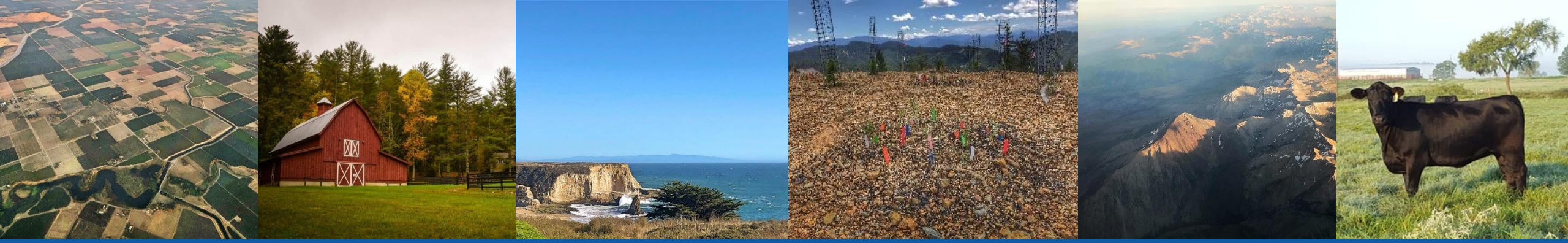


Analytical Methods and Validation

1. Abatement
2. Environment
3. Food
4. Livestock
5. Plants

Roadmap: The need for rapid quantitative methods for PFAS

Key Aspects

1. Validated & standardized methods for various matrices
2. Networks and forums/sharing information
3. Workshops & trainings
4. Lower cost of analysis

Timeline; what needs to be done when?

1. Create & maintain a database with available analytical methods for PFAS - ASAP
2. Available rapid & efficient methods – ASAP
3. Training for PFAS analysis: federal & state level
4. Isotopically labeled standards to improve analysis
5. Standard & certified reference materials (SRMs & CRMs)

Milestones for each high level aspect of the timeline:

1. Establish a database with available methods
2. Develop & validate methods for various matrices
3. Establish training system
4. Create workshops & forums to exchange information and knowledge

Early Deliverables (1-2 years)

- Method database – can funding be obtained? Data scientists
- Rapid & efficient, validated methods

Longer term deliverables (2-4 years)

- Sharing knowledge (regional & national levels)
- New standards, lower cost
- New SRMs/CRMs

Impacts:

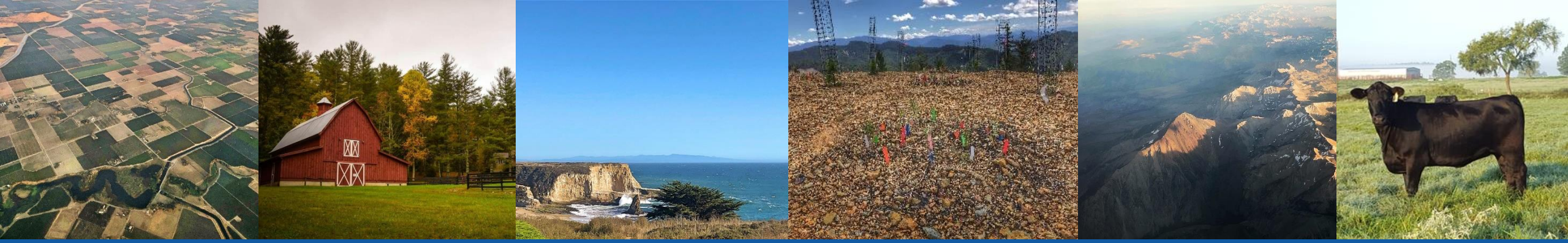
- Better methods => lower cost & quick turn around time
- Generated data will help farmers and communities and inform risk assessment for regulations
- Trained workforce
- Improved environmental & human health

Co-leader volunteers (as many as want)

Yelena Sapozhnikova

Lorna De Leoz

Jasmine Jones



Alternatives, Abatement & Remediation

1. Abatement
2. Environment
3. Livestock
4. Materials

Roadmap:

Reduce PFAs from agroecosystems while optimizing resource inputs

Key Aspects

1. **R**eplace
2. **I**mmobilize
3. **D**estroy

Timeline; what needs to be done when?

1. Electrochemical destruction 3-5 yrs
2. Hydrophobic/ oleophobic coatings 3-5 yrs
3. Biobased packaging 1-2 yrs
4. Biochar based water filters 3-5 yrs
5. Field scale evaluation of existing BMPs 2-4 yrs (Maine)
6. Thermal destruction evaluation 1-2 yrs
7. Phytoaccumulation 3-5 yrs
8. Treatment train alternatives 5-10 yrs
9. Long term monitoring >20 yrs

Milestones for each high level aspect of the timeline:

1. Replacement of low performance PFAS 1 year identify alternatives prototype yr 3
2. Replacement of mid performance PFAS 3 year identify alternatives prototype yr 6
3. Evaluate current pollution prevention BMPs and Case studies 4 years
4. Field evaluation of sorbents to reduce availability 4 years
5. Scalable for water treatment 3 years
6. Wastewater treatment 10 years

Milestones for each high level aspect of the timeline:

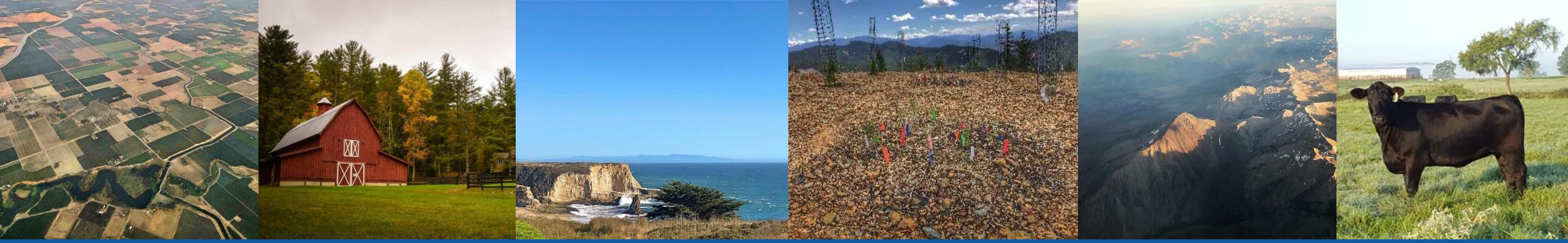
7. Evaluate thermal and electrochemical PFA destruction 3 years
8. Lab scale thermal destruction of PFAs from sorbed materials 4 years
9. Lab scale electrochemical destruction 4 years
10. Optimized destruction system for accumulated PFAs 8-10 years
11. Biological destruction 1-2 decades?

Impacts:

Remove 100 tons of PFAs from food packaging in 5 years
Source reduction of PFAs entering agroecosystems
Deliver a toolbox for partial reduction of PFAs moving from agroecosystems to environmental systems
Develop water treatment systems to remove 90% of PFAs

Co-leader volunteers (as many as want)

Everyone willing to help



Threshold and Action Limits

1. Abatement
2. Environment
3. Food
4. Livestock
5. Socio-Economic

Roadmap: Where and when to apply Thresholds and Action Limits

Key Aspects

1. Screening and threshold levels on all land applied sludges etc. (MI has some levels in place)
2. Mapping to show biosolid (all land) application history and PFA level
3. Soil Screening level testing (focusing on precursors, PFOA and PFOS)(ME has some levels in place)
   Production system dependent
4. Plant- uptake and plant product threshold
5. Plant-animal transfer factors and weighting
6. On-the shelf testing and thresholds

Timeline; what needs to be done when?

1. Mapping is on going but more data needed
2. Soil Screening level protocols developed but need to be implemented in many states.
3. Plant/crop product testing can be framed after current aflatoxin schema.(Threshold levels)
4. 3-4 yrs to gather more Plant-Animal transfer factors for multiple plants and species.

Milestones for each high level aspect of the timeline:

1. Production of Maps showing biosolid application
2. Identification and measurement of field PFAS level (gridded soil mapping)
3. Production of Plant-animal transfer values available for multiple feed ration-animal combinations
4.

Early Deliverables (1-2 years)

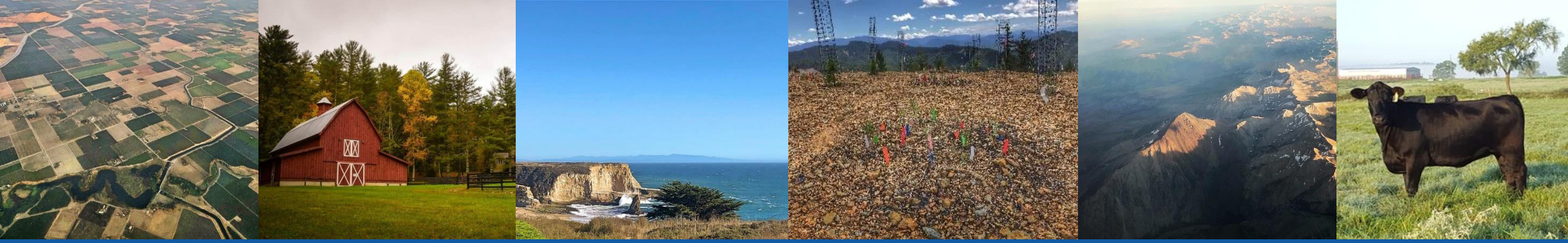
Longer term deliverables (2-4 years)

Impacts:

PFOA, PFOS should be the focus of PFAS research since they are the most harmful.

Co-leader volunteers (as many as want)

(list)



Data Tools and Mapping

1. Data
2. Environment
3. Food
4. Plants

Roadmap: Develop a data integration structure and harmonization system (1st)

Key Aspects and Timeline

1. Establish trans-disciplinary data governance boards
2. Create data catalogue (inventory)
3. Integrate existing data networks into a common access node that is flexible and agile
4. Develop/establish best practices that include minimum data standards
5. Highlight use cases to develop and refine the overall process

Data integration structure and harmonization (DISH)

Milestones for each high level aspect of the timeline:

Data Governance Boards:

1. Establish national board (create OR leverage), begin socializing the idea of a national data framework
2. Identify needed disciplines and stakeholders, roles and responsibilities, mission etc. Identify priorities, key aspirations, and intended use
3. Establish regional boards and connections to data within that region
4. Demonstrate applicability to region-specific use cases
5. Identify non-PFAS data (e.g. socioeconomic, additional chemistry) that may inform understanding of PFAS data and drive modeling efforts and understanding of abatement needs

Data Inventory:

*Catalog is not the final product, but establishes a first look at what data is our there

1. Identify existing sources of data and existing structures of PFAS data, to include categorization
2. Establish a template/framework for adding data
3. Establish a data dictionary

Early Deliverables (1-2 years)

- Inventory complete
- Catalogue established
- National board established
- Regional boards established and have utilized the data network to explore one regional or topic specific use cases that lead to actionable insights (mapping, clustering, identification of potential sources)

Longer term deliverables (2-4 years)

- Buildout of tools that utilize common access node (predictive models)
- Formalized best management practices

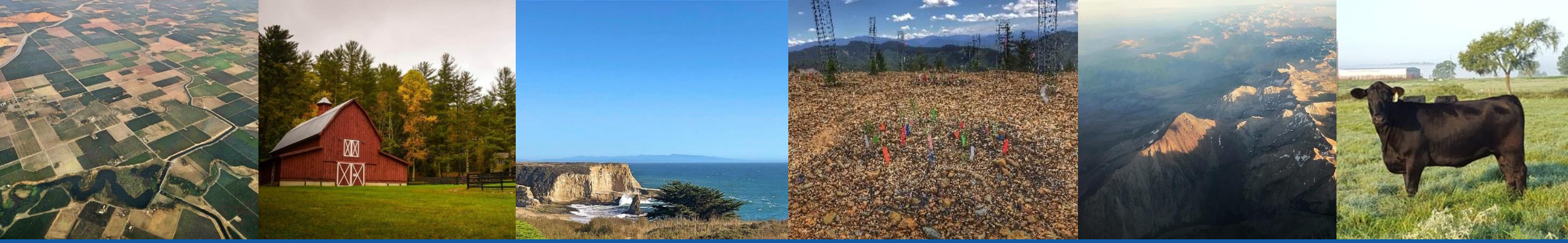
Impacts:

- Reduce redundancy in research
- Fosters data transparency and trust amongst stakeholders
- Improve efficiency of data queries
- Identification of data gaps
- Application within more complex tools
- Foundation of communication output
- Accelerates our understanding

Co-leader volunteers (as many as want)

(list)

- Diane Rowland
- Torsten Hahmann
- Stacy Wiggins
- Kurt Spokas



The Problems of PFAS Scale, Scope and Source Tracking

1. Abatement
2. Environment
3. Livestock

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Roadmap: Biosolids Management Program (The BMP)

Key Aspects

1. Background Levels
2. Actionable Thresholds
3. Testing Standardization
4. Data Repository

Timeline

1a. USDA/EPA/State Agency cooperative approach for wide-spread program approval, development, and adoption.

1b. Development of threshold/actionable levels

2. Background determination levels (consensus)

- Soil, groundwater, sediment, crops, biosolids, animals (livestock and wildlife)

3. Standardization of testing

4. Triage abatement/remediation begins (based on testing results)

5. Development of data repository

6. Downstream applications/interface development

Milestones (1A)

Program Approval/Development/Adoption

- USDA/EPA/State Agencies development framework of The BMP
- Stakeholder listening sessions (public comment)
- States approve The BMP, workshops (states/municipality discussions around adoption, etc), more stakeholder listening sessions

Milestones (1B)

Development of Actionable Thresholds

- USDA/EPA/State Agencies consensus
- Development of threshold levels for allowable biosolids application
- Interface with abatement teams for reducing biosolid PFAS levels below thresholds (to allow application)

Milestones (2)

2. Background Level Determinations

- Come to a science-based consensus on reasonable background levels to use for The BMP.
- Engage with producers and municipalities to communicate these levels (sets expectations; i.e., whats a significant deviation from background)

Milestones (3)

Standardization of testing

- Interface with analytical teams (available technologies, methodologies, detection limits across matrices, method validation, etc)
- Development of SOPs for frequency of testing, reporting templates, quality control criteria, etc
- Identify acceptable testing laboratories?
  - WWTPs? Commercial Labs? State Labs?

Milestones (4)

Triage for Abatement/Remediation

- USDA/EPA/State agencies triage sites based on previously established thresholds (see Milestone 1B)
- See abatement team roadmap for the "how"
- Development of a communication plan for high priority sites

Milestones (5 & 6)

5. Development of Data Repository
6. Downstream applications/interface development
    - See Data Group Roadmap

Early Deliverables (1-2 years)

- Upstream communication to policy makers
- Standardization of analytical methods

Longer term deliverables (2-4 or more years)

- Data repositories and data analysis applications
- Background/Threshold levels
- PFAS testing labs online
- Pilot scale implementation of program
- Identification of high priority sites for cleanup

Impacts:

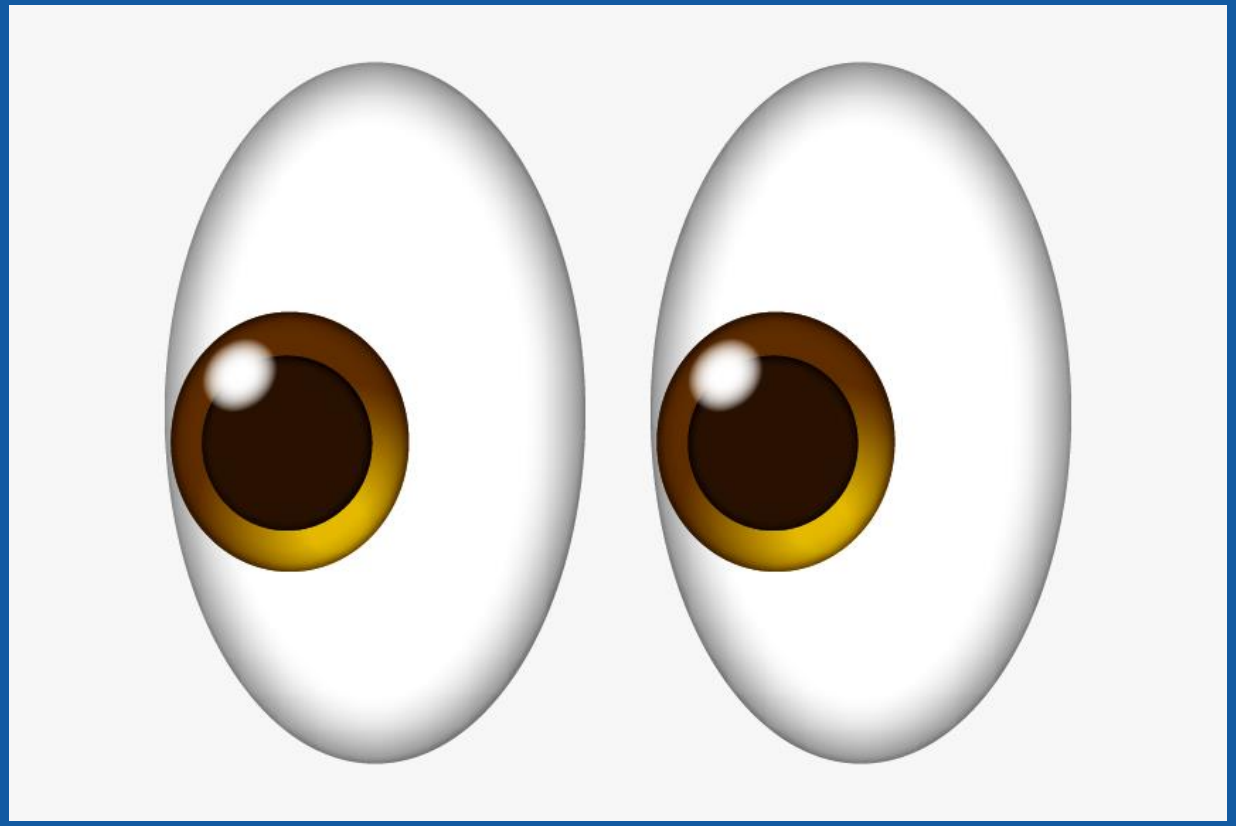
Reduction in agroecosystem exposures to PFAS contamination.

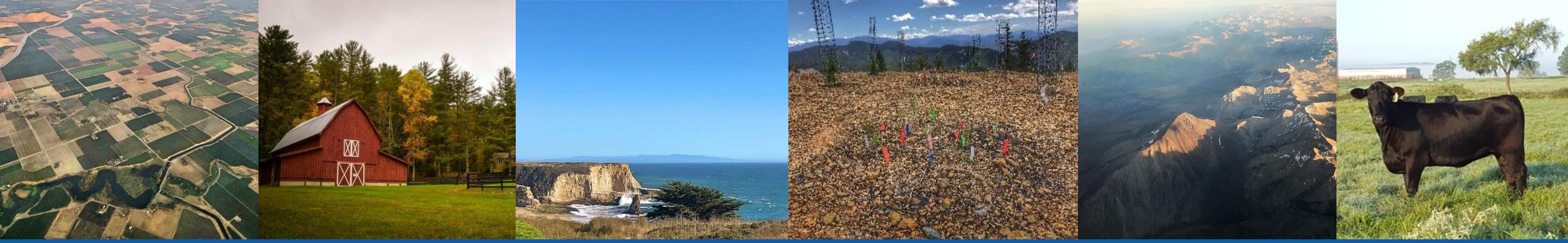
- Can then divert resources into combatting legacy PFAS contamination.

The BMP provides a roadmap for PFAS reductions in other systems (e.g., water reuse).

Co-leader volunteers and voluntolds

1.
2.
3.
4.
5.





Fate and Transport in Ag Systems

1. Environment
2. Food
3. Materials
4. Livestock
5. Plants

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Roadmap: Developing solutions to PFAS in whole production systems: fate, transport and effective engagement

Key Aspects

1. Predictive tools for PFAS transport through soil, plant, and animal
2. Understanding the effects on plant/animal species, physiology, and component partitioning
3. Evaluate production inputs and outputs
4. Develop guidelines for effective engagement to provide information on management options

Milestones for each high level aspect of the timeline:

1. Identify top commodities of interest across states, soils, climates
2. Validate and/or develop predictive models for soil, plants, and animals
3. Connect predictive tools across the production system
4. Develop guidelines for engagement based on predictive models

Early Deliverables (1-2 years)

- Synthesis of data across commodities, soils, climates
- Predictive models for plant, soil, animals

Longer term deliverables (2-4 years)

- Validated models for specific components
- Validated model across production system
- Universal guidelines for engagement based on models
- Expand to or incorporate non-production system and natural resource impacts and natural

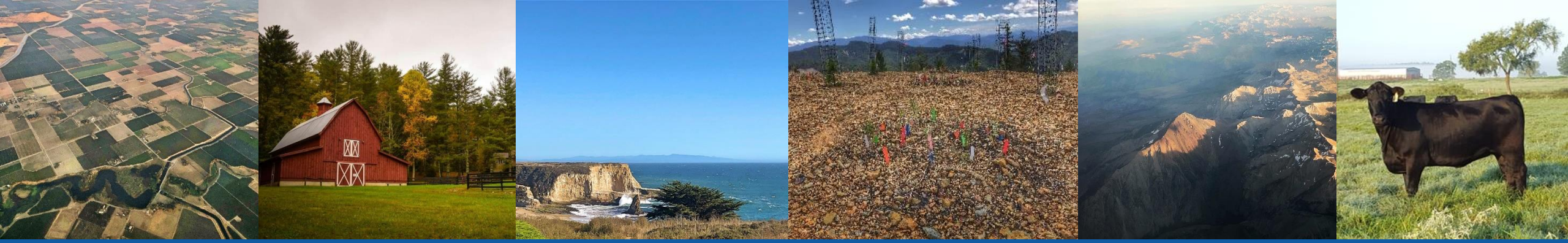
Impacts:

- State and federal agencies have stocked toolboxes for public health and regulatory decision
- Improved engagement, trust, and technology transfer stakeholders and state cooperators
- Foundational knowledge to inform critical production decisions
- Building blocks for best management practices

Co-leader volunteers

Researchers, farmer/ranchers, state agencies, extension, FDA

*Everything we do needs to be explained well



Communication and Education

1. Food
2. Materials
3. Socio-Economic

Roadmap: Research is needed to consolidate "lessons learned", open questions, and unknowns into targeted communication tools. These will help us to address uncertainty and provide evidence that generates assurance of good paths forward. This is needed for diverse audiences, such as farmers, consumers, policy makers, researchers and etc.

Key Aspects:

1. Identify knowns (e.g., sites), known unknowns (**baseline**), unknown unknowns
2. Recognize key audiences: farmers=states; consumers, farm communities, producers (this is state-specific)
3. Have teams of teams who have expertise to address necessary topics
4. Recognize that much PFAS-centric information is available and is expanding, and is of different levels of quality. Build on the best information and ensure effective communication and transparency.
5. How do people respond to information and process and use it?
6. Ensure engagement across all relevant federal and state agencies and experts

Timeline; what needs to be done when?

1. Collect baseline data on PFAS-affected community(ies)'s knowledge, using a National Survey with meta-data as well as all *informing* data. Several Teams will be engaged in collecting baseline data. This collection will be iterative over time.
2. Use data to generate a Needs Assessment at different levels of granularity.
3. Result: have known knowns and known unknowns (gaps).
4. Develop appropriate documentation that is empirical - for all levels of knowledge and highly useful for the public and for policy makers and that should be customized. (Simultaneously develop a catalog of PFAS case studies and stories.) Ensure PII protections! [Ensure schema of trusted messengers].
5. This information and the mediums will be informative for interested parties to informed and good and protective decisions

Milestones:

1. National survey and data collections done (round 1)
2. Playbooks developed following information consolidation - for states then other groupings (e.g., farmers, consumers, urban communities, tribes)
   (ensure playbooks are current)
3. Assess changes in behavior that are a result of use of the developed communication tools – behaviors that lead to better PFAS settings across agriculture. How powerful or not was the information sharing.
4. Assess health effects improvements based on information available, consideration, and implementation (human and on farm)

Early Deliverables (1-2 years)

National survey and data collection

Drafts of Playbooks; initial playbook release

Longer term deliverables (2-4 years)

Catalog of Playbooks released

Assessment of changed behaviors based on developed communication tools

Refine and improve communication tools

(ongoing) Ensure communication tools are current

Educational curricula

Ensure powerful engagements across agencies.

Impacts:

Better farmer, community and farmscape PFAS health

Farmer and consumer confidence

Informs late-adopters and helps them adopt

Co-leader volunteers (as many as want)

ALL