BMP Site Ranking Methodology: Statistical consideration of permit limits, natural background levels, number of samples, and exceedance frequency

Robert Pitt, Ph.D., P.E., BCEE, D. WRE, University of Alabama
Brandon Steets, P.E. & Rita Kampalath, Ph.D., Geosyntec Consultants
Outline

1. Site Introduction & Regulatory Context
2. BMP Site Ranking Methodology
3. Conclusions
1. Site Introduction & Regulatory Context
Santa Susana Site

- 2800-acre former federal government rocket engine testing and energy research facility (1950-1988)
- Owned by the Boeing Company (post-1966) and the U.S. Government
- Activities currently limited to demolition, remediation, and restoration
- Future parkland and open space
Stormwater discharges are regulated by the Los Angeles RWQCB through an individual NPDES permit. The permit includes Numeric Effluent Limits (NELs) for a wide range of constituents including:

- Dioxins (TCDD TEQ): $2.8 \times 10^{-8} \ \mu g/L$
- Total Lead: 5.2 $\mu g/L$
- Total Copper: 14 $\mu g/L$
Outfall Watersheds
Expert Panel

Members:
- Dr. Bob Gearheart, Humboldt State University
- Jonathan Jones, Wright Water Engineers
- Dr. Michael Josselyn, WRA Consultants
- Dr. Robert Pitt, University of Alabama
- Dr. Michael Stenstrom, University California, Los Angeles

Scope:
To oversee stormwater planning and design work, and provide input on monitoring, source removal activities, and various NPDES permit issues
12 background sites and 17 to 21 potential BMP subareas visited/monitored each year, depending on observed flows.
Public Involvement Process

- Boeing and Panel are committed to public involvement and transparency through regular meetings and tours.
- Panel has been open to direct communication, thus building confidence and trust.
Previous CASQA Talks

- Media Performance Testing – CASQA 2009
- New BMP Designs – CASQA 2011
- Subarea monitoring and BMP siting prioritization methodology – CASQA 2012
2. BMP Site Ranking Methodology
Overview

• Innovative, statistically rigorous approach
• Rank potential BMP subarea monitoring sites based on comparisons of:
  – Stormwater subarea concentrations with NPDES permit limits
  – Stormwater subarea particulate strengths with stormwater background particulate strengths
• Monitoring locations were scored based on number and percent of samples above NPDES permit limits and/or background
• Locations then ranked based on scores, and top locations identified
• Best professional judgment for BMP recommendations
• Process to be repeated annually through 2014
Attachment 1. Summary Flowchart for BMP Site Ranking Analysis Approach

1. Assemble **background** results from ISRA and BMP monitoring datasets
2. Calculate Particulate Strength concentrations (A) \( PS = \frac{\text{total-diss.}}{\text{TSS}} \)
3. Assemble **potential BMP subarea site** monitoring results (concentrations in water, C)
4. Calculate PS concentrations (B)
5. NPDES Permit Limits (D)

**Compare:**
- Potential BMP site PSs (B) with background PSs (A), and
- Potential BMP site concentrations (C) with NPDES permit limits (D)

- Determine pollutant-specific weighting factors (WFs) based on number of samples and percent above both critical thresholds.
- Average max metal and max dioxin WFs to determine multi-pollutant “score” for each site.
- Rank potential BMP subarea monitoring sites by multi-pollutant score. Rank potential BMP subarea monitoring sites by TSS WFs.

**Evaluate highest ranked sites** for suitability of new erosion or treatment controls, while utilizing best professional judgment to consider multi-pollutant and TSS scores, status of ISRA soil removal, demolition plans, existing or planned BMPs, and other pertinent factors.

**Proceed with new BMP designs and construction planning for recommended sites.**

**BMP siting analysis** to be repeated annually, along with evaluation of potential BMP monitoring locations.
### Example:

Site A: \(n = 10, m = 7\)  \(\Rightarrow \) Weight\(_A\) = 0.83

Site B: \(n = 14, m = 2\)  \(\Rightarrow \) Weight\(_B\) = 0.01

Based on weight alone, Site A would be prioritized over Site B.

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Basic Approach (example)

- **Highest priority**: > Background > Permit Limit
- **Second priority**: < Background > Permit Limit
- **Third priority**: > Background < Permit Limit
- **Not priority**: < Background < Permit Limit

The graph illustrates a probability distribution for different scenarios based on POC ( units ). The axes represent Cumulative Probability (%) on the Y-axis and POC (units) on the X-axis. The regions are color-coded to indicate different priority levels.
Example: Dioxin (TCDD TEQ)

- Background subareas occasionally exceed NPDES permit limit
- Water concentrations and particulate strengths at BMP subareas generally greater than at outfalls
Recent BMP Improvements

Legend
- NPDES Outfalls
- Sample Location
- BMPs
- Drainage
- Site Areas
- Subwatersheds
- ISRA-Completed and Planned

Helipad
ELV Channel
Northern Drainage
CM-9 Area
B-1 Area
Lower Lot
Outfall 008
### 2012/2013 Ranking Results

<table>
<thead>
<tr>
<th>Rank</th>
<th>Potential BMP Subarea (Co-locations)</th>
<th>Description</th>
<th>BMP Status</th>
<th>Approximate Upgradient Drainage Area (ac)</th>
<th>Multi-constituent Score</th>
<th>Rank from Maximum Metal Weighting</th>
<th>Rank from Maximum Dioxin Weighting</th>
<th>Total Number of Events Sampled</th>
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<tbody>
<tr>
<td>1</td>
<td>ILBMP0002a</td>
<td>Road runoff to CM-9</td>
<td>Addressed by current BMP; Influent site</td>
<td>2.5</td>
<td>0.95</td>
<td>1c</td>
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<td>EVBMP0003a (A2SW0001a)</td>
<td>CM-1 upstream west</td>
<td>Addressed by current BMP; Influent site</td>
<td>11.8</td>
<td>0.94</td>
<td>3c</td>
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<td>17</td>
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<td>3</td>
<td>EVBMP0001A</td>
<td>ELV culvert inlet (helipad road and ELV ditch, composite)</td>
<td>Will be addressed by BMP</td>
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<td>0.67</td>
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<td>EVBMP0002b</td>
<td>Helipad (pre-sandbag berms)</td>
<td>Addressed by current BMP</td>
<td>4.1</td>
<td>0.66</td>
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<td>5.5</td>
<td>EVBMP0005b</td>
<td>2012/13 ELV drainage ditch (pre-ELV-1C ISRA)</td>
<td>Will be addressed by BMP</td>
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<td>0.63</td>
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<td>5.5</td>
<td>A1SW0009-A</td>
<td>CM-9 downstream-underdrain outlet (post-A1LF asphalt removal, pre-filter fabric over weir boards)</td>
<td>BMP site has since been improved (old site)</td>
<td>16.4</td>
<td>0.63</td>
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<td>EVBMP0004b</td>
<td>2012/13 Lower Helipad Road</td>
<td>Will be addressed by BMP</td>
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<td>0.62</td>
<td>2</td>
<td>31.5</td>
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<td>APBMP0001b</td>
<td>Ashpile culvert inlet/road runoff</td>
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<td>ILBMP0001b</td>
<td>Lower lot 24&quot; stormdrain outlet</td>
<td>Addressed by current BMP and planned building demolition</td>
<td>23</td>
<td>0.57</td>
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<td>10</td>
<td>B18BMP0004a (B1SW0015, B18BMP004-5)</td>
<td>B-1 media filter north</td>
<td>Addressed by current BMP; Influent site</td>
<td>3.7</td>
<td>0.53</td>
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<td>14.5</td>
<td>LPBMP0001-A</td>
<td>Lower lot sheetflow (post-gravel bag berms)</td>
<td>Addressed by current BMP; discontinued</td>
<td>5.1</td>
<td>0.50</td>
<td>37.5</td>
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<td>14.5</td>
<td>B1SW0002a</td>
<td>Woolsey Canyon Road runoff</td>
<td>Addressed by current BMP; Influent site; discontinued</td>
<td>1.3</td>
<td>0.50</td>
<td>10</td>
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# 2012/2013 Ranking Results

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<th>Total Number of Events Sampled</th>
</tr>
</thead>
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<td>14.5</td>
<td>B1BMP0001 (B1SW0010)</td>
<td>B-1 media filter inlet (post-media filter installation)</td>
<td>BMP site has since been improved (old site); Influent site; discontinued</td>
<td>4.5</td>
<td>0.50</td>
<td>10</td>
<td>21</td>
<td>3</td>
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<tr>
<td>14.5</td>
<td>LXBMP0006</td>
<td>LOX east, runoff along dirt road</td>
<td>ISRA planned</td>
<td>0.43</td>
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<td>LPBMP0002</td>
<td>Lower parking lot influent to cistern</td>
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<td>EVBMP0006</td>
<td>2012/13 Area II Road near ELV ditch</td>
<td>Will be addressed by BMP</td>
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<td>B1SW0014-A (B1BMP0006)</td>
<td>B-1 media filter effluent (pre-media filter reconstruction)</td>
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<td>0.50</td>
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<td>LPBMP0001</td>
<td>Lower lot sheetflow (pre-gravel bag berms)</td>
<td>BMP site has since been improved (old site); discontinued</td>
<td>5.1</td>
<td>0.50</td>
<td>10</td>
<td>21</td>
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</tbody>
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**Notes:**
- Potential BMP subareas sorted by multi-constituent score, computed as described in Section 5.
- (*) These potential BMP subarea monitoring locations are upstream of existing stormwater quality treatment controls.
- (**) These potential BMP subarea monitoring locations have new planned (i.e., designed and ready for construction) stormwater quality treatment controls.
- (†) 2,3,7,8-TCDD detected in the 2012/13 water year in these subareas.
- The rounding of weights may account for similar weights being ranked differently.
- Approximate drainage areas based on the cumulative drainage area of the SWMM catchment in which the monitoring location is located (Geosyntec, 2011). At locations where the monitoring point is upstream of the catchment outfall a “<” sign is used.
- **Bolded** locations indicate that both the NPDES permit limit and 95th percentile background particulate strength threshold were exceeded for any one POC.
- **Gray** text indicates historic subarea monitoring sites that are discontinued.
- All sites ranked in the top 15 of the multi-constituent table are located in Outfall 009.
3. Conclusions
Water Quality Improvements

- Demonstrated by ranks, comparing influent and effluent.
- Limited to sites with at least 2 samples.

*Average of impacted B1 influent streams

BMP Monitored

*Better water quality
Benefits & Advantages

- **Precedent** – methodology has been presented to RWQCB staff and accepted for use in BMP planning
- **Proven** – methodology has been tested and shown to result in effective site prioritization and demonstrable water quality improvement
- **Defensible** – methodology is based on sound statistical principles
- **Flexible** – methodology can accommodate wide range in number of samples, sites, and pollutants
- **Robust** – BMP recommendations generally don’t change when a few sample results are removed here and there
- **Accounts for background** – prioritization results consider when observed water quality is due to background sources
- **Inexpensive** – statistical analysis is cheaper than watershed modeling (i.e., model development, testing, calibration, scenario simulation, etc.)
  - Methodology can also be used in combination with modeling as 2nd line of evidence for BMP situing
Potential Use & Applicability

• For sites or watersheds with multiple monitoring locations and a regulatory driver for prioritizing BMP placement (such as NELs, numeric effluent limits, or NALs, numeric action levels!), for instance:
  – Large Industrial General Permit sites (e.g., landfills, field labs, federal facilities)
  – MS4 outfalls in a watershed under a TMDL
  – Agricultural watersheds
  – Wherever watershed-wide BMP planning is needed and limited resources require spatial prioritization

• Limitations:
  – Significant data needs (number of locations) – although it’s possible to mitigate for this (e.g., by using modeling or land use-based data)
  – Requires regulators to be understanding of an iterative process...
Acknowledgements

• Other Panel members
• The Boeing Company
  – Paul Costa & Debbie Taege
• NASA
  – Pete Zorba
SSFL Surface Water Expert Panel work products can be found at: