Introduction

- Gwinnett County is located in metro Atlanta
- County covers ~435 mi²
- 2013 Population Estimate = 859,304
Georgia Environmental Protection Division (EPD) requires:

- Watershed Assessment and Protection Plans for expanded or renewed NPDES wastewater permits and drinking water permits
Background

Watershed Assessment – 1998

Watershed Protection Plan - 2000

Goal

TSS Yield < 1,600 lb/ac/yr
• Performance based
• Quantifiable
To meet this goal, the watershed protection plan outlines three strategies:

- New development requirements
- Improving affected areas
- Related activities to improve watersheds
To meet this goal, the watershed protection plan outlines three strategies:

- New development requirements
- Improving affected areas – Watershed Improvement Plans (WIP) developed to address this component
- Related activities to improve watersheds
Background

Watershed Improvement Plans

- Watershed Characterization
  - Stream Inventories
  - BMP Inventories
- Watershed Modeling
- Development of CIP to meet Watershed goal
Streambank Monitoring Goals

• How much of stream TSS loads are a result of streambank erosion?

• Provide field data to support assumptions in model
  • TSS production rate (lbs/ft$^2$) – model used 12 lbs/ft$^2$
  • Erosion category – assumption of uniform production
Streambank Erosion Monitoring Program

- 50 sites initially established in 2004
- Stratified Random process for site selection:
  - Publicly owned parcels with a stream
  - Random number generator in GIS to rank the sites
Site Establishment

• Installation of Bank Pins
  • 2-4 pins per bank
  • 4mm brass rods
  • Installed flush with bank
Site Establishment

- Channel Cross Section
  - Permanent rebar benchmark in overbank area
  - Measurements on ~1’ intervals
  - Capture key items:
    - Top of bank
    - Toe of bank
    - Edge of water
Site Monitoring

Since the initial site establishment in 2004, sites have been monitored on an annual basis in April/May each year.

Data Collection (all years):
- Locate and measure bank pins
- Classify each bank % exposed (quartiles)
- Cross section
- Bank failure mode (none, cantilever, slide)
- Rosgen Classification
- Four standard photos (us, ds, lb, and rb)

Data Collection (select years):
- Pebble count
- Soil sample for bulk density analysis
## Data Compilation and Analysis

### Example of Production Rate Calculations

<table>
<thead>
<tr>
<th>Bank Pin</th>
<th>Erosion Length</th>
<th>Production Rate (lbs/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>28 mm (0.091 ft)</td>
<td>7.60</td>
</tr>
<tr>
<td>#2</td>
<td>8 mm (0.026 ft)</td>
<td>2.17</td>
</tr>
<tr>
<td>#3</td>
<td>67 mm (0.219 ft)</td>
<td>18.18</td>
</tr>
<tr>
<td>Average</td>
<td>34.33 mm (0.112 ft)</td>
<td>9.32</td>
</tr>
</tbody>
</table>

**Erosion Rate**

\[
Erosion \ Rate = \frac{\text{Length}_{YearX+1} - \text{Length}_{YearX}}{\text{Time Between Measurements}}
\]

\[
\frac{28 \text{mm}}{1} \times \frac{0.03936 \text{inches}}{1 \text{mm}} \times \frac{1 \text{foot}}{12 \text{inches}} = 0.091 \text{ feet}
\]

\[
\frac{0.0918 \text{ feet}}{1} \times \frac{82.7 \text{ lbs}}{1 \text{ ft}^3} = 7.60 \text{ lbs/ft}^2
\]
## Monitoring Results

### Average Annual TSS Production Rate

<table>
<thead>
<tr>
<th>Year</th>
<th>TSS Production Rate (lb/ft(^2))</th>
<th>TSS Production Rate (approximate quantitative method) (lb/ft(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>5.2</td>
<td>6.7</td>
</tr>
<tr>
<td>2006</td>
<td>7.0</td>
<td>11.1</td>
</tr>
<tr>
<td>2007</td>
<td>4.0</td>
<td>5.9</td>
</tr>
<tr>
<td>2008</td>
<td>2.1</td>
<td>4.1</td>
</tr>
<tr>
<td>2009</td>
<td>2.5</td>
<td>4.6</td>
</tr>
<tr>
<td>2010</td>
<td>6.1</td>
<td>11.1</td>
</tr>
<tr>
<td>2011</td>
<td>5.7</td>
<td>8.6</td>
</tr>
<tr>
<td>2012</td>
<td>2.0</td>
<td>6.5</td>
</tr>
<tr>
<td>2013</td>
<td>3.8</td>
<td>5.3</td>
</tr>
<tr>
<td>Average</td>
<td>4.2</td>
<td>7.1</td>
</tr>
</tbody>
</table>
Annual TSS Production vs. Total Rainfall

\[ y = 0.1163x - 1.9028 \]
\[ R^2 = 0.6659 \]

\[ y = 0.1782x - 2.3504 \]
\[ R^2 = 0.7756 \]
# 2005 – 2013

## Storm Events per Monitoring Year

<table>
<thead>
<tr>
<th>Year</th>
<th>WQ Event (1.20 in.)</th>
<th>1 year (3.36 in.)</th>
<th>2 year (3.84 in.)</th>
<th>5 year (4.80 in.)</th>
<th>10 year (5.52 in.)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>13</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>2006</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>2007</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>2008</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2009</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>2010</td>
<td>18</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>2011</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>2012</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>2013</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
Annual TSS Production vs. Events ≥ 85 percentile

- **Average TSS Production - Bank Pin**: $y = 0.437x + 1.5098$, $R^2 = 0.9105$
- **Average TSS Production - Bank Pin (approximate quantitative)**: $y = 0.307x + 0.3379$, $R^2 = 0.9056$

![Graph showing the annual TSS production vs. events greater than or equal to 1.2 inches.](image)
Erosion Length as a Function of Percent Exposed Soil on Bank

- A two-sample hypothesis tests were performed to compare the populations.
- There is statistically significant difference in erosion rates between the 75-100% category and the 0-25% category (the erosion rate is statistically significantly higher at the 75-100% bank exposed category).
Conclusions

- Watershed modeling used 12 lb/ft$^2$ for stream bank TSS production.
- Based on 9 years of bank pin data, TSS production = 7.1 lb/ft$^2$.
- A positive correlation exists between annual rainfall depth and TSS production.
- An even stronger relationship exists between the number of storms greater than 85th percentile (1.2”) event the TSS production.
- The highest category of bank exposed (75-100%) may erode at a higher rate.
Questions?

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