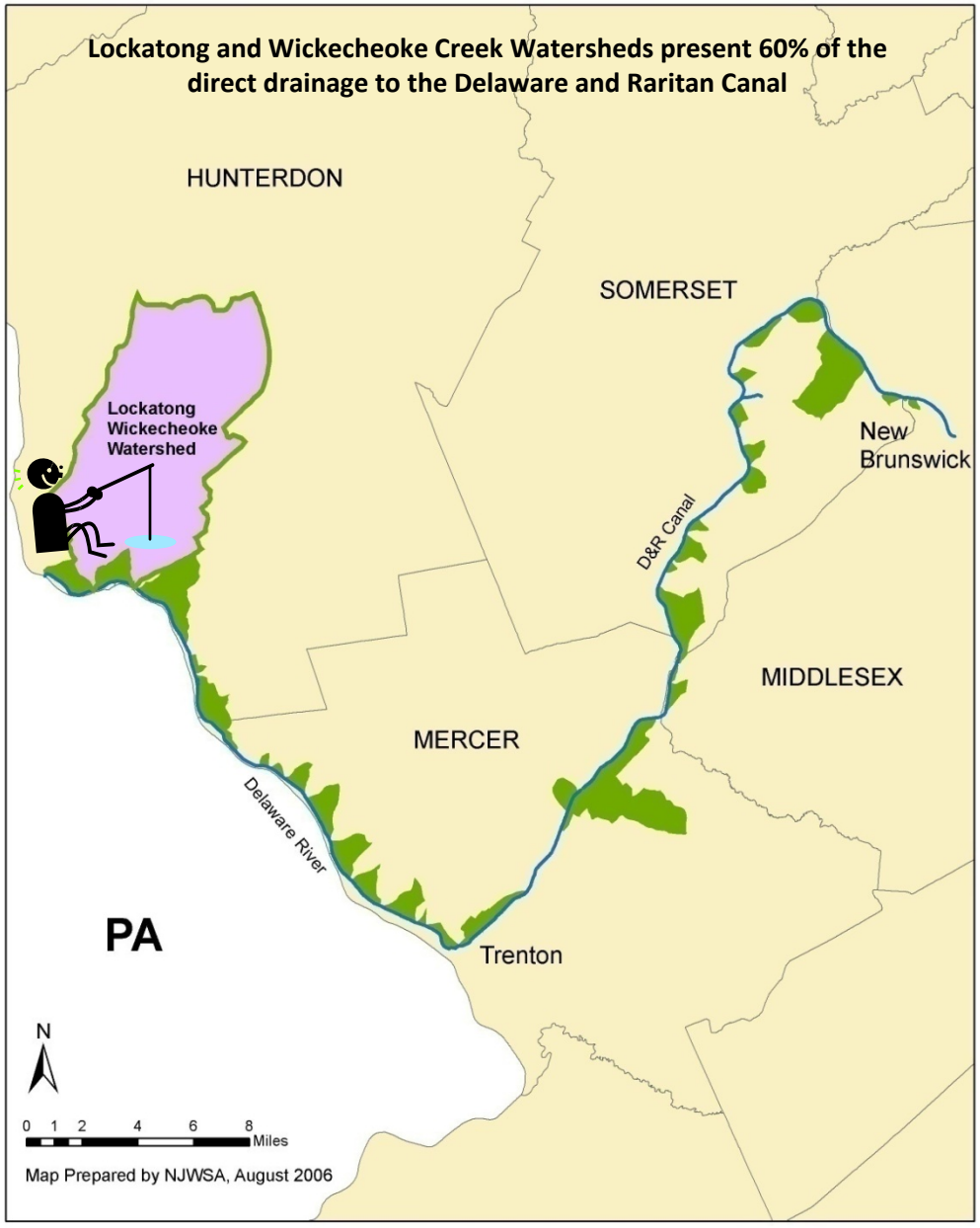
Presented by Todd Kratzer

NJ Water Monitoring Summit

December 2, 2011

Direct Drainage to the Delaware & Raritan Canal

(Downstream of the Delaware River Intake)



Sediment Loadings

Data Source: Lockatong and Wickecheoke Creek Watershed Sediment and Phosphorus Source Report by the US Dept of Agriculture Natural Resources Conservation Service (2007):

•18,500 tons/year of storm-induced sediment loads discharging into the D&R Canal from agriculture, forest, roads, and stream bank erosion

- **3, 700 tons/year of storm-induced sediment loads are conveyed to the stream channels from road surfaces and the associated drainage systems**
- **12, 400 tons/year of sediment from stream-channel destabilization and erosion caused by the combination of increased runoff flows and the upland sediment loads**

Sediment is a major vehicle for conveying nutrients and other contaminants to the streams and produces stream-bank erosion due to channel filling

Increasing substrate loadings to the D&R Canal increases annual maintenance and treatment costs for potable water supplies, degrades the aquatic ecosystem, and suppresses recreational opportunities for fishing, boating, and swimming



Targeted sediment sources in the watersheds

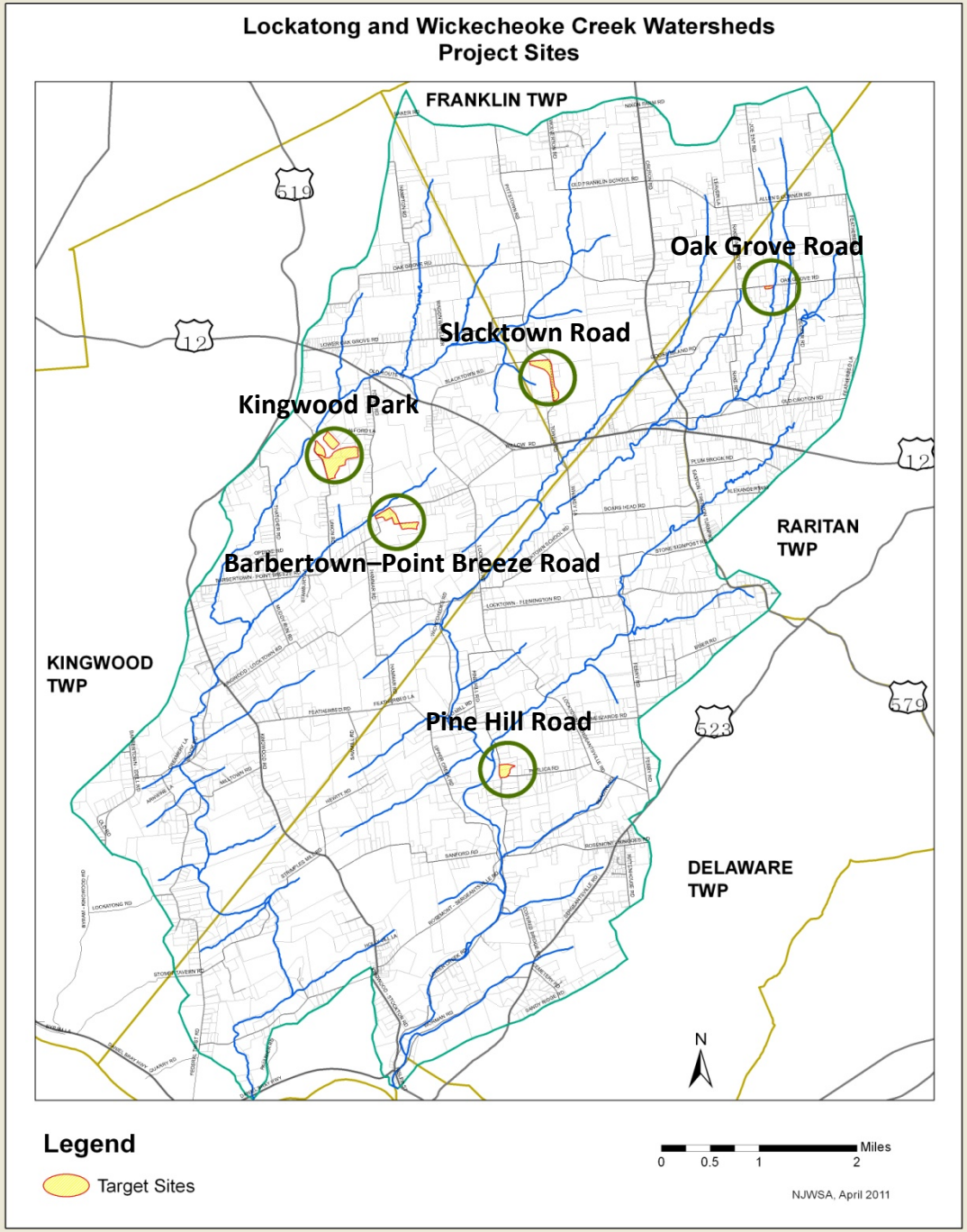





Effects to stream channel
from storm-conveyed sediment and stream bank erosion


Increased sediment loads degrade the stream, and increase operation and treatment costs for potable water supplies

Delaware and Raritan Canal sediment removed by dredging


Lockatong and Wickecheoke Creek Watersheds
Project Sites
FRANKLIN TWP
Oak Grove Road
Slacktown Road
Kingwood Park
Barbertown–Point Breeze Road
RARITAN TWP
KINGWOOD TWP
Pine Hill Road
DELAWARE TWP
519
12
523
579
N
Legend
Target Sites
Miles
0 0.5 1 2
NJWSA, April 2011

Benefits of Automated Sampling

Automated samplers were installed and operated by Authority staff for the collection of storm flow data and water samples during rain events at each project site

- Each sampler can be programmed to collect either grab or composite samples at selected flow depth, time/date, precipitation, and/or water quality activation targets during a runoff event
- Samples can be collected to represent water quality snapshots along the entire hydrograph
- Each sampler provides refrigeration for sample preservation prior to laboratory analyses
- In-situ samplers eliminate the often untimely instantaneous process of organizing staff, traveling to each site, and collecting samples during intense storms
- It is now possible to sample storm events occurring on a weekend or at night, and in remote locations

Sample-Collection Protocol

- Samplers were housed in the field in constructed shelters
- Each sampler was powered by two 12- volt batteries that were recharged daily by a 50 watt solar panel
- Sampler activation was triggered by selected water flow depths, calibrated for each sampling site
- Water depths were measured and recorded by the sampler at 2-minute intervals
- Water depths were associated with flow at 0.02 foot intervals
- Intake tubing was automatically purged and flushed for quality-control prior to each sample collection
- Up to 14 individual grab samples were collected for a storm event, pending water-depth triggering levels
- Samples were automatically cooled to 4^{o} C after the first sample of the event was collected
- Sampling quality control was guided by a Quality Assurance Project Plan approved by the NJDEP

Sampler Installation/Operation

All components of the sampling, including installation, operations, and data interpretation, were performed by NJWSA staff

Preparations for field-housing installation


Avalanch

Sample intake

Concealed pressure transducer

Automated sampling system

Collected samples

Revised: August 31, 2011

Field Data Sheet

Site Number/Name: _____ **Date(s) of rain event:** _____

Date (mm/dd/yy): _____ **Time (military):** _____ **Staff:** _____

Weather conditions [circle all that apply]: clear sky, some clouds, mostly cloudy, overcast, raining, drizzle, sunny, calm, breezy, windy, humid, warm, hot, cool, cold, snowing, sleeting

Field-structure/equipment condition (i.e., good/operational, damage/vandalism, etc.):

Drainage-channel conditions [circle all that apply]: no flow; trickle; baseflow; puddled; storm flow; water color (clear, or hue – slight, moderate, extreme); turbidity (clear, slight, moderate, extreme); visible high-water marks; turtles; frogs/tadpoles; salamanders/newts; crayfish; snakes; fish; deer; geese; ducks; snails; worms; emergent/aquatic insects; aquatic plants (rooted, algae/attached, % coverage _____)

***Check when completed*:**
Data downloaded, backed up, and reviewed (file labeled with "*Site-Date-Time*") _____;
Bottles replaced ____; **Transducer condition** ____; **Suction and pumping tubing condition** ___;
Intake unobstructed _____; **Sampler program reviewed and activated** _____

Number of sample bottles used: _____ **Numbers for LE & Peak:**
Sample collected in bottle number(s): _____ **thru** _____ **Numbers for TE:**

Laboratory Water Quality Samples: ***Date/Time of initial LE sample*** (military, 24 hr): _____
and initial TE sample (military, 24 hr): _____

Nitrite:_____	Nitrate:_____	Total P:_____	Turbidity:_____
TKN: _____	Ammonia:_____	Chloride:_____	TSS:_____

***Disconnect one connector from sampler and remove breaker between solar panel and batteries before testing the following*: Combined battery voltage: _____ Solar panel voltage: _____**
Combined battery current (amps): _____ Solar panel current (amps): _____
Green light illuminated (Y or N) Red light illuminated (Y or N)

On-site monitoring: [record all that apply]:

Air Temperature (^{o}C):_____	***Time*** (military, 24 hr): _____
Water Temperature (^{o}C):_____	Instrument type (i.e., YSI 63):_____
pH (standard units):_____	Instrument type: _____
Specific Conductivity (us/cm):_____	Instrument type: _____
Conductivity (us/cm):_____	Instrument type: _____
	Instrument type: _____

Other site/sampler characteristics/notes:
Desiccant (approx. _____ % blue)
Time: _____ Refrigeration temperature _____ ^{o}C, and Water depth _____ feet
Water depth zeroed (Y or N)
Initial trigger depth reset (Y or N) from _____ feet to _____ feet

List individual sample date/time, bottle #, events, and water level on reverse side of sheet --→

What data did we collect for storms?

Data were collected throughout the storm hydrograph for flow and water quality concentrations to obtain existing water quality loadings for specific parameters (i.e., nutrients and solids)

Loading (mass per unit time) = concentration (mass per unit volume) x flow (volume per unit time)

Concentration represents the mass of contaminant suspended/dissolved in a unit volume of storm flow (e.g., milligrams per liter)

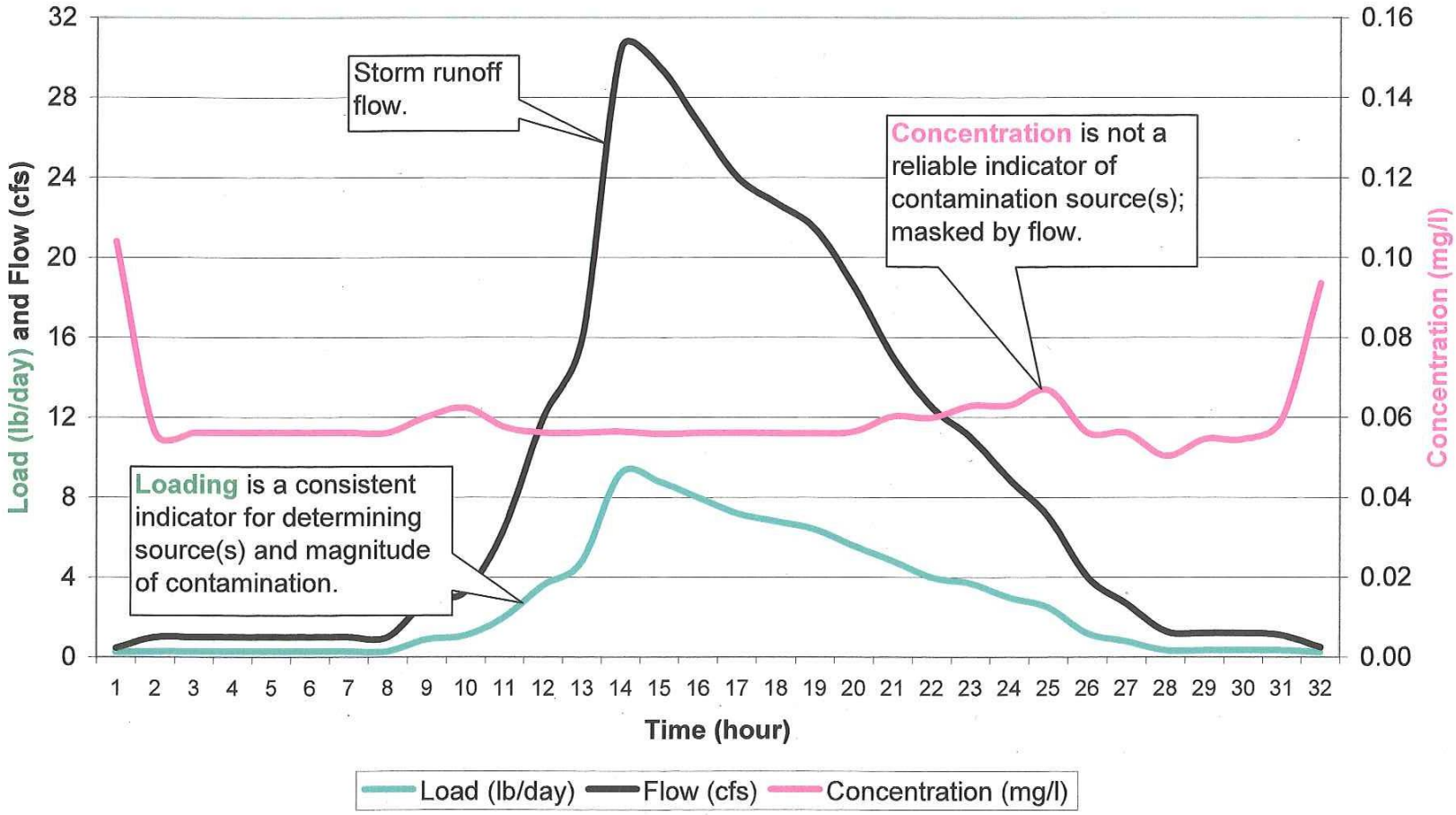
- Is directly dependent on the instantaneous volume of solution (dilution), providing a better indication of potential impacts to the health of aquatic biota (lower flow can produce greater concentrations and higher flow can produce reduced concentrations for a pollutant loading)
- Used as a target for aquatic biota and human health regulatory criteria, and permit compliance

Loading represents the mass of contaminant suspended/dissolved in the flow over a unit of time (e.g., pounds per day)

- Is a more direct measurement of a contaminant level over the duration of a flow event, and provides a good indication of the type of contaminant source (point or non-point)
- Non-point sources of pollution loading vary directly with flow levels while point sources remain fairly constant during varying flow levels
- Used as a regulatory target for long-term watershed health

Loading provides a more reliable representation of contaminant source(s) and the magnitude of contamination

Concentration Versus Loading As Indicators of Pollution



Data Collection/Analyses

Water level and the time/date of individual sample collections were downloaded from the samplers to a notebook computer following each sampling event

Sample collection times were located on the storm hydrograph

Samples collected from the leading edge to the peak were composited and analyzed separately from the samples composited from the trailing edge

Water levels for each site were transformed to flows using the Mannings equation

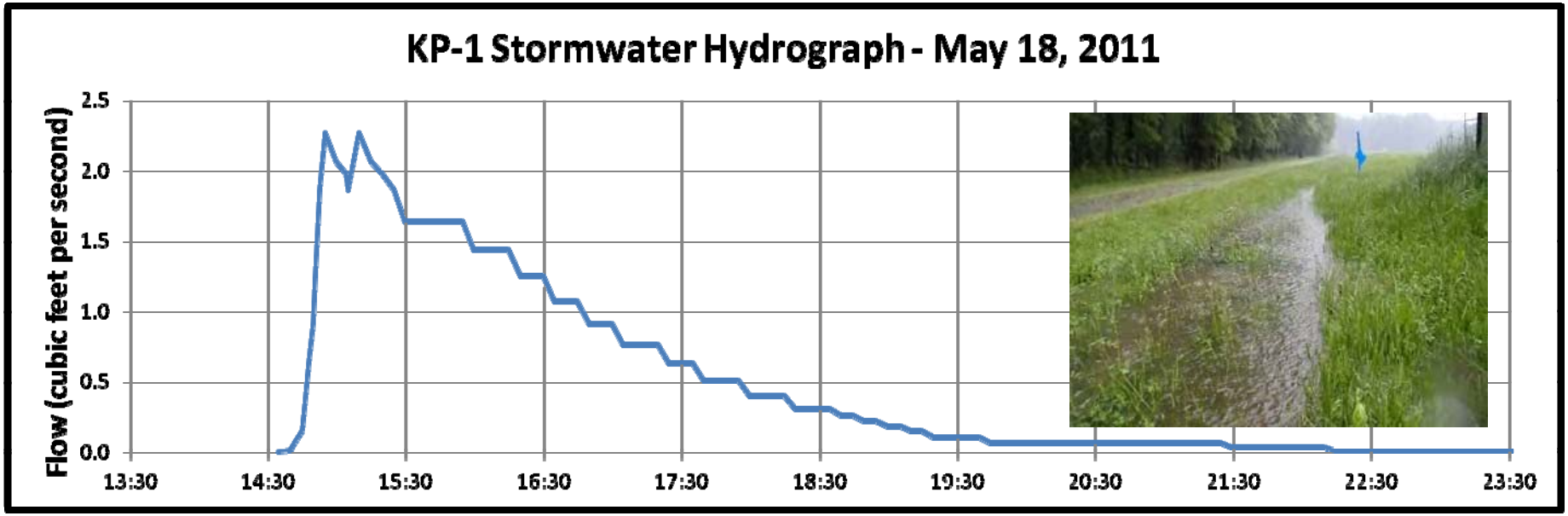
Laboratory results were combined with the respective incremental flow values to derive loadings for the leading edge and trailing edge of each storm event

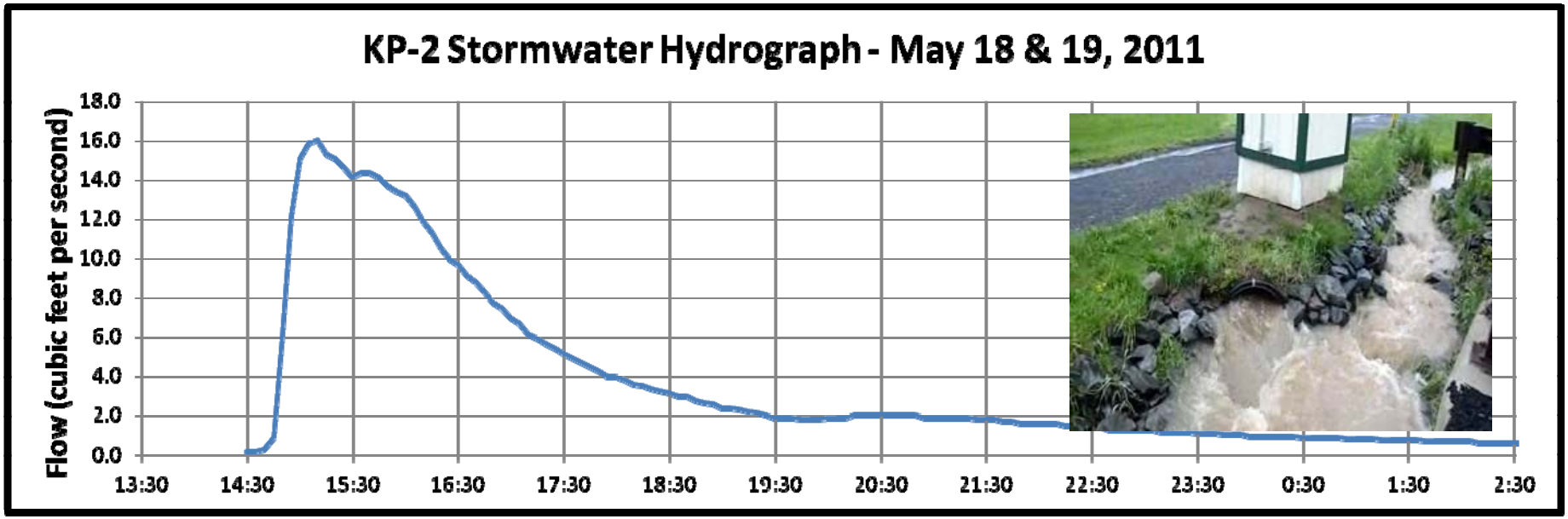
Precipitation data were collected from 3 continuous monitors within the watersheds

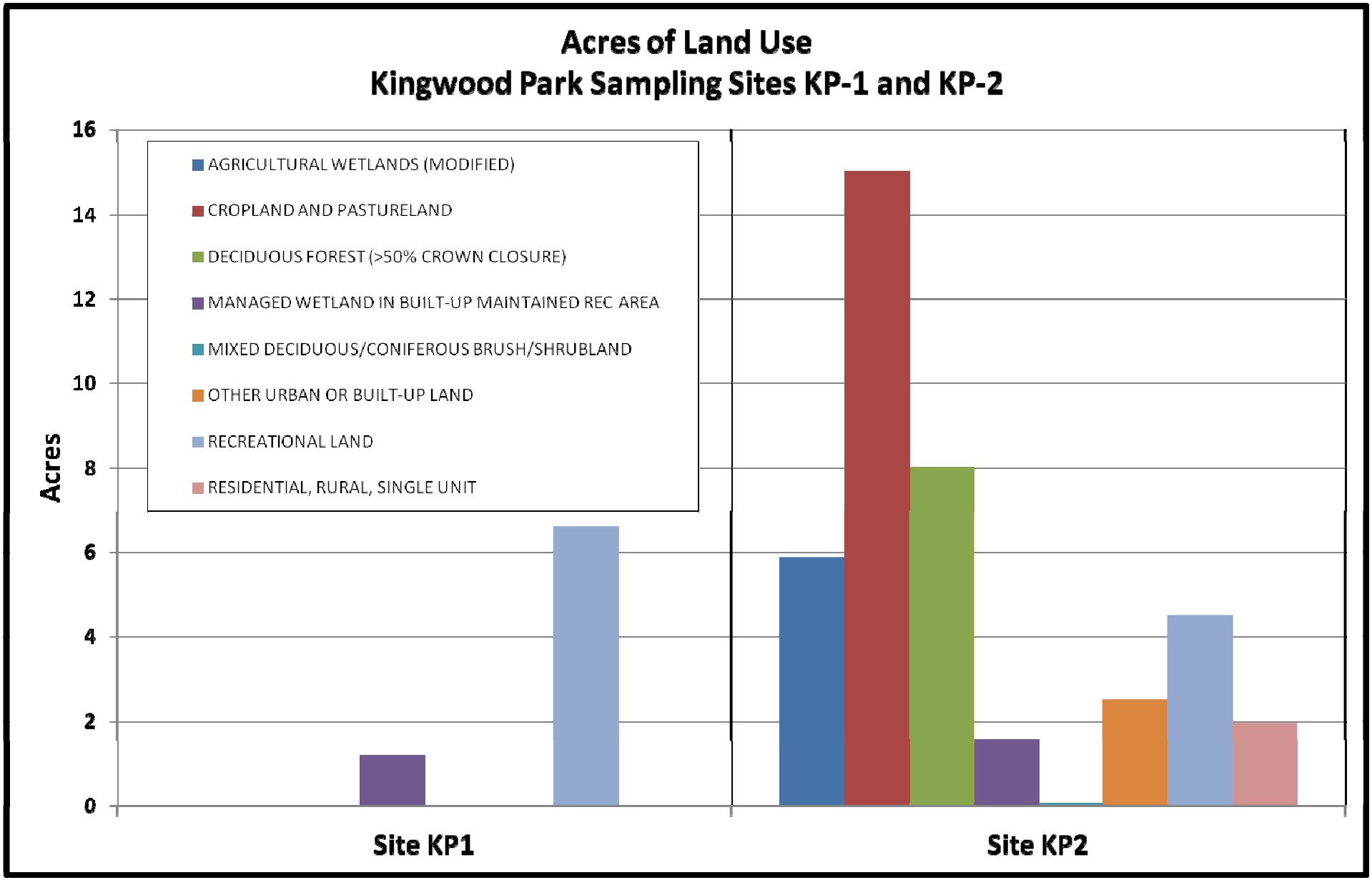
Data Interpretation/Uses

- Total runoff volume and loadings for nutrients and solids are calculated for each storm event
- The data provide measured site information to calibrate computer model simulations, to accurately design stormwater controls and quantify their effectiveness, and to forecast runoff conditions associated with future changes in land use(s)
- Precipitation data are being compared to the measured storm volumes for each event to determine the percentages of runoff and storage

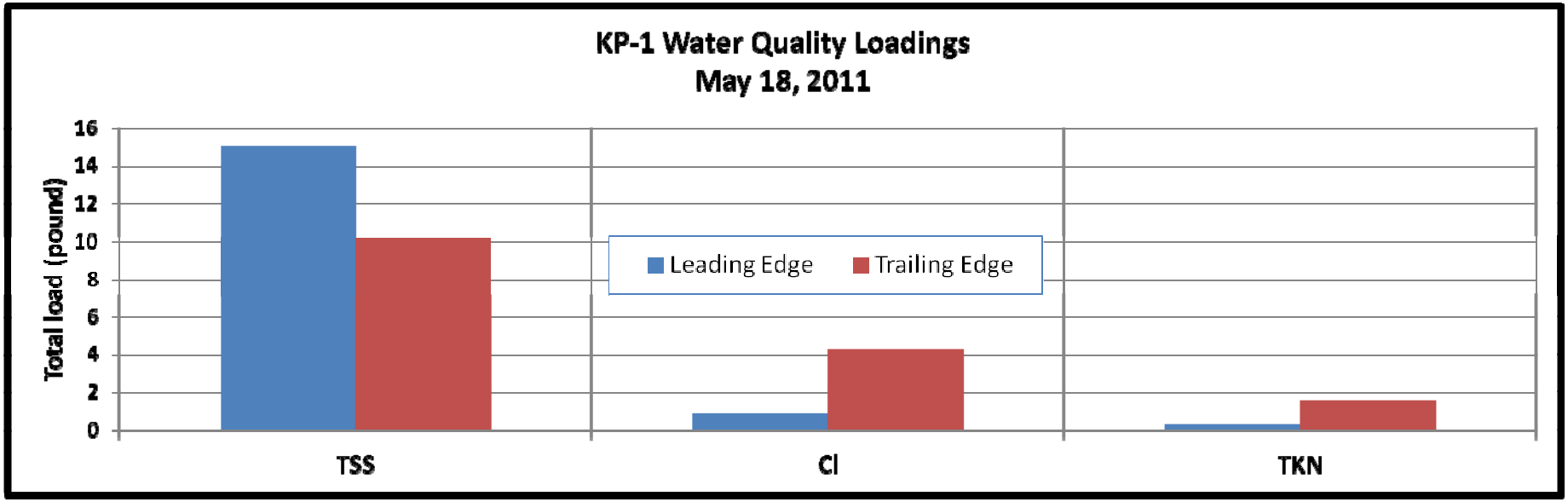
Comparison of Storm Runoff from 2 Sampling Sites in Kingwood Park

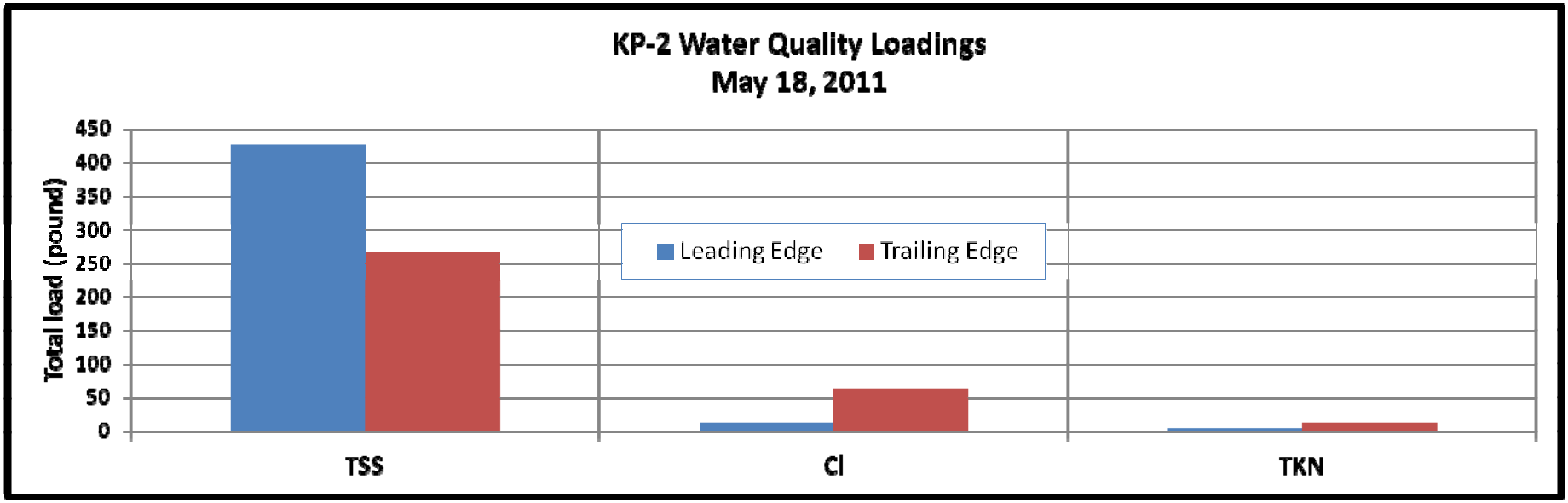





Acres of Land Use
Kingwood Park Sampling Sites KP-1 and KP-2
Acres
16
14
12
10
8
6
4
2
0
AGRICULTURAL WETLANDS (MODIFIED)
CROPLAND AND PASTURELAND
DECIDUOUS FOREST (>50% CROWN CLOSURE)
MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA
MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND
OTHER URBAN OR BUILT-UP LAND
RECREATIONAL LAND
RESIDENTIAL, RURAL, SINGLE UNIT
Site KP1
Site KP2

Comparison of Water Quality Loadings from 2 Sampling Sites in Kingwood Park





Sharing expertise and experience between numerous agencies and organizations

Effect of concentrated flow from curbed driveway

Effect of ATV traffic on stream channel


We ALL need to protect OUR water supply

Contact:

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Program information/reports:

http://www.raritanbasin.org/lockwick.html