

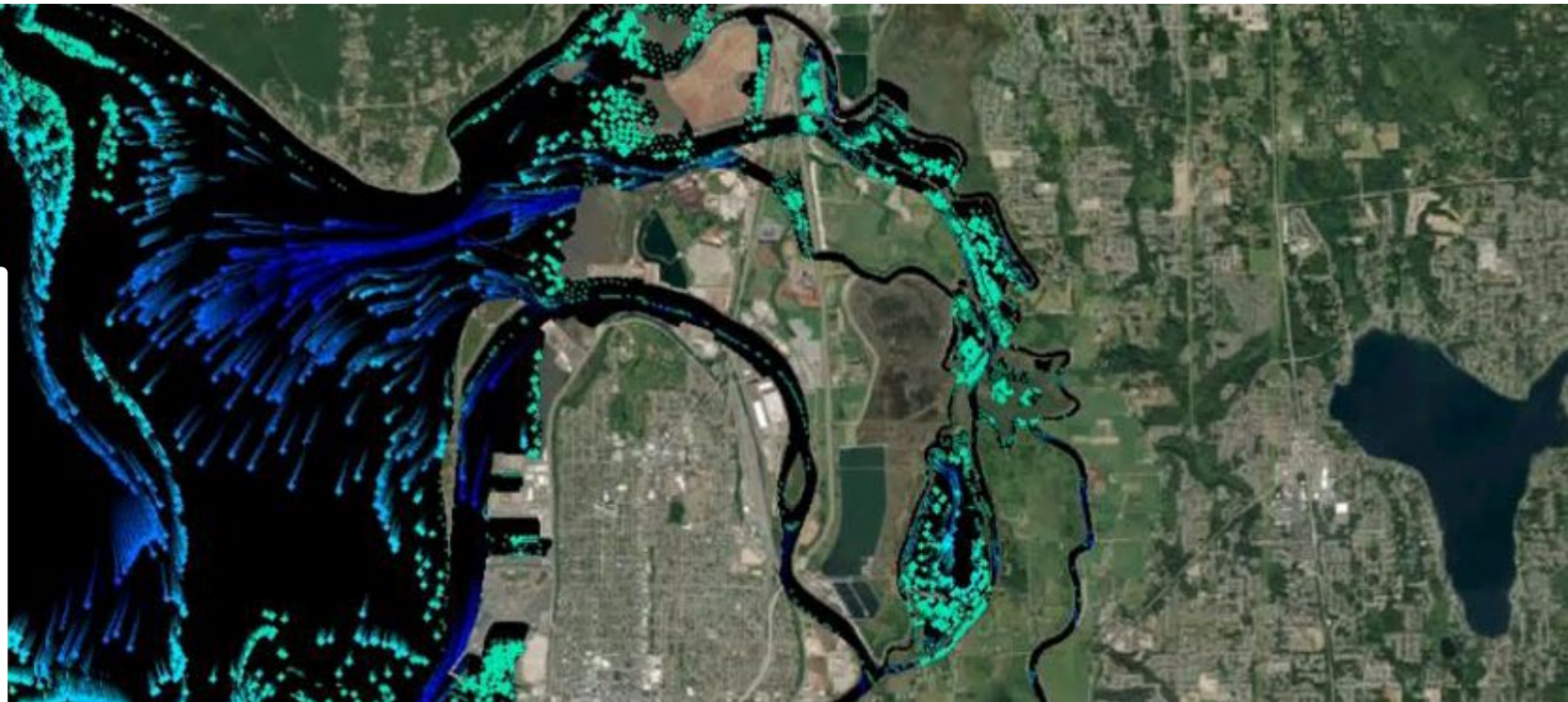
Waterborne Plastic Assessment & Collection Technologies

Presented by Ben Maurer, National Renewable Energy Laboratory

Science and Technology Advisory Committee Meeting

Partnership for the Delaware Estuary

December 2, 2021



The Vision

Cleaner waterways and healthier communities by 2040 through

- a 50% or greater reduction in U.S. waterborne plastic emissions into the ocean (relative to 2016), and*
- the reintroduction of a cumulative 10 million metric tons of plastics into the circular economy.*



Sensing



Collection



Conversion



Redesign

Sources of Plastic Debris



NANO



MICRO



MESO



MACRO

Renewable power



Measurement



Collection



Conversion



Redesign

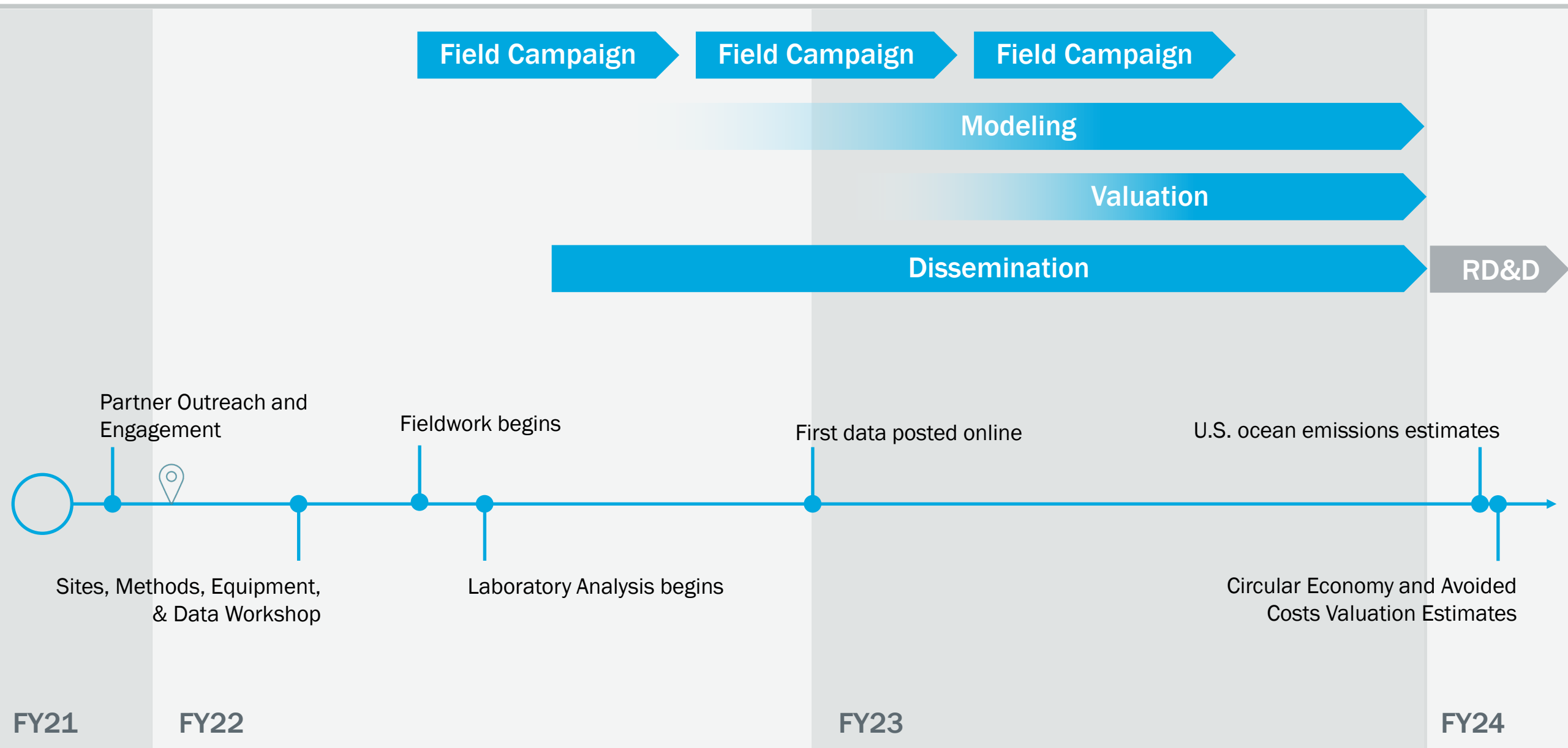
VALUATION OUTPUTS

- Economic
- Carbon
- Energy
- Environmental
- Social
- Health

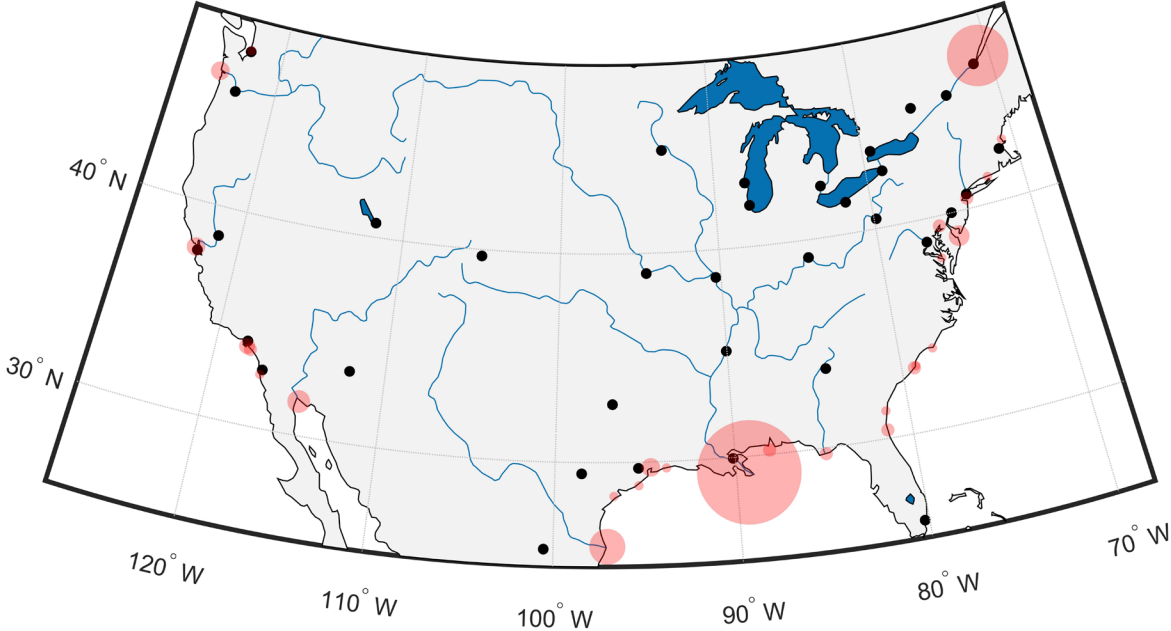


Waterborne Plastic Assessment
& Collection Technologies

Timeline



Assessing U.S. Rivers



River	Mississippi	Delaware	Sacramento	Los Angeles	Columbia	Total
Energy	764 GWhr/yr	7 GWhr/yr	31 GWhr/yr	<1 GWhr/yr	2.7 GWhr/yr	805 GWhr/yr
Outflow	13,300 m ³ /s	340 m ³ /s	797 m ³ /s	6 m ³ /s	3,592 m ³ /s	18,035 m ³ /s
Plastics	699 tons/yr	15 tons/yr	10 tons/yr	8 tons/yr	26 tons/yr	745 tons/yr
% of Total	58 – 65%	2%	1 %	0 – 1 %	1-2%	51 – 71%
Population	76.7 M	7.5 M	6.0 M	5.0 M	7.3 M	102.5 M
Terminus	Gulf of Mexico	Atlantic	San Fran. Bay	Pacific	Pacific	-
Rationale	Magnitude	Watershed data	Planned Project	Periodicity	Infrastructure	-
Local Partner	-	-	-	-	-	-
HBCU/HSI/AIANSI	-	-	-	-	-	-

Estimations of riverine plastic from Schmidt et al. 2017. Estimations of the hydrokinetic resource are from the MHK Atlas.

Field Campaign & Laboratory Analysis



Repeated sampling of a river over the course of a year

- Capture seasonal highs and lows as well as flooding events at sites using accepted monitoring and assessment guidelines
- Work executed by local universities or nonprofits

Comparable high-quality, cross-watershed, full-spectrum data

River

Condition (e.g. flooding)
Flow rate (avg., max., min.)
Current profiles
Turbulent kinetic energy
Turbidity
Depth and water level (stage)
Substrate
Seasonality (drought & flooding)
Presence of large debris
Precipitation
pH
Solar irradiance

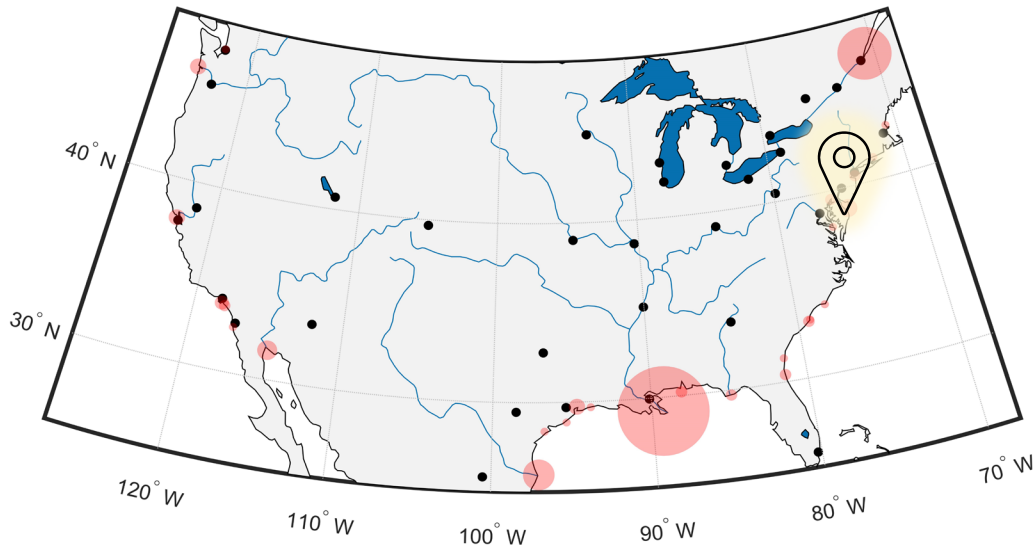
Plastics

Total mass
Water column position
Resin type
Additives and elemental analysis
Resin form (e.g. film)
Particle size and shape
Surface topology
Molecular weight distribution
Crystallinity and thermal properties
Mechanical properties
State of degradation
Source

Locality

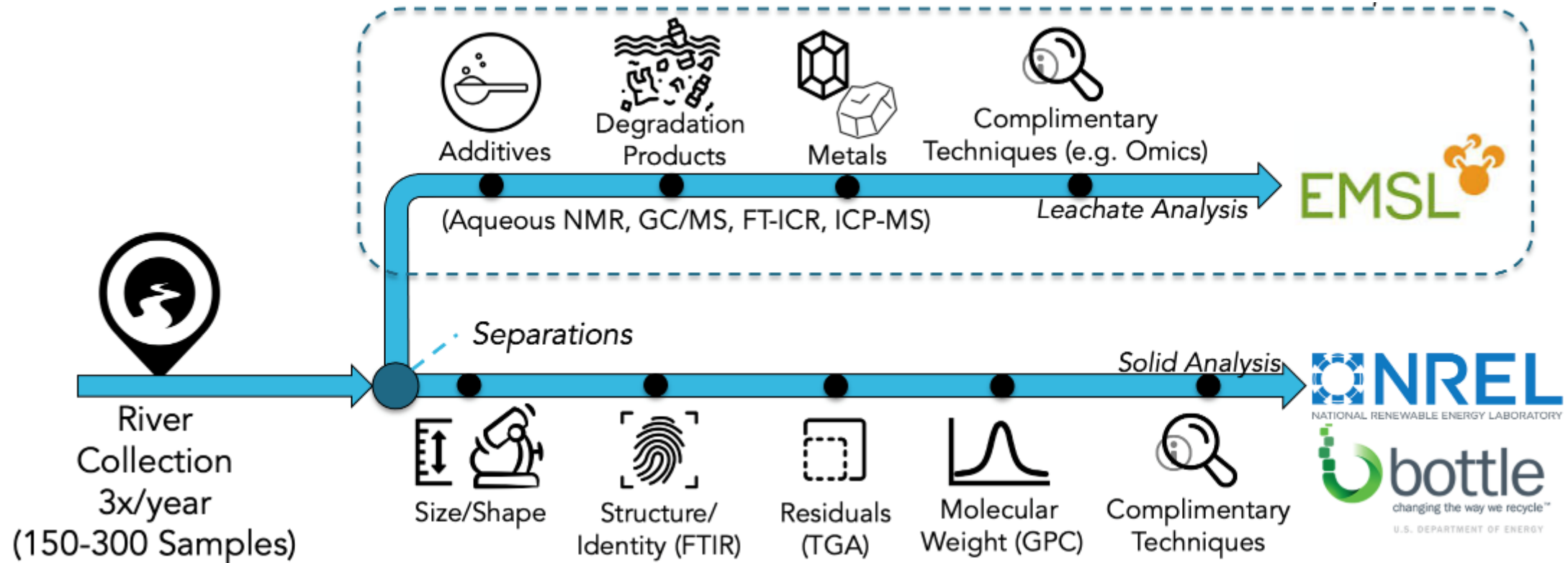
Piers and ramps
Dams or weirs
Wastewater resource recovery facilities
Combined sewage overflows
Material Recovery Facilities
Endangered or sensitive species
Recreational activity
Commercial activity
Industrial activity

WaterPACT + EPA Region 3



- **Methods/Equipment/Planning Workshop**
- **Collaboration in on-river field sampling**
 - Multi-day transects, 3x per year
 - Leveraging equipment, experience, expertise
 - Ship Ops, Collection, Netting, Bottling, Blanks, (Shipping)
- **Leveraging existing river networks, data, analysis, and ongoing work**

Sample Workflow

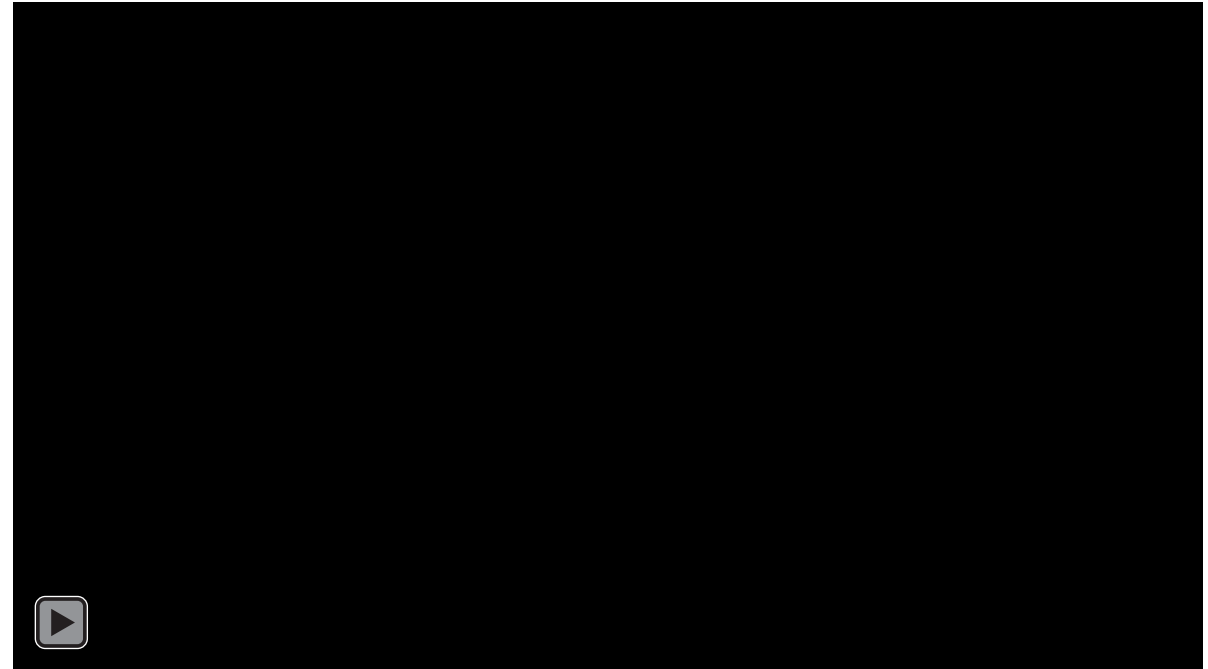


For more information on EMSL Large Scale Awards, see: <https://www.emsl.pnnl.gov/projects>

Modeling

Energy, fate & transport modeling of a river and estuary

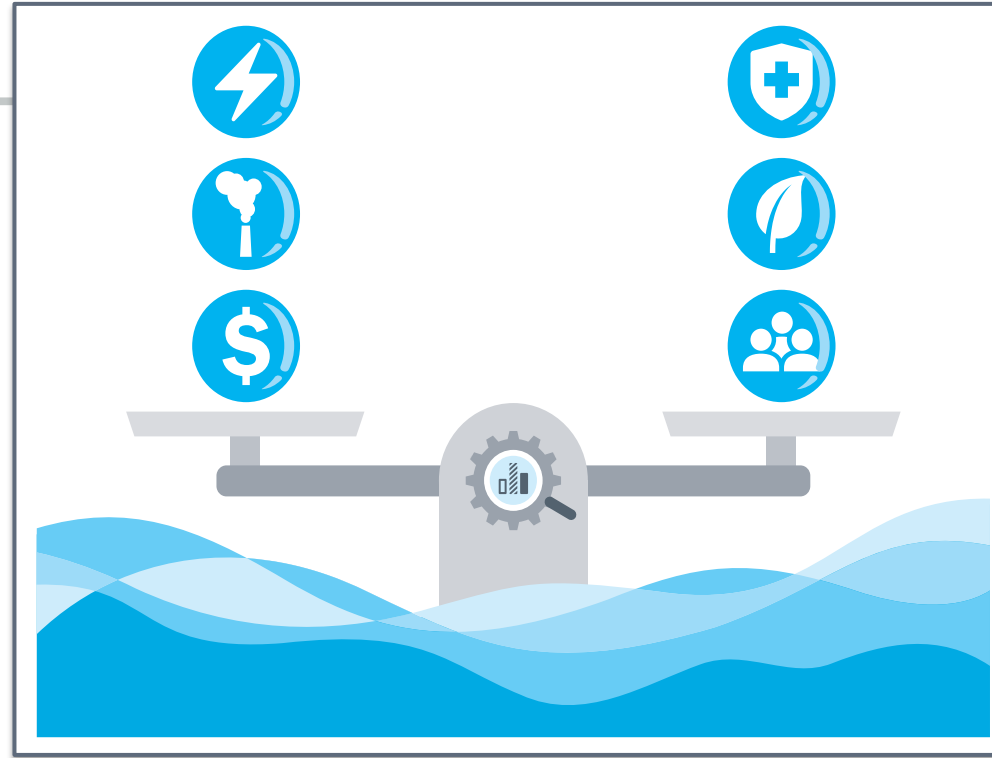
- Watershed and hydrodynamic modeling of:
 - Riverine hydrokinetic resource
 - Fate and transport of measured particles
- Leverages existing 3-D particulate, hydrodynamic, and watershed models
- Calibrated against field measurements
- Leverages BER-funded Integrated Coastal Modeling (ICoM) project



Along-river model of sources, sinks, transports, and transformations of plastics

For more information on ICoM project, see: <https://icom.pnnl.gov>

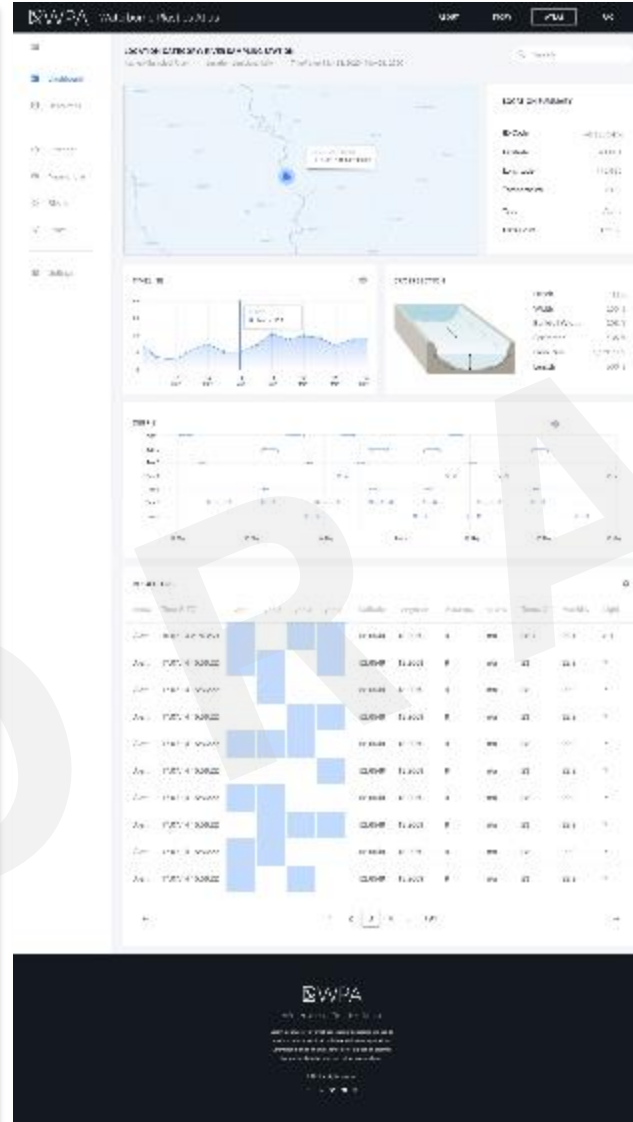
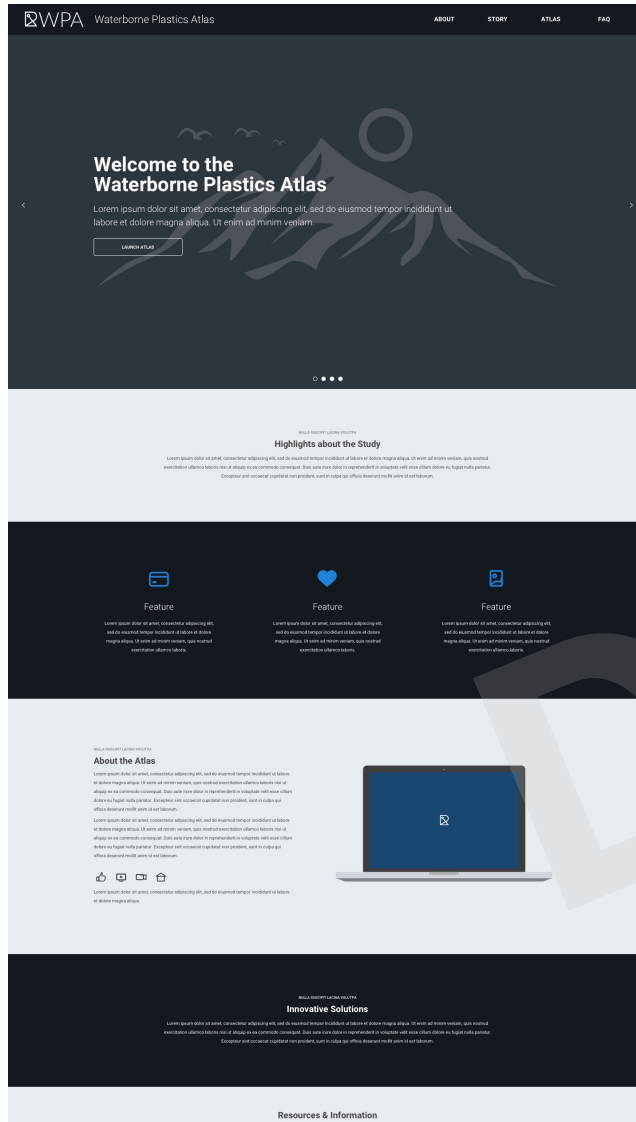
Valuation



- Valuating reclaimed plastics feedstocks relative to existing, emerging, and prophetic supply chains
- Leveraging the modeling tools of the BOTTLE initiative, and partnering with global leader and HBCUs, HSIs, and AINASIs

Economic, carbon, energy, social, health and environmental valuation of measured plastics

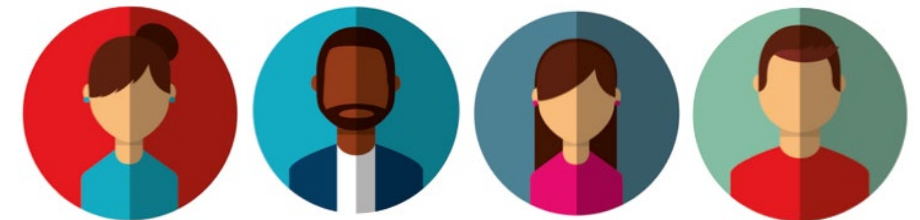
Data Dissemination



Data Portal and Visualization Atlas

- Key stakeholder-facing website to directly share TBs of field measurement, laboratory analysis, modeling, and valuation findings
- Leverages riverine hydrokinetic MHK Atlas work and informs improvements

Accessible, actionable data



Anticipated to be available in FY22: www.waterpact.org

WaterPACT - waterborneplastics@nrel.gov

Ben Maurer - ben.maurer@nrel.gov

www.waterpact.org coming soon



Links

Water Power Technologies Office	https://www.energy.gov/eere/water/water-power-technologies-office
Advanced Manufacturing Office	https://www.energy.gov/eere/amo/advanced-manufacturing-office
Bioenergy Technologies Office	https://www.energy.gov/eere/bioenergy/bioenergy-technologies-office
Office of Science Biological and Environmental Research	https://www.energy.gov/science/ber/biological-and-environmental-research
Environmental Molecular Sciences Laboratory Projects	https://www.emsl.pnnl.gov/projects
BioOptimized Technologies to keep Thermoplastics out of Landfills and the Environment (BOTTLE)	https://www.bottle.org/
DOE Plastics Innovation Challenge	https://www.energy.gov/plastics-innovation-challenge/plastics-innovation-challenge
Integrated Coastal Modeling	https://icom.pnnl.gov/
Integrated Terrestrial-Coastal Modeling System	https://climatemodeling.science.energy.gov/presentations/integrated-terrestrial-coastal-modeling-system-dhsvm-fvcom-rift
Materials Flow through Industry Supply Chain Modeling Tool	https://www.nrel.gov/manufacturing/mfi-modeling-tool.html
Water Power Resource Atlas	https://maps.nrel.gov/mhk-atlas/
Waterborne Plastics Assessment & Collection Technologies	https://www.waterpact.org/ (not up yet)

Schedule

