Alternative Fecal Coliform & Stormwater Test Methods

Puyallup Stormwater Conference
November 6th, 2014

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Shilo Sprouse, CESCL, CSI - City of Pullman
• South Fork of Palouse River (SFPR) CWA-303d listed for FC
• DOE surveyed SFPR and identified FC sources
• SFPR TMDL Report (2009) established targets
• City of Pullman has SWMP to facilitate NPDES Phase II compliance
Overview

• Pullman study background
• Strategy & mindset
• FC Data interpretation
• Alternative FC test
• 5 flow measurement methods
Strategy & Mindset

- Two stages: Investigation followed by performance testing
- Performance testing *must use approved methods*
- Investigation can use most effective methods
- Quick, easy, & cheap methods give more data, faster
- Investigation data used to direct QAPP
- Share findings, share success
The Palouse in Summer

Dry-land Agriculture: Wheat/Peas/Lentils
The Palouse in Winter
TRADITIONAL STORMWATER STUDY TOOLS

1 min / 43830 mins ~ 0.0023%
Interpretating FC Results
Fecal Coliform Colonies in FC Membrane Test

Blue due to Aniline Blue pH Indicator
Main lines of Pullman Stormwater Study System

Shaded labels with bold print indicate data-logged site
# FC Monitoring Data (cfu/100ml)

<table>
<thead>
<tr>
<th>Date</th>
<th>Lake</th>
<th>Swale</th>
<th>Outfall</th>
<th>Stadium</th>
<th>Joseph</th>
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<tbody>
<tr>
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<td>455</td>
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</table>

Quick changes within sampling session
Normalized FC Data

Normalized Distribution

Fecal coliform (cfu/100ml)

Lake
Swale
Outfall
Stadium
Joseph
Geomean Std
High Std
FC Sample Timing

FC Sample collected in Pullman after 12:00

Delivered to Moscow before 17:00

Sent to Spokane and tested before 12:00 the next day

Image: Google Earth
Pour-Plate FC Method
Typical FC Plate Results
Alternative FC Media
Direct Plating Tools
Incubator Details
Plate Counter
Construction
5 Alternative Flow Measurement Methods
#1: Paddle-Wheel Flow Meter
Always take the simplest approach...
#2 ...Video

• Camera... or phone
  - ON A LANYARD!
• Grass fragments, sawdust, or ice
• Reference dimensions
• Frame by frame
Flows in Corrugated Pipes
#3: Stream Width
Width – more sensitive than depth

Accurate without confined space entry
Measuring Flow Dimensions with "ImageJ"
Weir character: Width (theory) vs. measured flow

Calculated using Bernoulli

- Evergreen
- Joseph
- Swale
- Fit Lake
- Fit Stadium

Power (Evergreen) Power (Joseph) Power (Swale) Power (Lake) Power (Stadium)

y = 15.0803x^{0.3240} R^2 = 0.9799
y = 9.4044x^{0.3604} R^2 = 0.9933
y = 10.065x^{0.3461} R^2 = 0.9852
y = 7.7951x^{0.3492} R^2 = 0.8297
y = 3.8174x^{0.3058} R^2 = 0.9640
#4: Stream Trajectory
Flow Changes — 12H32 & 16H15 on 3/20/12
Theoretical Flow Trajectories
Trajectory testing possible when reference scale present
#5: Cold Flush™
Onset’s HOBO U23-004 Temperature Logger

• Specification
  Range: -40 to 70°C
  Resolution: 0.02°C
  Response: 30 s (to 90%) in stirred water
  Stability: <0.1°C drift/year
  Readings: ~43,500
Testing Temperature Sensitivity
Temperature Sensitivity Tests

Added 25.5kg of 38.5°C water over 10 minutes
Recap

• Many alternative approaches
• Find your best-fit
• Calibrate, test, & record
• Cheap Screen → QAPP
• Fix, then $$$ monitor
• Share insights, share success
Acknowledgements

Dr. Kelly A. Brayton

City of Pullman

• Mark Workman P.E. – City Supervisor
• Kevin Gardes P.E. – Director of Public Works
Questions ?
More Tools...
FC Sampling Equipment
• Temperature pole
• Sampling pole
• Safety!
Field (~$15) Thermometers vs. NIST ($$$) Thermometer

\[ y = 1.0061x - 0.2981 \]
\[ R^2 = 0.9999 \]
\[ y = 1.0267x - 1.0623 \]
\[ R^2 = 0.9996 \]
• Powerful light
Reference dimensions
Irrigation system (times indicated) along with wash-downs (blocked)

<table>
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<th>Date</th>
<th>Temperature (°C)</th>
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<tr>
<td>07/08/11</td>
<td>Valley: 19:22</td>
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<td>07/09/11</td>
<td>Stadium: 3:42</td>
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<tr>
<td>07/10/11</td>
<td>Evergreen: 23:21</td>
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</table>

07/11/11

Temperature (°C)
Logger modifications before field use — sleeve addition and trimming
Replacing desiccant before field use
Installing on a ladder rung

1. Thread
2. Hang on the ladder
3. Secure with a clip
4. Tighten the thread
Probability Plots
## Example Calculation

<table>
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<th>Data</th>
<th>Sorted Data</th>
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<th>Probability of Rank</th>
<th>NORMSINV of Probability</th>
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</table>
...changing flow conditions at the outfall