Regulatory Context

• The Clean Water Act sets goals for water quality by applying one or more “designated uses” to each water body.

• Criteria set the minimum water quality necessary to attain those uses.

• MDE considers water quality characteristics that don’t meet the criteria to be “stressors”.
Regulatory Framework

- **Designated Uses**
  - Support of fish and aquatic life
  - Recreation (swimming)

- **Criteria**
  - Biological criteria
  - Bacteriological criteria
  - Chemical criteria
  - Physical criteria

Community Context

- The community plays a critical role in determining the water goals (i.e., the designated uses).
- Developing educational, communication, presentation and other tools approaches so that the community can make informed decisions about water quality is a critical need of the water program.
Scientific/Management Context

• Understanding the:
  – Variety and magnitude of stressors facing urban water quality goals,
  – Interaction of those stressors, and
  – The appropriate thresholds for water quality criteria in urban areas is critical to addressing the right problems.

• However, particularly within urban habitats with numerous concurrent or historic impacts and high spatial and temporal variability, we have no broadly accepted criteria for critical habitat components such as
  – contaminated sediment,
  – appropriate levels of sediment loads (clean sediment), and
  – no credible tools to evaluate and quantify linkages between biological community measures and stressors.

• This has become critical within the TMDL program.
Criteria Development

• Biological: multi-metric indicator
  – Reference water body approach
  – Based on minimally impacted water bodies
    “Reference” based on non-biological factors
    (human influence gradient)

• Bacteriological: Based on risk of “credible gastrointestinal illness” from epi study. Two recommended indicators
  – E. coli
  – Enterococcus

Criteria Development

• Chemical/Water column: Based on survival/mortality in lab tests
• Chemical/Sediment: No EPA recommended numeric criteria – MD uses weight of evidence approach.
• Clean Sediment
  – EPA providing some guidance on potential approaches for suspended and bedded sediments
  – No EPA recommended numeric criteria
TMDL Guidance

- Impairments should be addressed within 8-13 years from time of listing.
- “Addressed” means:
  - Complete a TMDL
  - Demonstrate that water quality criteria are currently being met,
  - A “technical fix” will correct the problem by the next listing cycle, or
  - Demonstrate and justify that a pollutant is not the cause of the problem.
- TMDLs should provide “reasonable assurance” that the load allocations in the TMDL can be achieved.

Findings - Biological

- Urban areas among most impacted
- Likely multiple insults
- Primary cause of degradation often difficult to document.
- Established threshold based on least impacted, generally cannot be met when urban landuse > 20-35%.
Urban Land Use and Biological Integrity

Probability that an MBSS site will fail biological criteria (i.e., is degraded) with increasing percentage of urban land use, by stream order (Vølstad et al. 2003)

Issues - Biological

- Reference approach vs Stressor ID
- Stressor ID methodology—attribute cause; application and implementation proving difficult.
- Alternative approaches needing community input:
  - Different reference waters
  - Lower range (justification?)
  - Just apply BMPs and “general improvements” without targeting specific stressors
Findings - Bacteriological

- Extreme range in enumeration results
- Bacteria sources difficult to identify
  - Uncertainty in watershed modeling
  - Bacteria Source Tracking promising alternative
- Sources in urban watersheds
  - Human contribution varies by watershed; estimated from 10 to 50%
  - Wildlife and domestic pets are significant
  - Limited livestock in urban watersheds, however can be site specific
- General trends from low flows to high flows (Anacostia)
  - Increase in domestic
  - Decrease in human
  - Livestock inconsistent
  - Increase in wildlife

Issues - Bacteriological

- Source tracking methods are new technology and evolving (no standardized methods)
- No controls for significant sources, especially urban areas developed prior to 1985
- Public health risk from non-human sources is not understood
Building BST Libraries in Urban Areas

- Rates of Correct Classification (RCC) for vary per source category

<table>
<thead>
<tr>
<th>Source Category</th>
<th>Anacostia River</th>
<th>Rock Creek</th>
<th>Cabin John Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% RCC</td>
<td>Rank</td>
<td>% RCC</td>
</tr>
<tr>
<td>Domestic</td>
<td>93 %</td>
<td>2</td>
<td>93 %</td>
</tr>
<tr>
<td>Human</td>
<td>97 %</td>
<td>1</td>
<td>94 %</td>
</tr>
<tr>
<td>Livestock</td>
<td>93 %</td>
<td>2</td>
<td>87 %</td>
</tr>
<tr>
<td>Wildlife</td>
<td>71 %</td>
<td>4</td>
<td>69 %</td>
</tr>
</tbody>
</table>

In General...
- ARA provides better discrimination of domestic and human sources
- There is limited Livestock in Urban Watersheds
- Wildlife has much diversity and lower RCC may result from sampling design (e.g. what sources to target – deer, beaver, rats, etc)

BST Uncertainty

% Correct vs. Unknown

<table>
<thead>
<tr>
<th>Cutoff Probability</th>
<th>Anacostia River</th>
<th>Rock Creek</th>
<th>Cabin John Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Correct</td>
<td>% Unknown</td>
<td>% Correct</td>
</tr>
<tr>
<td>0.25</td>
<td>82</td>
<td>0</td>
<td>74</td>
</tr>
<tr>
<td>0.375</td>
<td>82</td>
<td>1</td>
<td>74</td>
</tr>
<tr>
<td>0.50</td>
<td>85</td>
<td>8</td>
<td>76</td>
</tr>
<tr>
<td>0.60</td>
<td>89</td>
<td>19</td>
<td>80</td>
</tr>
<tr>
<td>0.70</td>
<td>93</td>
<td>30</td>
<td>86</td>
</tr>
<tr>
<td>0.80</td>
<td>93</td>
<td>33</td>
<td>93</td>
</tr>
<tr>
<td>0.90</td>
<td>98</td>
<td>90</td>
<td>98</td>
</tr>
</tbody>
</table>
Findings – Chemical/Sediment

• “Legacy” pollution degrades some areas of Baltimore Harbor.
• Generally too diffuse to use dredging or capping.
• Clean up targets not clear.
• Complex mixtures.
• Multiple ingestion routes.

Findings – Chemical/Sediment

• Conducting TIE for Harbor
• Issues/Concerns:
  – May be no “primary” cause of impairment.
  – How do we write a TMDL if probable stressor chemical and end targets are not clear?
  – How to quantify “natural recovery” if appropriate.
Findings – Clean Sediment

• In non-tidal systems linkage to endpoint is uncertain
• Reference watershed approach typically applied
• Issues/Concerns:
  – Determining the appropriate reference condition for urban watershed
  – How to accurately quantify relative sources
    • Modeling vs. sediment source tracking
    • Hydrologic modification of stream system (e.g. channel erosions)
    • Legacy sediments
  – How to write a TMDL if end targets not clear

General Issues

• How can State government best engage the public to address expectations for water quality?
• What information is needed to inform the public and how should this technical material be presented?
• Can the academic community help State water quality managers answer the technical aspects of some of these questions?
• Part of the response to these issues should be refined local planning processes that better address water quality issues up front and avoid or minimize these problems in the future.