Modeling Potential Sources - LDCs

(06/16/11)

Jasjeet Kaur
Kyna McKee
R. Karthikeyan

*Biological and Agricultural Engineering*
*Texas A&M University*

Lucas Gregory

*Texas Water Resources Institute*
Flow Duration Curves

• Flow Duration Curve
  – A graph showing the flow rate versus the time
  – Time is illustrated as percentage of the year
  – Graph shows the relative percentage of the year that stream flow exceeded a designated flow level
  – Able to break up the flow rates into categories
    • Low flows
    • Dry conditions
    • Mid-range flows
    • Moist conditions
    • High flows
Load Duration Curves (LDCs)

• Load Duration Curve
  – Combines concentrations of a pollutant with flow at the same time to develop a load
  – The LDC illustrates the load of a pollutant versus the time that a given load is exceeded
  – Time is illustrated as percentage of the year
  – Able to see if a stream is exceeding the standard in terms of load (flow and concentration)
  – Able to calculate a percent reduction based on flow categories
Example Load Duration Curve
Load Duration Curve With Observed Loads During Different Flow Conditions

Example Load Duration Curve
Example Load Regression Model

Load Regression Model on Load Duration Curve Plot

- High Flows
- Moist Conditions
- Mid-range
- Dry Conditions
- Low Flows
- Load Duration Curve
- Load Regression Curve

Percent of Days Load Exceeded

Load (cfu/day)

64.7%
51.4%
26.9%
LDC Usefulness (source ID based on LDC)
Historical Load Duration Curve Analysis
Historic Data Summary

- TCEQ *E. coli* data for 3 stations
  - Attoyac Bayou at US 59 (16076)
    - 55 E. coli data points from **2000 – 2008**
    - Used 17 data points that corresponded with instantaneous flow measurements
  - Attoyac Bayou at SH 21 (10636)
    - 37 E. coli data points from **2000 – 2008**
    - Used 15 data points from **2000 – 2005** that corresponded with modeled flow
    - Used SWAT simulated flows from **1995 – 2005**
  - Attoyac Bayou at SH 7 (15253)
    - 20 E. coli data points from **2000 – 2008**
    - Used 9 data points from **2000 – 2005** that corresponded with modeled flow
    - Used SWAT simulated flows from **1995 – 2005**
Attoyac Bayou at US 59 (16076): Instantaneous Flows

Flow Duration Curve

Percent of Days Flow Exceeded

Flow (cfs)

0 10 20 30 40 50 60 70 80 90 100

0 2 4 6 8 10 12 14 16 18

Copyright© Biological and Agricultural Engineering Department, Texas A&M University
Attoyac Bayou at 59 (16076)

Historic Load Duration Curve (16076); n = 17

- Maximum Allowable E. coli Load
- Load Regression Curve
- High Flows
- Moist Conditions
- Mid-Range
- Dry Conditions
- Low Flows
### Attoyac Bayou at US 59 (16076)

<table>
<thead>
<tr>
<th>Flow Condition</th>
<th>Percent Reduction</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Flows</td>
<td>56</td>
<td>16</td>
</tr>
<tr>
<td>Moist Conditions</td>
<td>62</td>
<td>12</td>
</tr>
<tr>
<td>Mid-Range</td>
<td>65</td>
<td>9.1</td>
</tr>
<tr>
<td>Dry Conditions</td>
<td>68</td>
<td>6.9</td>
</tr>
<tr>
<td>Low Flows</td>
<td>N/A</td>
<td>0</td>
</tr>
</tbody>
</table>
Attoyac Bayou at SH 21 (10636): SWAT Flows

Flow Duration Curve

- Flow (cfs)
- Percent of Days Flow Exceeded

Copyright © Biological and Agricultural Engineering Department, Texas A&M University
Attoyac Bayou at SH 21 (10636)

Historic Load Duration Curve (10636); n = 15

- **E. coli Load (CFU/day)**
- **Percent of Days Load Exceeded**
- **Load Regression Curve**
- **Maximum Allowable E. coli Load**
- **High Flows**
- **Moist Conditions**
- **Mid-Range**
- **Dry Conditions**
- **Low Flows**
## Attoyac Bayou at SH 21 (10636)

<table>
<thead>
<tr>
<th>Flow Condition</th>
<th>Percent Reduction</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Flows</td>
<td>66</td>
<td>1,064 to 19,695</td>
</tr>
<tr>
<td>Moist Conditions</td>
<td>55</td>
<td>489</td>
</tr>
<tr>
<td>Mid-Range</td>
<td>41</td>
<td>235</td>
</tr>
<tr>
<td>Dry Conditions</td>
<td>19</td>
<td>79</td>
</tr>
<tr>
<td>Low Flows</td>
<td>N/A</td>
<td>0.14</td>
</tr>
</tbody>
</table>
Attoyac Bayou at SH 7 (15253): SWAT Flows

Flow Duration Curve

Copyright © Biological and Agricultural Engineering Department, Texas A&M University
Attoyac Bayou at SH 7 (15253)

Historic Load Duration Curve (15253); n=9*

* Not enough data points were available to develop needed load reductions
## Attoyac Bayou at SH 7 (15253)

<table>
<thead>
<tr>
<th>Flow Condition</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Flows</td>
<td>466 to 15,648</td>
</tr>
<tr>
<td>Moist Conditions</td>
<td>193</td>
</tr>
<tr>
<td>Mid-Range</td>
<td>73</td>
</tr>
<tr>
<td>Dry Conditions</td>
<td>13</td>
</tr>
<tr>
<td>Low Flows</td>
<td>0.0005</td>
</tr>
</tbody>
</table>
Questions?

attoyac.tamu.edu