The California Trash Monitoring Playbook

Tony Hale, Shelly Moore
Lorenzo Flores, Pete Kauhanen
San Francisco Estuary Institute

February 18, 2021

SFEI 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
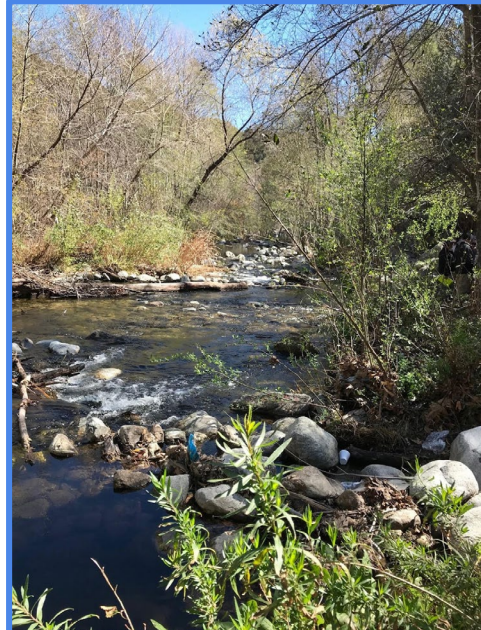
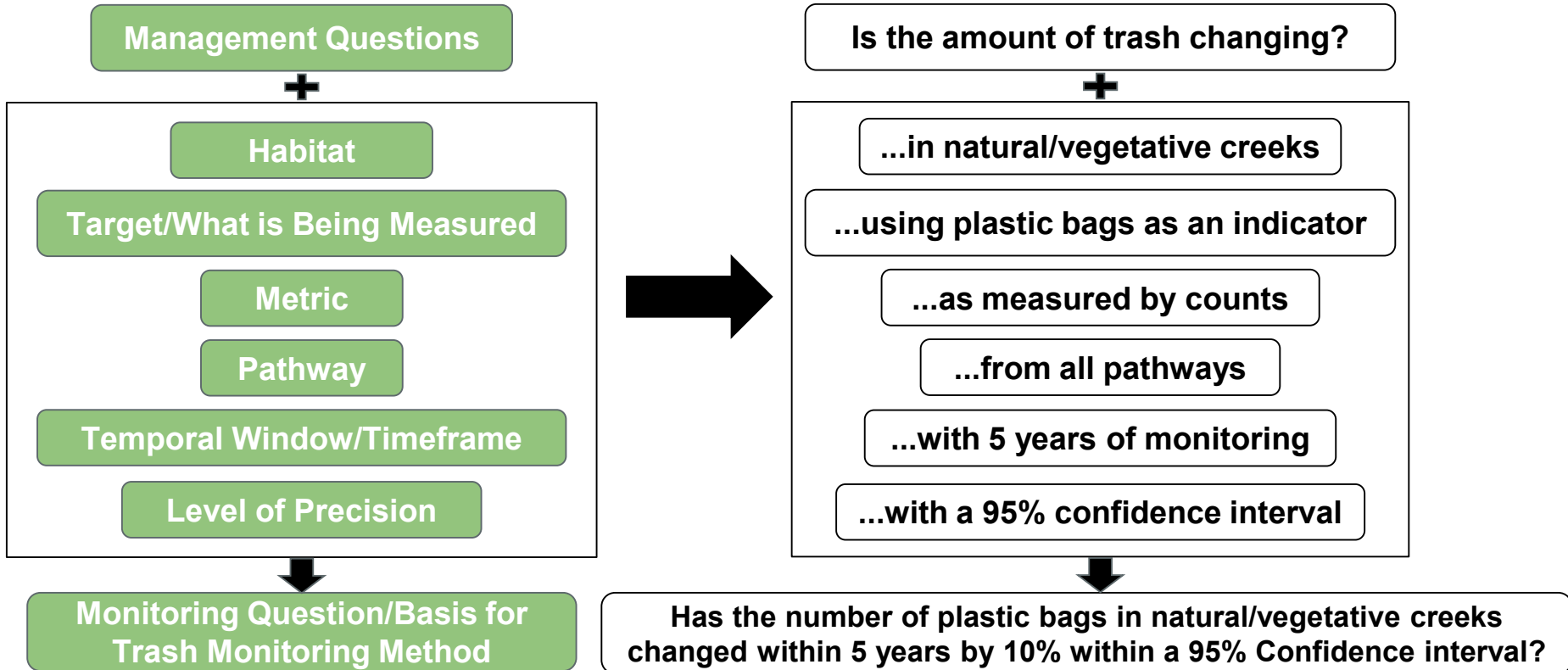# COMMON QUESTIONS

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
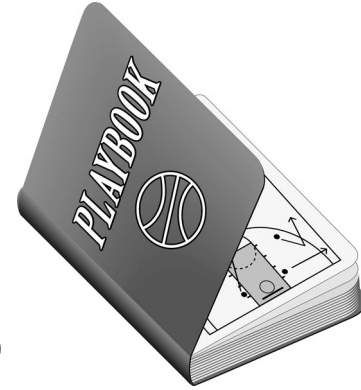
DESCRIBE THE METHODS

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

Example Creek Assessment Area
(300 Feet in Length)

Most Upstream Point
(Width #3)

Top of Bank
(Length of Assessments Area)

150 Feet

Mid-Point
(Width #2)

150 Feet

Most Downstream Point
(Width #1)

Not to Scale
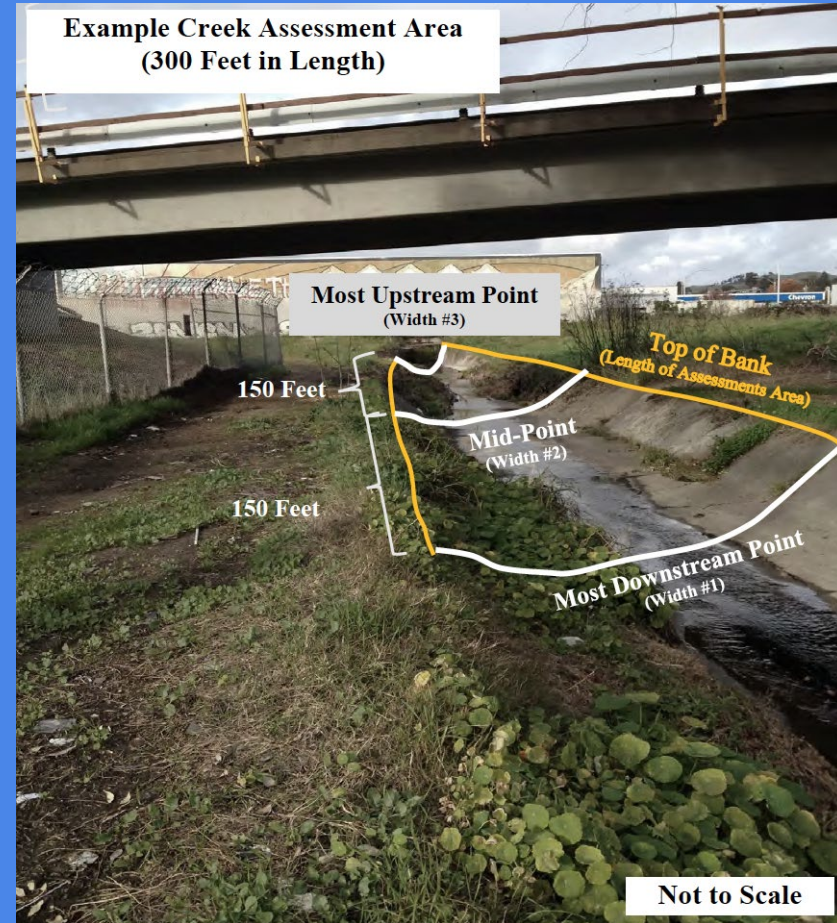
Photo taken from the BASMAA Receiving Water Trash Monitoring Program Plan for the San Francisco Bay Region.

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

Example Creek Assessment Area
(300 Feet in Length)

Most Upstream Point
(Width #3)

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(Length of Assessments Area)

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Most Downstream Point
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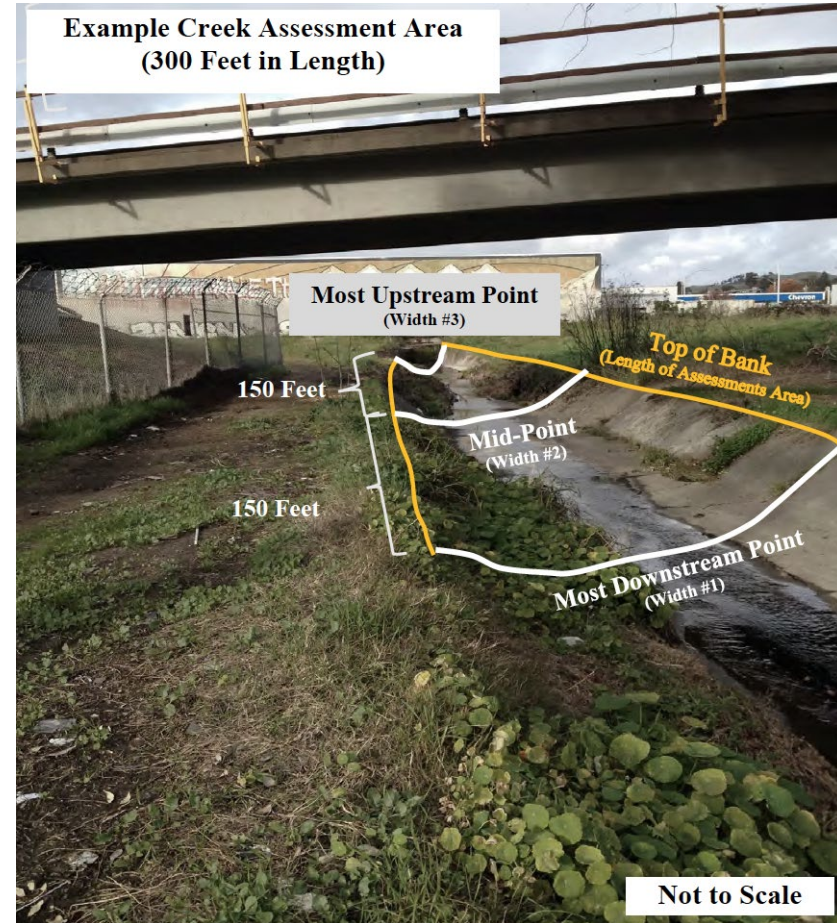
QUANTITATIVE - SMC TALLY METHOD

- 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?

Field Testing Report
for the California Trash Monitoring Methods Project
12.20.2020

FUNDED BY
California Ocean
Protection Council

PREPARED BY
Southern California Coastal Water Research Project
3535 Harbor Blvd., Suite 110
Costa Mesa, CA 92626

AUTHORS
Shelly Moore, Tony Hale,
Stephen B. Weisberg, Lorenzo Flores,
Pete Kauhanen

SFEI
SAN FRANCISCO
ESTUARY INSTITUTE

San Francisco Estuary Institute
4911 Central Ave.
Richmond, CA 94804

COMPARISON TABLE / MATRIX

METHOD	MONITORING QUESTIONS	BIAS	REPEATABILITY	RESOURCES
A				$$$$ 👤👤👤👤
B				$$$ 👤👤👤
C				$$ 👤👤
D				$ 👤

TALLY METHOD EXTINCTION CURVES
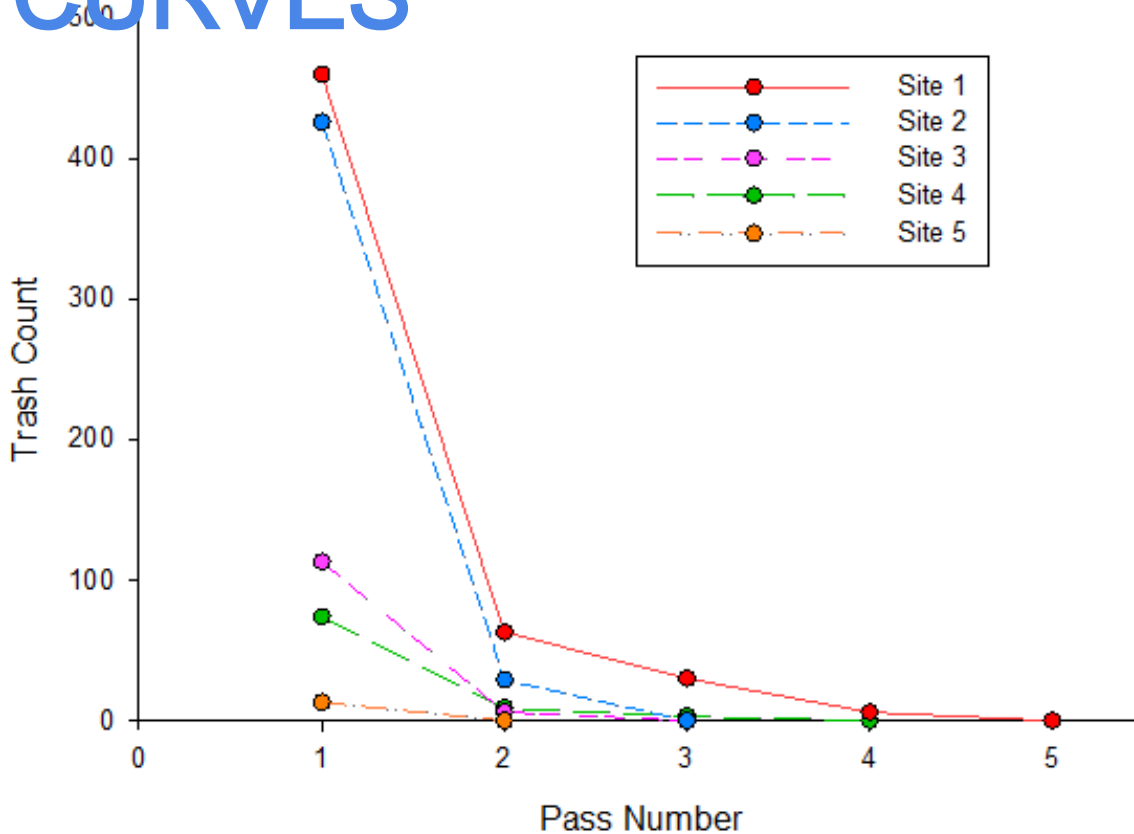
Site 1

COMPARISON OF DIFFERENT TEAMS
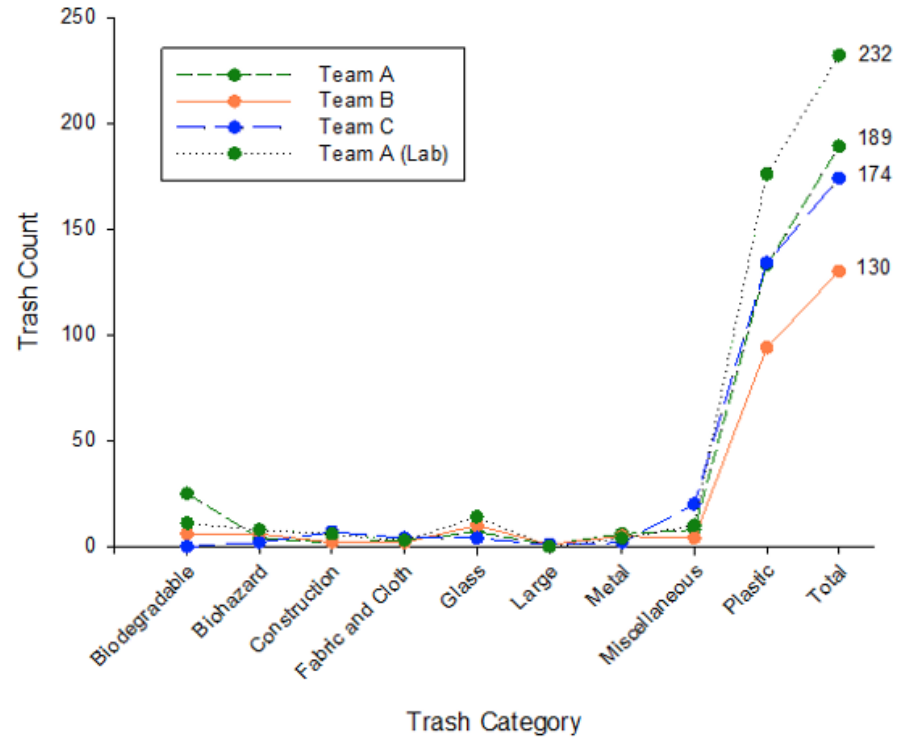
METHOD RELATIONSHIPS

Volume vs Qualitative
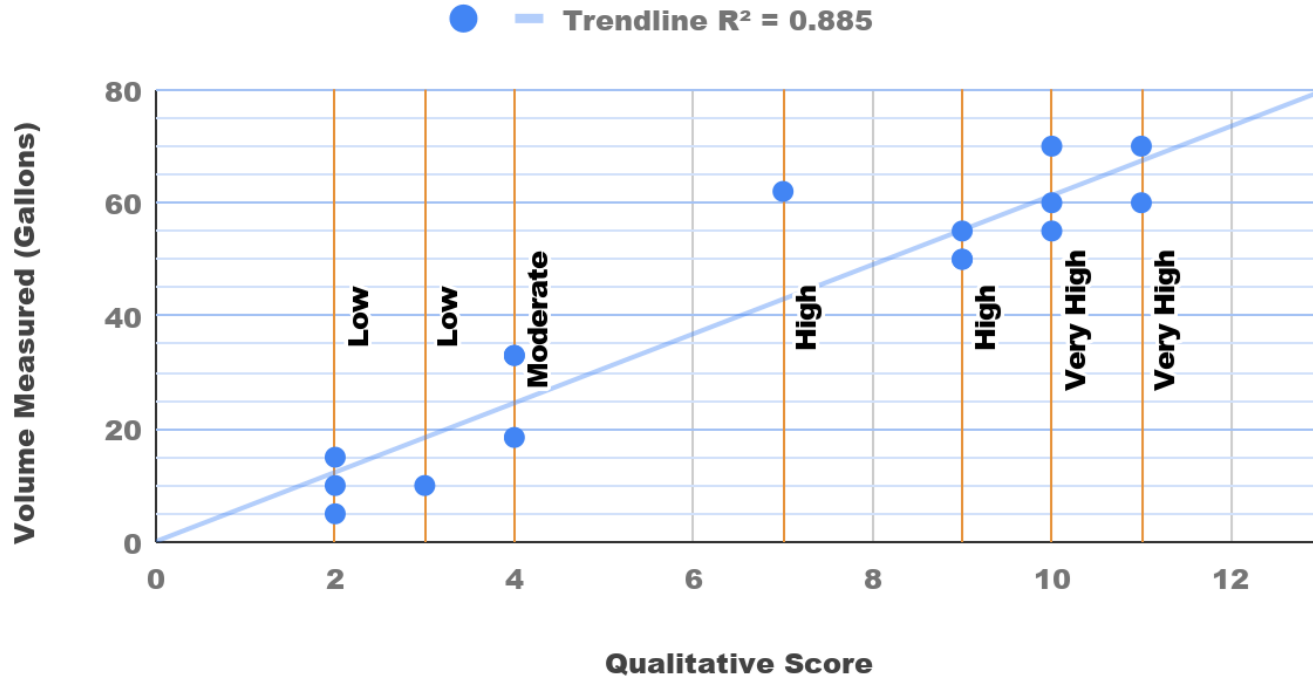
COMPARISON OF UAS VS TALLY

UAS Imagery (Manual) vs Tally Amount
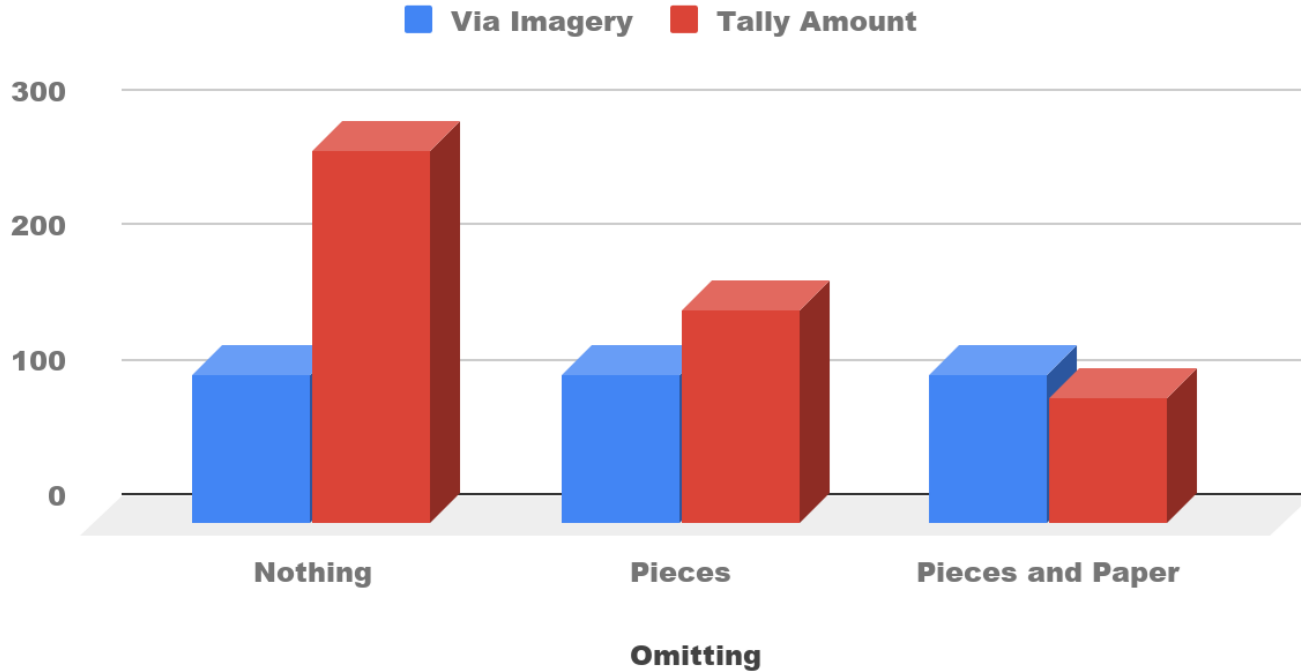
SUITE OF RELATED METHODS

- 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
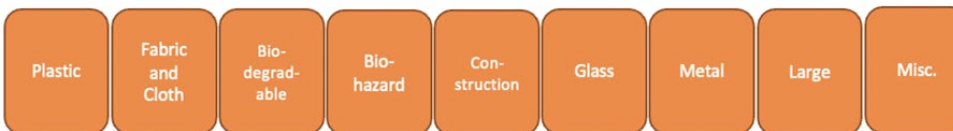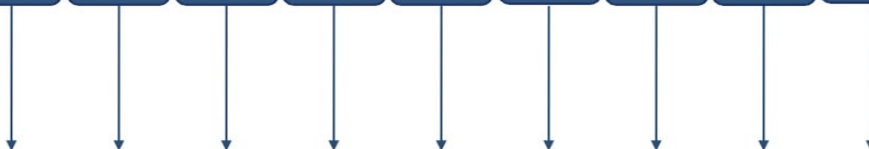
Qualitative

Tier 1 Visual

Low	Moderate	High	Very High

Quantitative

Tier 2 UAS

Plastic	Not Plastic

Tier 3 Volume

Plastic	Fabric and Cloth	Bio-degrad-able	Bio-hazard	Con-struction	Glass	Metal	Large	Misc.

Tier 4 Tally*

Bag – Single Use	Natural (Cotton, Wool)	Food Waste	Condoms	Bricks	Glass Bottles	Aluminum Foil Pieces	Furniture/ Appliances	E-Waste
Bag – Reusable	Shoes	Paper/ Cardboard	Dead Animals	Concrete/ Asphalt	Glass Pieces	Aluminum /Steel Cans	Garbage Bags of Trash	Foam Rubber
Beverage Bottles	Synthetic Fabric	Yard Waste/ Leaf Piles	Human Waste/ Diapers/TP	Fabricated Wood	Glass Other	Auto Parts	Shopping Carts	Hose/ Hose Pieces

Tier 1
- 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?

Tier 2
- 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?

Tier 3
- 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?

Tier 4
- 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

METHOD	ACCURACY	PRECISION	RESOURCES
Tier 1 - VISUAL	Low-Med	Low-Med	👤
Tier 2 - UAS	Low-Med	Low-Med	👤👤
Tier 3 - VOLUME	Med-High	Low-Med	👤👤👤
Tier 4 - TALLY	Med-High	Med-High	👤👤👤👤

METHOD CONSIDERATIONS
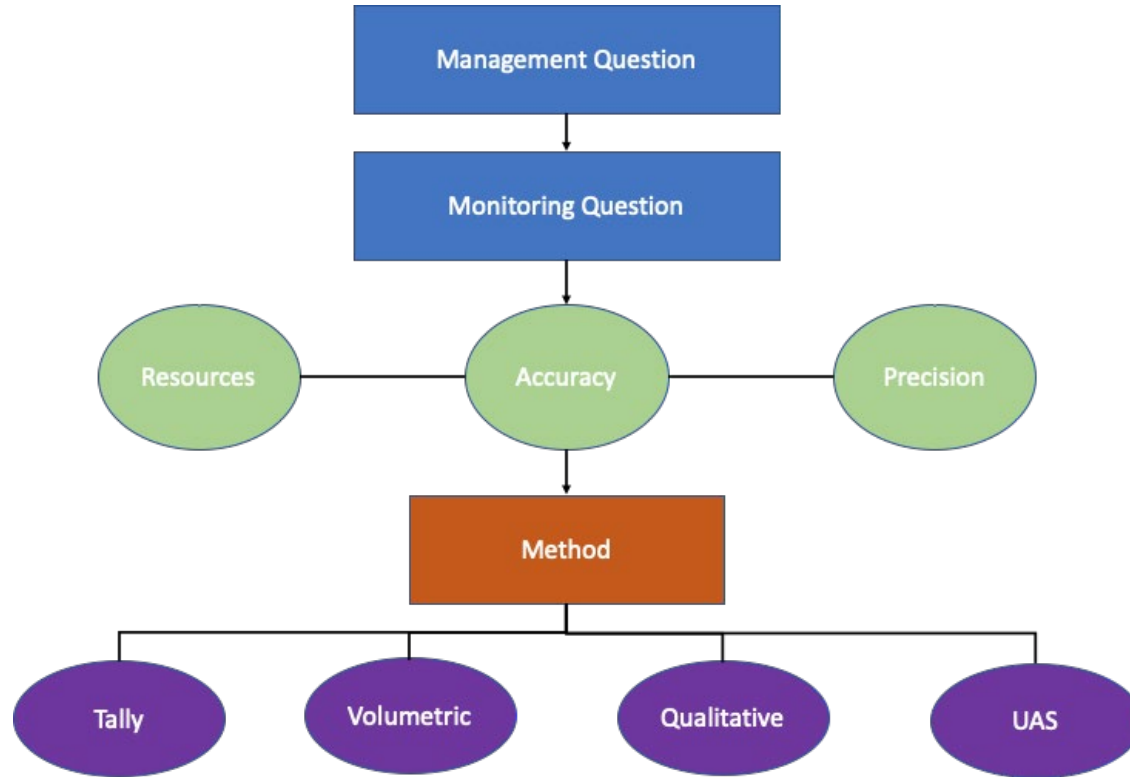
MOBILE APPLICATION FOR VISUAL ASSESSMENT

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 tonyh@sfei.org

  - Shelly Moore, SFEI shellym@sfei.org