Green/Duwamish River Watershed

Pollutant Loading Assessment

Technical Advisory Committee Meeting
April 6, 2016
Model selection

Watershed
- Point Sources
  - LSPC
    - Subwatershed Flows
    - Subwatershed Concentrations (sediment, conventional parameters, bacteria, metals, toxic contaminants)
  - EFDC
    - Water Surface Elevation
    - Temperature and Dissolved Oxygen Profiles
    - Water and/or Sediment Concentrations (sediment, conventional parameters, bacteria, metals, toxic contaminants)
- Receiving Water
  - Point Sources
  - Temperatures
  - Concentrations
- Food Web
  - Food Web Model
  - Tissue Concentration of Contaminants
LSPC Watershed Model

► Previous TAC meeting (July 6, 2015) went through the characteristics and proposed application of the LSPC model in detail.

- We won’t repeat that material here…
- Focus here on decisions and refinements made in conjunction with QAPP
- Example of first phases of calibration process

► Phased approach – First phase addresses flow and sediment calibration

- may be further refinements (and additional data) for toxics calibration
Refinements to Existing HSPF Models

- Combine 17 linked HSPF model to one LSPC model
- Extend model area to cover direct drainage to LDW within City of Seattle
Model Boundaries and Time Period

- Work with existing (2007) land use classes
- Treat Howard Hanson Dam as boundary condition
  - Do not model upstream watershed
  - Use gaged flows
  - Use fixed (seasonal?) assumptions for water quality
  - Check flow, temperature and water quality performance based on downstream monitoring at Tukwila

- Time Period:
  - Extend end from 2009 to at least 2016
  - Hydrologic Calibration
  - Model calibration period for hydrology: 1996-2016
Calibration

► Flow
  ▪ Continuously measured and simulated
  ▪ Multiple volumetric error statistics
  ▪ Nash-Sutcliffe coefficient of model fit efficiency

► Water Quality
  ▪ Sparse, point-in-time measurements
  ▪ Report annual and seasonal relative error statistics for sediment calibration
  ▪ For toxics – calibration subject to change through updates to QAPP as additional data are collected
Hydrologic Calibration

Duwamish and Green River Watersheds
Flow Gage Locations

Map produced by H. Nicholas, 02-28-2016
NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet
Sediment Transport Calibration

► Existing hydrology calibration is reasonable
  ▪ Will extend calibration and identify potential improvements

► Sediment transport:
  ▪ Limited suspended sediment data
  ▪ Depends on channel scour and deposition processes

► Strategy
  ▪ Use all available data to improve hydraulic simulation of shear stress and scour/deposition
  ▪ Use 1996-2016/7 data as available for calibration
    ▪ Use all data
    ▪ Spatial corroboration by fitting to multiple monitoring points
Example: Black River/ Springbrook Creek Model
Gage 12113346: Springbrook Creek nr Orilla

- Over-predicts in Winter-Spring; under in Summer-Fall...
### Error Stats: Springbrook Creek nr Orilla

#### HSPF Simulated Flow

**REACH OUTFLOW FROM DSN 262**

- **8-Year Analysis Period:** 10/1/2001 - 9/30/2009
- **Flow volumes are (inches/year) for upstream drainage area**

| Total Simulated In-stream Flow: | 14.65 |
| Total of simulated highest 10% flows: | 5.99 |
| Total of Simulated lowest 50% flows: | 1.94 |
| Simulated Summer Flow Volume (months 7-9): | 1.05 |
| Simulated Fall Flow Volume (months 10-12): | 4.44 |
| Simulated Winter Flow Volume (months 1-3): | 6.40 |
| Simulated Spring Flow Volume (months 4-6): | 2.76 |
| Total Simulated Storm Volume: | 4.24 |
| Simulated Summer Storm Volume (7-9): | 0.28 |

#### Observed Flow Gage

**12113346 Springbrook Creek near Orilla**

- **Manually entered data**
- **Drainage Area (sq-mi): 8.44**

| Total Observed In-stream Flow: | 15.34 |
| Total of Observed highest 10% flows: | 6.62 |
| Total of Observed lowest 50% flows: | 2.51 |
| Observed Summer Flow Volume (7-9): | 1.78 |
| Observed Fall Flow Volume (10-12): | 5.54 |
| Observed Winter Flow Volume (1-3): | 5.35 |
| Observed Spring Flow Volume (4-6): | 2.68 |
| Total Observed Storm Volume: | 5.56 |
| Observed Summer Storm Volume (7-9): | 0.60 |

#### Errors (Simulated-Observed)

<table>
<thead>
<tr>
<th>Error Statistics</th>
<th>Recommended Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error in total volume:</td>
<td>-4.51</td>
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<tr>
<td><strong>Error in 50% lowest flows:</strong></td>
<td><strong>-22.68</strong></td>
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<tr>
<td>Error in 10% highest flows:</td>
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<td><strong>Seasonal volume error - Summer:</strong></td>
<td><strong>-41.04</strong></td>
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<td>Seasonal volume error - Fall:</td>
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<td>Seasonal volume error - Winter:</td>
<td>19.64</td>
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<tr>
<td>Seasonal volume error - Spring:</td>
<td>3.32</td>
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<tr>
<td><strong>Error in storm volumes:</strong></td>
<td><strong>-23.65</strong></td>
</tr>
<tr>
<td><strong>Error in summer storm volumes:</strong></td>
<td><strong>-53.06</strong></td>
</tr>
</tbody>
</table>

- Nash-Sutcliffe Coefficient of Efficiency, E: 0.785
- Baseline adjusted coefficient (Garrick), E': 0.570
- Monthly NSE: 0.724

*Model accuracy increases toward 1.0*
Sub-daily Hydraulic Analysis - simulated hourly or 15 minute flows

Springbrook Creek at Orilla, 11/13-11/15/01
Simulated Shear Stress

- Controls channel scour/deposition of cohesive sediment
Black R. : Suspended sediment calibration

Simulated Wateryear 2004 of TSS for Rch 470 0317

Date/Time

TSS (sim > 0)
Watershed Model – Next steps

► Starting now, we will assemble information:
  ▪ Spatial data
  ▪ Flow and suspended sediment calibration time series
  ▪ Meteorological data
  ▪ Additional hydraulic information

► After QAPP finalization
  ▪ Convert existing model structure to LSPC
  ▪ Extend boundary inputs to new time period
  ▪ Hydrodynamic re-calibration
  ▪ Sediment Transport re-calibration

► And then…
  ▪ Toxics data assembly and calibration
Questions and Discussion
(It’s always sunny in Seattle!)