Plan for the Webinar

- Introduce presenters
- Review purpose of the Playbook
- Describe the Methods
- Overview of the Method Evaluations
- Describe the Method Playbook
- Address questions
REVIEW PURPOSE OF THE PLAYBOOK
BACKGROUND

Trash has become a management focus throughout the world.

In California we have:

- Bans
- Total Maximum Daily Loads (TMDLs)
- Statewide Trash Policy (Trash Amendments)
  - Track 1
  - Track 2 - requires monitoring
STATEMENT OF PROBLEM

- Wide variety of considerations when monitoring trash
  - What are the management questions?
  - Which habitats are of concern?
  - What monitoring resources are available?

- Methods are developed independently of one another

- We recognize a need to identify/develop standardized monitoring methods to allow for optimum level of comparability spatially and temporally
STAKEHOLDER CONCEPTUAL MODEL WORKSHOP

- Develop a shared understanding of the key and unresolved issues surrounding trash monitoring
- Develop a list of the main management questions that would guide trash monitoring and examples of the scientific monitoring questions
- Provide recommendations and input regarding trash monitoring methods field testing, validation, and standardization
WHAT CAME OUT OF THE MEETING

● Questions
  ○ How much trash is out there?
  ○ At what rate is it changing?
  ○ What are the sources of trash (how much does the source contribute)?
  ○ What are the most effective management actions?
  ○ What is the effect or cost of trash impacts?

● Habitats
  ○ Primarily interested in receiving waters - streams and rivers
  ○ Applicable throughout California

● Methods of interest
  ○ Evaluate currently used methods
  ○ Investigate new innovative methods
COMMON QUESTIONS

Spatial Comparisons

Eg. “How does my stream compare in trash to the one in another county?”

Temporal Comparisons

Eg. “Is trash in my neighborhood getting better or worse?”
TRANSLATING MANAGEMENT QUESTIONS INTO MONITORING SCIENTIFIC QUESTIONS

**Management Questions**

- Habitat
- Target/What is Being Measured
- Metric
- Pathway
- Temporal Window/Timeframe
- Level of Precision
- Monitoring Question/Basis for Trash Monitoring Method

**Is the amount of trash changing?**

- ...in natural/vegetative creeks
- ...using plastic bags as an indicator
- ...as measured by counts
- ...from all pathways
- ...with 5 years of monitoring
- ...with a 95% confidence interval

**Has the number of plastic bags in natural/vegetative creeks changed within 5 years by 10% within a 95% Confidence interval?**
STATEWIDE STANDARDS FOR TRASH MONITORING METHODS PROJECT

● Funder:
  ○ Ocean Protection Council

● Project Leads:
  ○ San Francisco Estuary Institute (SFEI)
  ○ Southern California Coastal Water Research Project (SCCWRP)

● Partner Agency:
  ○ State Water Resources Control Board

3 Years 2017-2020
APPROACH

- Field test four methods
  - Three currently being used by others
  - One novel method

- Bring together a Technical Advisory Committee of experts

- Involve Stakeholders
  - Inform and solicit feedback
  - Participate in field testing
PRODUCTS

- Field Testing Report
- Playbook for Trash Monitoring
  - Standard Operating Procedures for each method
  - Includes information to help stakeholders choose their method
  - Recommends data management and analysis standards to allow for comparability
  - Usable by a variety of stakeholders
- Outreach and Training
  - Modules with instruction on each method
  - Meetings with a variety of stakeholders to share project information
DESCRIBE THE METHODS
METHODS

- Qualitative: Rapid Trash Assessment

- Quantitative:
  - Volume: Bay Area Stormwater Management Agencies Association riverine method
  - Counts: Southern California Stormwater Monitoring Coalition riverine tally method

- Novel method
  - UAS: manual and machine learning-based identification of trash
QUALITATIVE - VISUAL OBSERVATION METHOD

- Rapid assessment method
- Based on a scale of 1-12 (1=lowest; 12=highest)
- Characterized as Low, Moderate, High, Very High

Low

Very High
QUANTITATIVE - BASMAA VOLUMETRIC METHOD

- Trash measured by volume
- Precise, accurate extractive method
- Categorized according to pathway
- Project team recommended and implemented categories aligned with material types found in other methods
- Volume is an advantageous metric for wet environments, given variability in mass for inundated material
QUANTITATIVE - SMC TALLY METHOD

- Developed and used since 2007 in Southern California by the Stormwater Monitoring Coalition
- Counts individual trash by material and item categories
- Measures change over time for trash load, as measured by counts

Field teams from BASMAA and the SMC participated in intercalibration events in Northern and Southern California.
NOVEL - UAS METHOD

New Development

Goals:

- Expand the geospatial range
- Increase temporal density
- Enhance ease of data collection
- Automate counting
- Improve repeatability

Testing:

- Manually via imagery
- Automatically via artificial intelligence
Unoccupied Aerial Systems

We fly high above the ground to maximize the area covered.

A pilot can cover many times more space with an aerial vehicle than she can on foot.
Unoccupied Aerial Systems

We fly to leverage flight planning software.

A given area can be reflown precisely and repeatedly
• in quick succession
• or after many years

These surveys can monitor change over time.
OVERVIEW OF THE METHOD EVALUATIONS
FIELD TESTING REPORT

- Evaluated each method individually
  - Accuracy
  - Precision
  - Resources

- Compared methods
  - Is one method predictive of another?
<table>
<thead>
<tr>
<th>METHOD</th>
<th>MONITORING QUESTIONS</th>
<th>BIAS</th>
<th>REPEATABILITY</th>
<th>RESOURCES</th>
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TALLY METHOD EXTINCTION CURVES

Site 1
COMPARISON OF DIFFERENT TEAMS
Volume vs Qualitative

Trendline $R^2 = 0.885$
COMPARISON OF UAS VS TALLY

UAS Imagery (Manual) vs Tally Amount

- Via Imagery
- Tally Amount

Omitting

Nothing
Pieces
Pieces and Paper
SUITE OF RELATED METHODS

- Tobacco Product Waste Method (CDPH)
- Chicago Stream Survey (Univ of Chicago)
- Supercomputing
  - Kinetica
  - Oracle
- Escaped Trash Assessment Protocol (USEPA)
DESCRIBE THE METHOD PLAYBOOK
WHAT THE PLAYBOOK INCLUDES

● Field Sampling Considerations
  ○ Site Access Permits, Permissions, and Other Considerations
  ○ Safety
  ○ Invasive Species

● Quality Assurance Requirements
  ○ Training Materials
  ○ Field Audits
  ○ Repeated Walking Over Assessment Areas
  ○ Post-event Data Record Review

● Consistency in Measurements for Comparability
  ○ Training
  ○ Common Vocabulary
  ○ Recommends amount/unit area measurement where applicable
WHAT THE PLAYBOOK INCLUDES (CONT.)

● Data Capture and Standardization
  ○ Field Forms
  ○ Data from project
  ○ Machine-learning algorithm
  ○ Mobile Application for Stations Info and Visual Assessment

● Standard Operating Procedures for Each Method

● Tiered Method Approach - Will discuss here
TIERED METHOD APPROACH

Tier 1 Visual
- Low
- Moderate
- High
- Very High

Tier 2 UAS
- Plastic
- Not Plastic

Tier 3 Volume
- Plastic
- Fabric and Cloth
- Biodegradable
- Biohazard
- Construction
- Glass
- Metal
- Large
- Misc.

Tier 4 Tally*
- Bag—Single Use
- Bag—Reusable
- Natural (Cotton, Wool)
- Food Waste
- Condoms
- Bricks
- Glass Bottles
- Aluminum Foil Pieces
- Furniture/Appliances
- E-Waste
- Shoes
- Paper/Cardboard
- Dead Animals
- Concrete/Asphalt
- Glass Pieces
- Aluminum/Steel Cars
- Garbage Bags of Trash
- Foam Rubber
- Beverage Bottles
- Synthetic Fabric
- Yard Waste/Yard Trimmer
- Human Waste/Dispenser
- Fabricated Wood
- Glass Other
- Auto Parts
- Shopping Carts
- Hose/Hose Pieces
● How much trash is in my stream or river?
● In which of my receiving waters is trash most prevalent?
● How does my area compare to others?

● How many pieces of trash are visually countable across a very broad landscape?
● How does the amount of visible trash vary according to landscape conditions at a broad scale?

● Is the volume of plastic increasing or decreasing in the study area?
● Does the trash volume increase in the study area following a storm event?

● Is the amount of expanded polystyrene increasing or decreasing?
● Has the expanded plastic bag ban reduced levels in the study area?
# ESTIMATES OF MEASUREMENT AND RESOURCES

<table>
<thead>
<tr>
<th>METHOD</th>
<th>ACCURACY</th>
<th>PRECISION</th>
<th>RESOURCES</th>
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</thead>
<tbody>
<tr>
<td>Tier 1 - VISUAL</td>
<td>Low-Med</td>
<td>Low-Med</td>
<td>⬠</td>
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<tr>
<td>Tier 2 - UAS</td>
<td>Low-Med</td>
<td>Low-Med</td>
<td>⬠ ⬠</td>
</tr>
<tr>
<td>Tier 3 - VOLUME</td>
<td>Med-High</td>
<td>Low-Med</td>
<td>⬠ ⬠ ⬠</td>
</tr>
<tr>
<td>Tier 4 - TALLY</td>
<td>Med-High</td>
<td>Med-High</td>
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METHOD CONSIDERATIONS

Management Question

Monitoring Question

Resources

Accuracy

Precision

Method

Tally

Volumetric

Qualitative

UAS
MOBILE APPLICATION FOR VISUAL ASSESSMENT

Uses ESRI’s Survey 123

- Automatically structures data
- Embeds teaching tools for informed interpretation
- Collects location data
- Collects imagery
- Active connectivity not required
FINDINGS AND CONCLUSIONS

- Size Matters for All Methods
- Costs Vary by Resource Type
- Method Relationships can Predict Results
- Trash density metric facilitates broad comparability
- Training is critical for repeatability

SO WHICH METHOD IS BEST?
ADDRESS
QUESTIONS
FOR MORE INFORMATION AND TO DOWNLOAD THE REPORT (available 2/22/21):

- Visit trashmonitoring.org
- Contact:
  - Tony Hale, SFEI
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  - Shelly Moore, SFEI
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