



Passive Sampling Technology Update (PSU-1)

Interstate Technology & Regulatory Council
www.itrcweb.org



ECOS

ERIS
ENVIRONMENTAL RESEARCH
INSTITUTE OF THE STATES

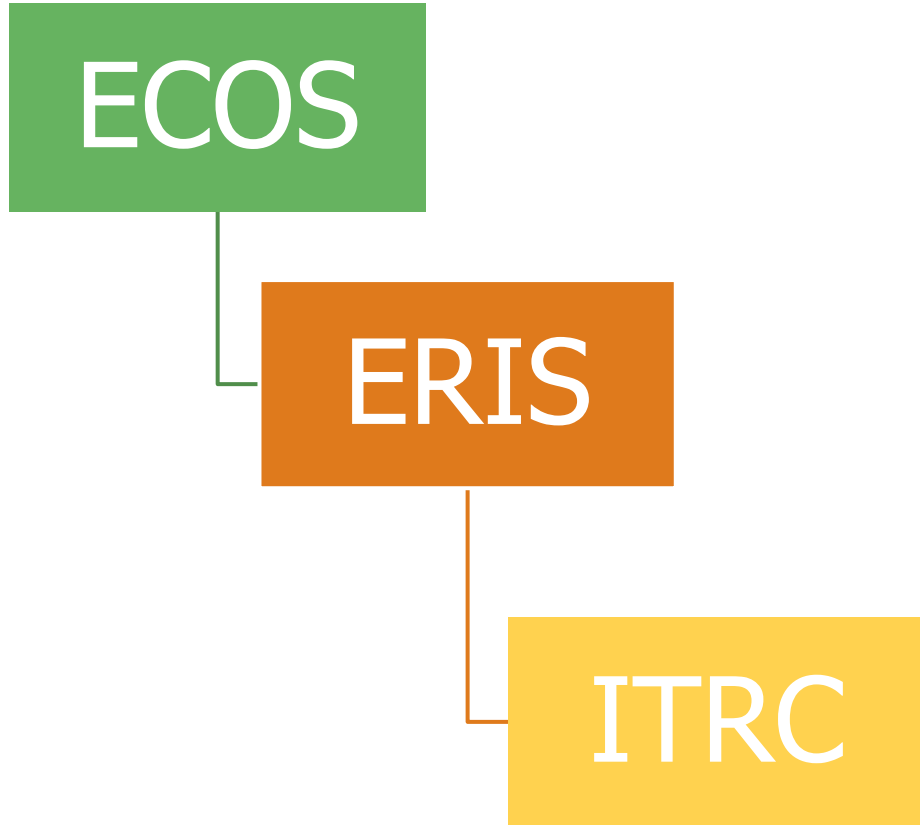
<https://psu-1.itrcweb.org/>

What is ITRC?

- ITRC is a program of the Environmental Research Institute of the States (ERIS)
- State-led environmental coalition with membership from state, federal, tribal, and international agencies, academia, private sector, and the public stakeholders
- Develops training materials and documents to provide technical knowledge and best management practices for addressing environmental challenges



Organization



Environmental Council of the States (ECOS)

- The national nonprofit, nonpartisan 501(c)(6) association of state and territorial environmental agency leaders

<https://www.ecos.org/>

Environmental Research Institute of the States (ERIS)

- Separate and affiliated 501(c)(3) education and research nonprofit corporation affiliated with ECOS

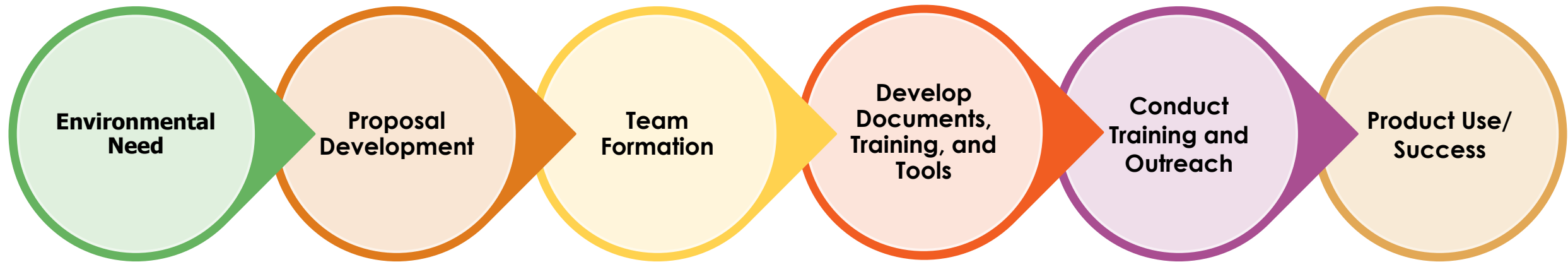
<https://www.eristates.org/>

Interstate Technology & Regulatory Council (ITRC)

- Program of ERIS

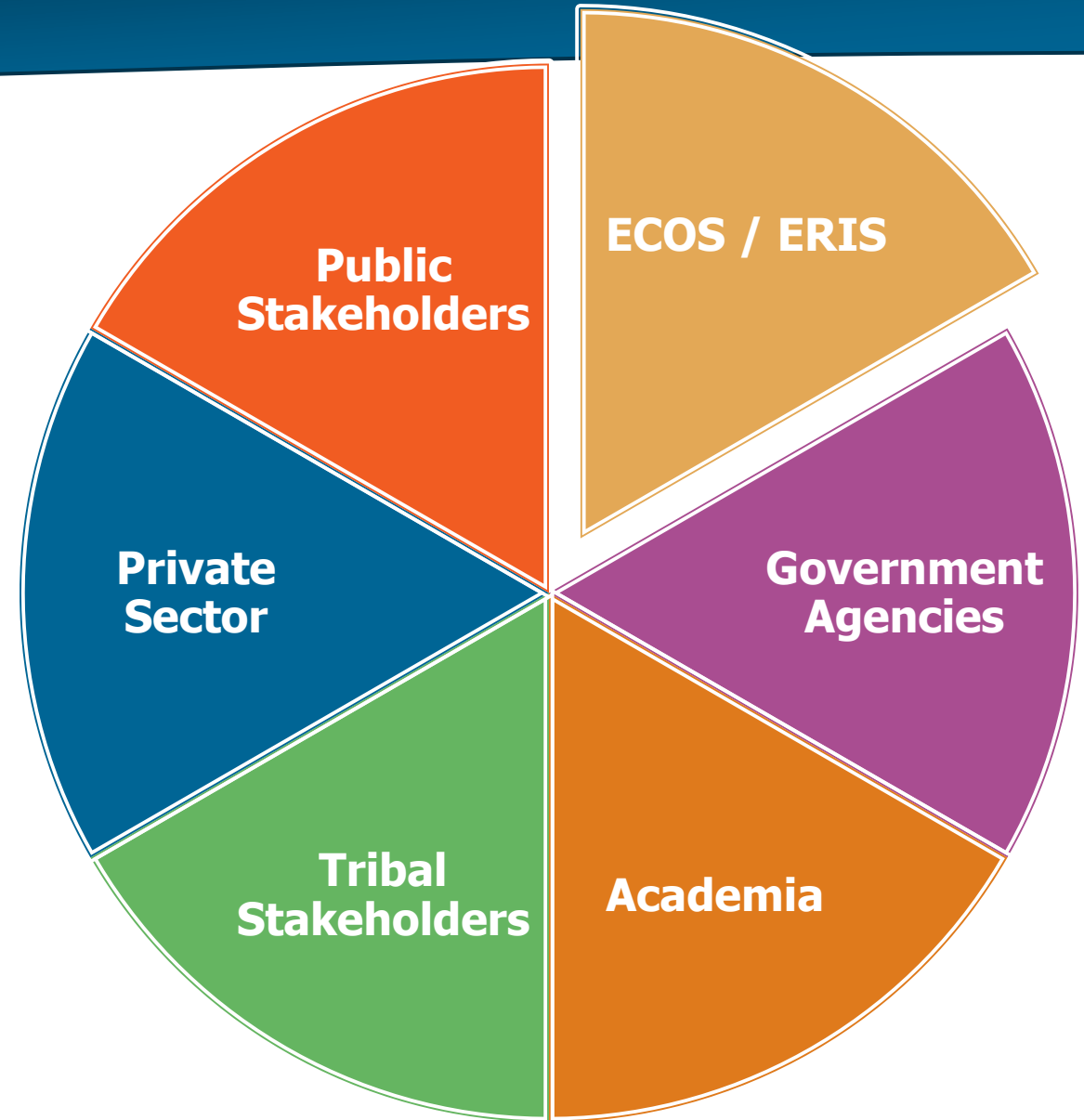
<https://itrcweb.org/about/about>

ITRC Project Development Process



ITRC Membership

- **FREE** for government agencies, Tribal stakeholders, academia, and public stakeholders
- Private Sector participation through our Industry Affiliates Program (IAP)
- Learn from and network with a diverse group of environmental professionals with several areas of expertise
- Write and review documents
- Develop and deliver training
- Leadership and professional development opportunities



Focus Areas



Guidance Materials

ITRC develops peer-reviewed resources that provide the environmental community with technical knowledge and foster consistent regulatory approaches. To date, ITRC has published over 150 guidance documents.



Trainings and Webinars

Free webinars, offered with EPA's Clu-In, deliver accessible, on-demand technical and regulatory insights drawn from ITRC resources. To date, ITRC's trainings, both online and in-person, have reached over 200,000 participants.



Project Teams

Our project teams bring together members with diverse expertise to fulfill our mission by developing products that address environmental challenges.



Green and Sustainable Chemistry Team



Sustainable Management of Waste from Energy Resources Team



Underwater Munitions Team



Advanced Site Characterization Tools (ASCT) – Update Team

New Project Teams for 2026



Phytotechnologies Update

Modernizing ITRC's existing Phytotechnology Guidance by integrating new science and tools and providing nature-based cleanup strategies for today's environmental challenges.



PFAS Treatment Technologies

Developing a new, comprehensive ITRC guidance document on PFAS Treatment including treatment technologies, performance verification, and management of residuals.



Petroleum Training Workgroup

Building a training roadmap to equip new environmental professionals with essential petroleum concepts and resources.



AI/ML in the Environmental Field

Exploring how artificial intelligence and machine learning can empower more informed, timely, and effective environmental decisions across regulatory and technical landscapes.

ITRC Membership



Benefits!

Learn: Support research & reference and case study identification

Write: Help draft content for final products

Review: Provide comments to draft & final products

Train: Develop and deliver training materials & courses

Network: Participate in calls/meetings, surveys, and discussion posts



Leadership Opportunities

Project Team Leaders and Subgroup Leaders

Board of Advisors

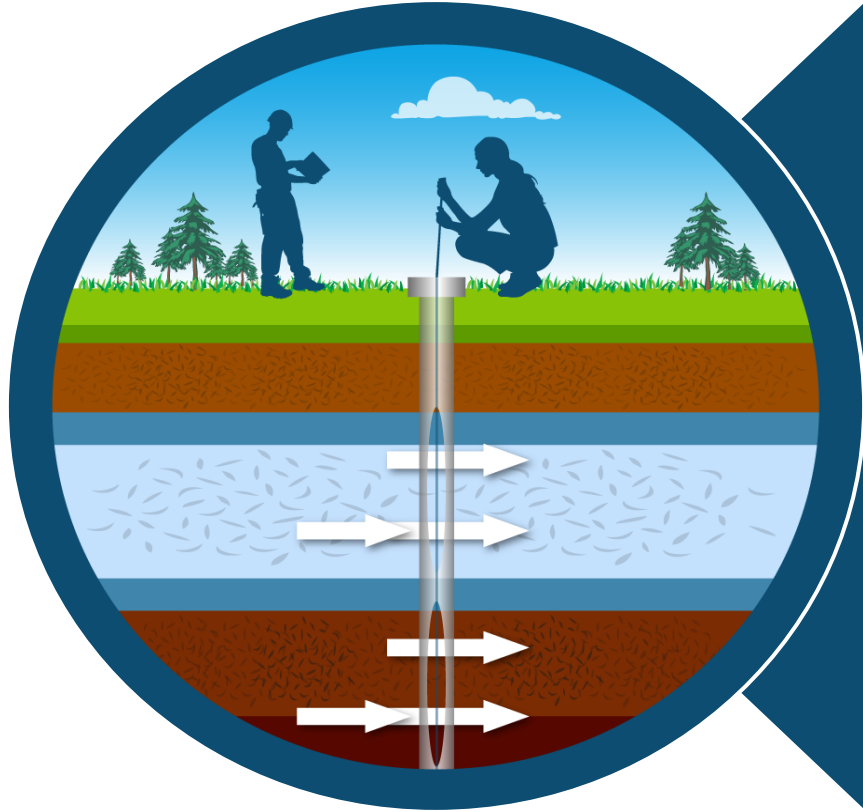
State Engagement Program

Emerging Environmental Leaders Forum

How do you sign up?



Why Passive Sampling



This guidance will...

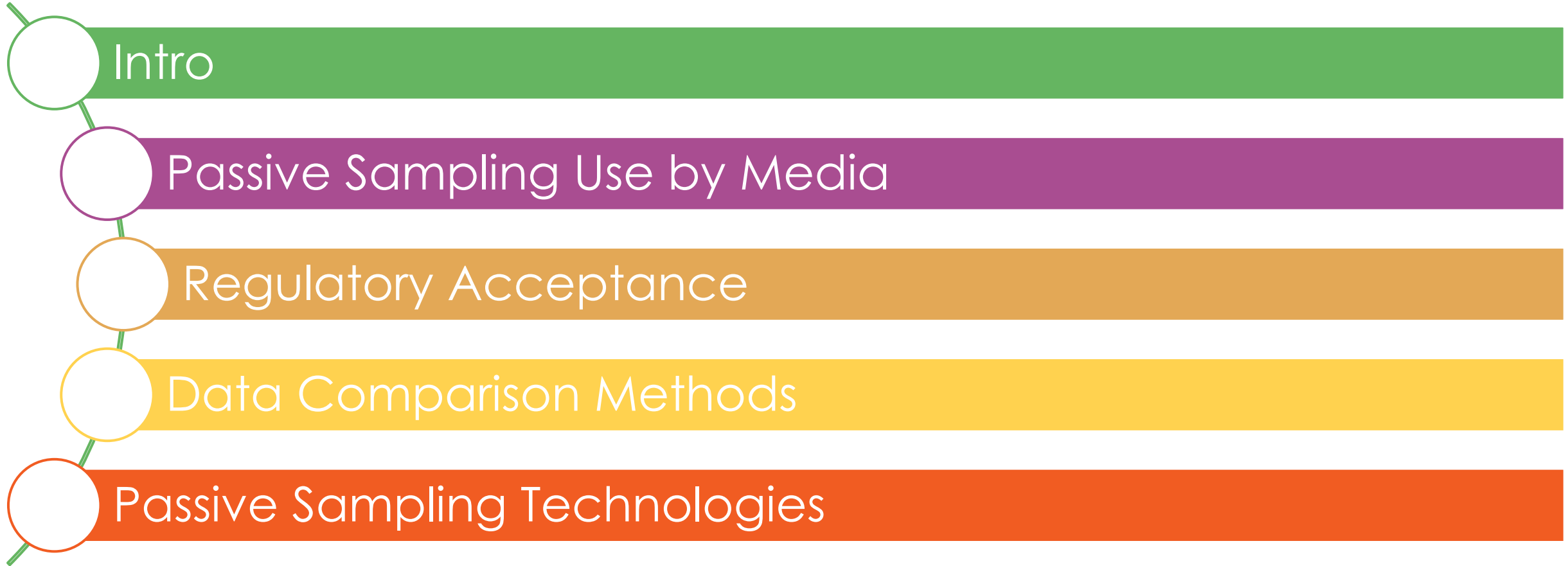
- Help appropriately transition sites to passive sampling
- Build confidence in passive sampling
- Enable more sustainable management of monitoring sites.

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Why Passive Sampling

- Growing interest in benefits of passive sampling and availability of newer devices increased the requests for regulatory review, approval, and acceptance on project sites.
- Few, if any, specific regulations addressing the use of passive samplers have been written into promulgated documents.
- Use and/or approval process varies widely by agency and even by individuals within an agency due to lack of reliable, vetted information on the use and efficacy of passive sampling technologies.

Passive Sampling Outline



What is Passive Sampling?

Passive Sampling

Using a device that acquires a sample from a discrete location without inducing active media transport.

The passive technologies considered in this document

- rely on exposure of the sampling device to media in ambient equilibrium during the deployment period
- are classified into three types of technology based on the sampler mechanism and nature of the collected sample.

Active Sampling vs Passive Sampling

Active sampling methods rely on the movement of a medium by the sampling equipment to draw the medium and chemicals into the sampling device, causing deviations from the natural flow or ambient conditions.

- Generally, require a power source
- Could affect sampling results during active media transport
- Could be hard to reproduce sample due the media transport occurring during sampling
- Investigation Derived Waste is greater during Active Sampling
- Generally, requires more personal to conduct the sampling events

Active Sampling vs Passive Sampling

Passive sampling programs can result in several benefits:

- elimination of a power source
- reduction in IDW
- less equipment
- fewer personnel needed on site.
- May also lead to additional benefits of increased site accessibility & help achieve green and sustainable metrics

Passive Sampling by Media

- Passive sampling techniques across multiple media
 - Groundwater, surface water, porewater, sediment, soil gas, indoor/outdoor air, soil and NAPL
- Table with comprehensive list of passive sampling devices, type of sampling technology, and applicable media
- Discusses physical conditions for each media affecting fate and transport of chemicals within the medium and collection of representative samples to consider when selecting a passive sampling device

Passive Sampling by Media

- Section 2 Table
 - comprehensive list of passive sampling devices
 - type of sampling technology
 - applicable media
- Technologies can produce quantitative results, qualitative data may also be acquired.

Sampling Device	Technology Type	Groundwater	Surface Water	Pore-Water	Sediment	Soil Gas	Indoor Air*	Outdoor Air*	Soil	NAPL
UnderSleeve™	Grab	●	●							
Snap Sampler®	Grab	●	●							
Thin-Walled Soil Samplers	Grab								●	●
Passive Diffusion Bag (PDB)	Equilibration	●	●	●						
Dual Membrane™ Passive Diffusion Bag Sampler (DMPDB™)	Equilibration	●	●	●						
Nylon Screen Passive Diffusion Sampler (NSPDS)	Equilibration	●	●	●						
Peeper Sampler	Equilibration	●	●	●						
Regenerated Cellulose Dialysis Membrane Sampler (RCDM)	Equilibration	●	●	●						
Rigid Porous Polyethylene Sampler (RPPS)	Equilibration	●	●	●						
Polymeric Sampling Devices	Equilibration	●	●	●		●	●	●		
PISCES Sampler	Accumulation		●							
Ceramic Diffusion Sampler / Ceramic Dosimeter	Equilibration	●	●	●						
AGI Universal Sampler (formerly the Gore Sorber®)	Accumulation	●	●	●		●	●	●		
Polar Organic Chemical Integrated Sampler (POCIS)	Accumulation	●	●	●						
Sentinel™	Accumulation	●	●	●						
Semipermeable Membrane Devices (SPMD)	Accumulation	●	●	●		●	●	●		
Diffusion Gradient in Thin Films (DGT) Sampler	Accumulation	●	●	●						
Mineral Samplers (Min-Traps®)	Accumulation	●								
Badjello® Sampler	Accumulation						●	●		
Waterloo Membrane Sampler™	Accumulation					●	●	●		
Beacon Sampler	Accumulation				●	●	●	●		
Dart Sampler	Accumulation				●				●	●
Fossil Fuel Traps	Accumulation					●				●
Bio-Trap® Sampler	Accumulation	●	●							

Table 2-1. Passive Samplers by Media Type

● = Primary application
 ● = Secondary application

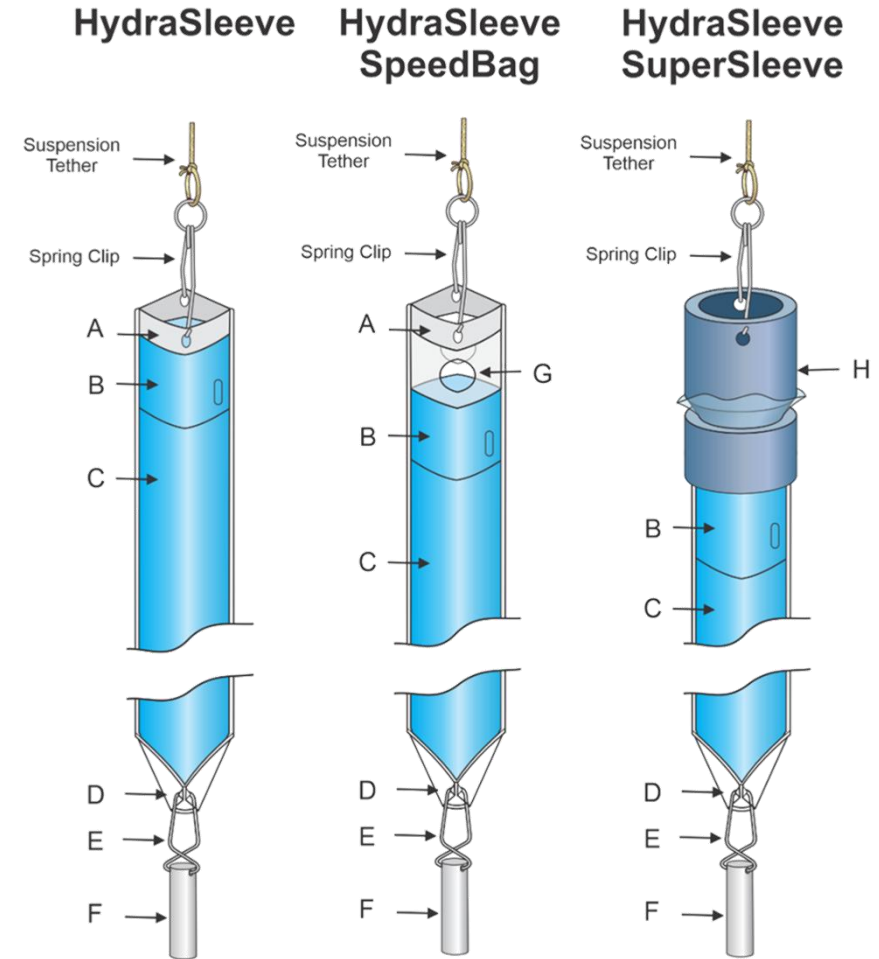
Passive Sampling by Media

- **Porewater** refers to sediment porewater rather than soil porewater. Porewater is described as water located within the pore spaces between sediment particles that may represent the mobile water interacting between groundwater and surface water within permanent surface water features or intermittently flooded features (such as seasonal streams, intertidal zones, or stormwater swales/basins).

Types of Passive Sampling Technologies

- Grab – Devices that recover a sample of the selected medium that represents the conditions at the sampling point including any chemicals present, at the moment of sample collection
- Equilibration – Devices that rely on diffusion of the analytes for the sampler to reach and maintain equilibrium with the sampled medium
- Accumulation – Devices that rely on diffusion and adsorption to accumulate analytes in the sampler.

- Primary Media Application: Groundwater & Surface Water
- Device collects a “whole water” sample of the water flowing through the saturated screen *all chemicals in the water within the sample interval at the instant it is retrieved.*
- All HydraSleeve samplers are made from a collapsible, flexible tube of low- or high-density polyethylene (LDPE or HDPE) that is sealed at the bottom end and has a self-sealing reed valve at the open top end.
- There are three versions of the HydraSleeve that are constructed with the same valve but vary by sampler dimensions, volume capacity, and method of attachment to the tether line.
 1. HydraSleeve
 2. HydraSleeve-SuperSleeve
 3. HydraSleeve-Speedbag.



Source: NJDEP, figure used with permission.

Snap Sampler[®]

Grab
Sampler

- Primary Media Application: Groundwater
 - Secondary Application: Surface Water
- Collects a "whole water" unfiltered, undisturbed sample
- Collects from a consistent depth
- Collects a maximum of 1.5 litres of sample from inch or greater diameter wells
- None, or minimal, IDW
- Effective sampling in low yield and short water column wells

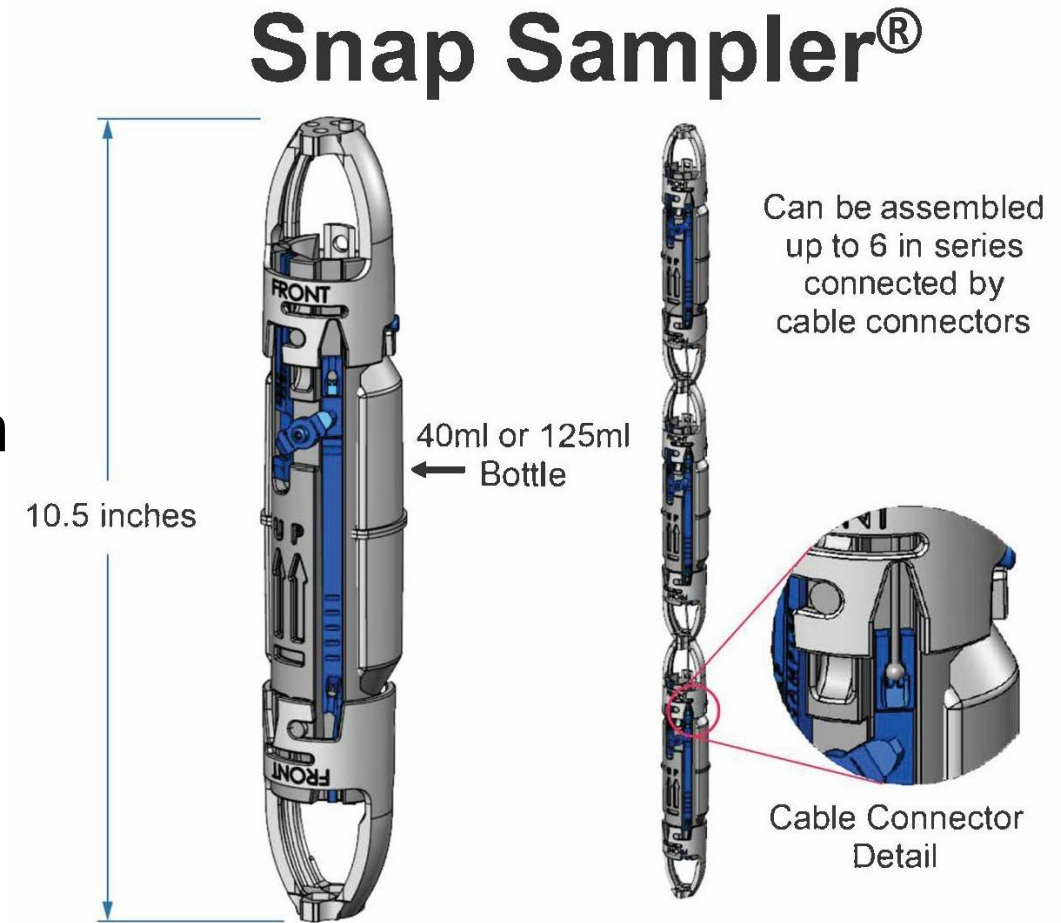


Illustration Adapted from ProHydro Inc.

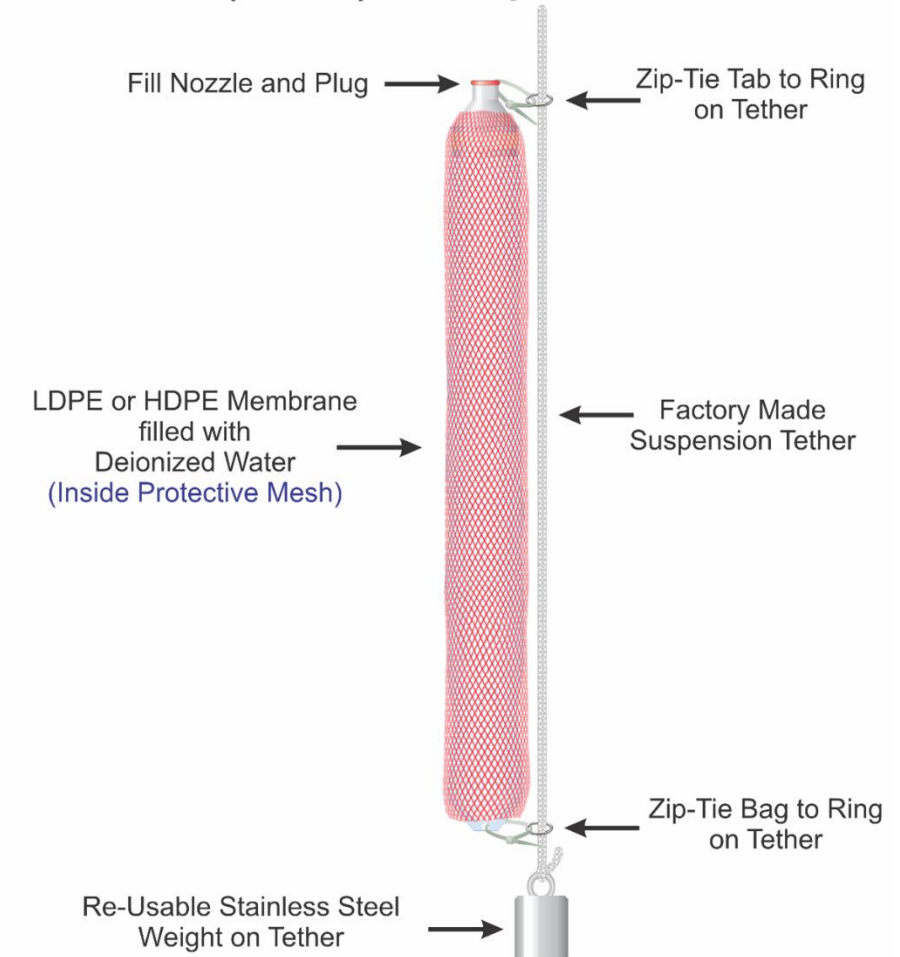
Source: NJDEP, figure used with permission.

Passive Diffusion Bag (PDB)

Equilibrium
Sampler

- Primary Media Application: Groundwater, Surface Water, and Porewater
- Limited to volatile organic compounds, depending on membrane type
- Need to equilibrate for at least two weeks
- Additional samplers can be deployed at multiple depths in same well
- Easily deployed and retrieved
- Samplers are readily available

Passive Diffusion Bag (PDB) Sampler

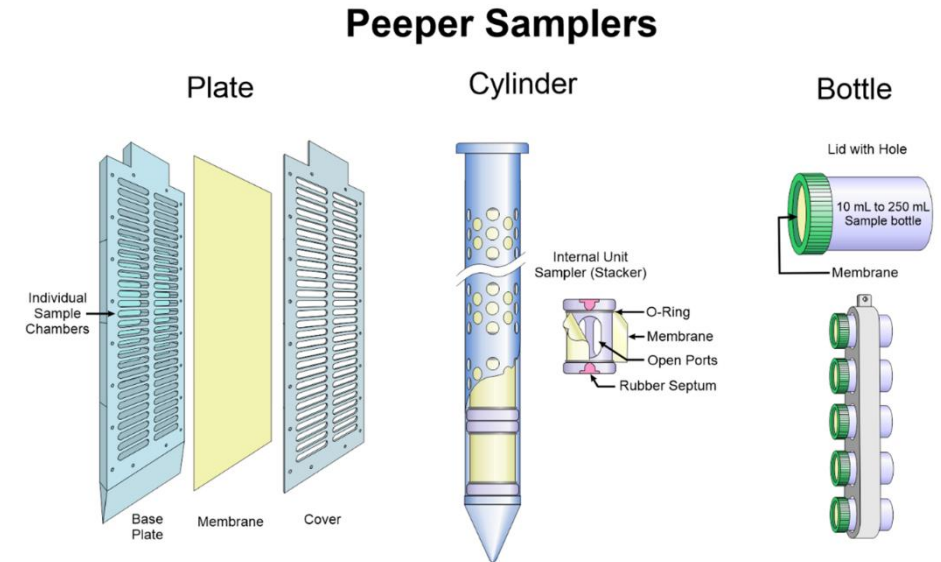


Source: NJDEP, figure used with permission.

Peeper Sampler

Equilibrium
Sampler

- Primary Media Application: Groundwater, Surface Water, and Porewater
- Commercially available and easy to assemble and use
- Can be deployed at multiple and any depth in monitoring wells
- Provide good vertical resolution
- Provide more representative pore water sample results in sediment
- May be easily damaged in surface water
- Housings can be reused

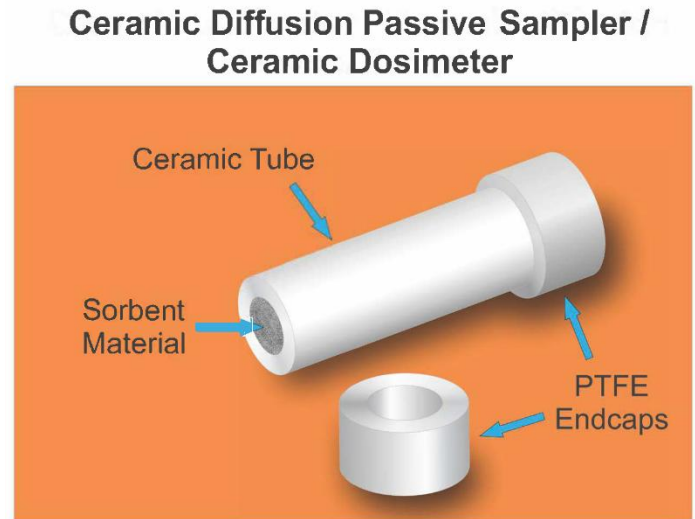


Source: NJDEP, figure used with permission.

Ceramic Diffusion Sampler / Ceramic Dosimeter

Equilibrium
Sampler

- Primary Media Application: Groundwater, Surface Water, and Porewater
- The ceramic diffusion sampler is a diffusion-based equilibrium-type passive sampler to collect VOCs and SVOCs in aqueous media with excluding non-aqueous phase liquid (NAPL).
- The ceramic dosimeter is an accumulation-type passive sampler to collect VOCs and SVOCs in aqueous media.
- The ceramic diffusion sampler is filled with reagent water only, and the ceramic dosimeter is filled with polymeric sorbent to preconcentrate the analytes from aqueous media.



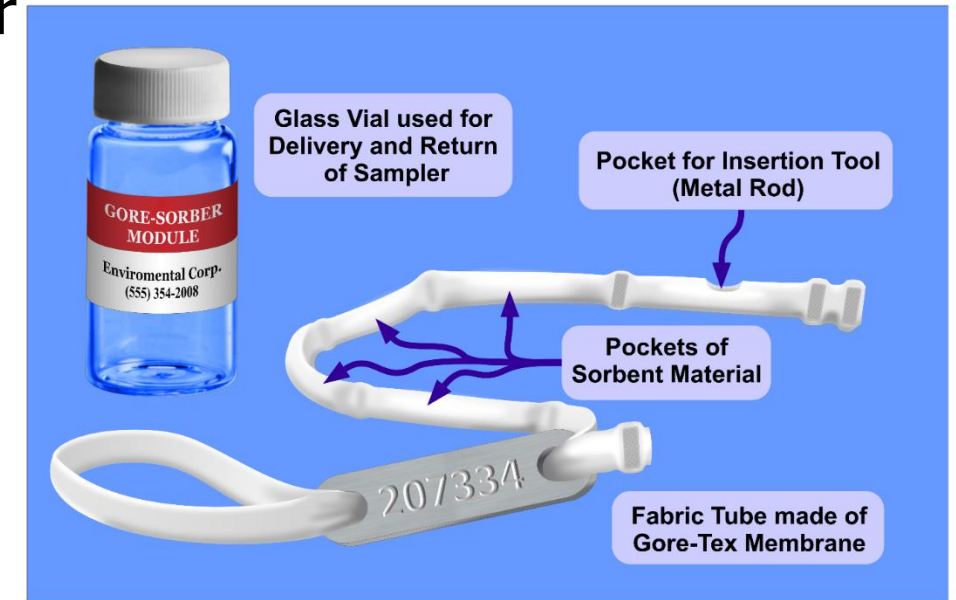
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AGI Universal Sampler (formerly the Gore Sorber®)

Accumulation
Sampler

- Primary Media Application: Groundwater, Surface Water, Porewater, Soil Gas, Indoor Air, and Outdoor Air
- Simple to install and retrieve
- Samples wide range of VOCs and SVOCs
- Relatively short resident times needed
- Suitable for small diameter monitoring wells
- Chemical detection limited by vapor pressure
- Results are mass sorbed so require calibration data to interpret concentrations

AGI Sampler



Source: NJDEP, figure used with permission.

Radiello® Sampler

Accumulation
Sampler

- Primary Media Application: Indoor Air & Outdoor Air
- Convenient to use
- Different materials allow different chemicals to be sampled
- Cartridges can be reused
- Uptake rates needed to calculate concentrations
- Results affected by ambient conditions (humidity, temperature)
- Cartridges and time deployed are specific to the chemicals of interest

Radiello®



Source: NJDEP, figure used with permission.

Waterloo Membrane Sampler™

Accumulation
Sampler

- Primary Media Application: Indoor Air, Outdoor Air and Soil Gas
- Insensitive to ambient conditions (humidity, wind)
- Easily deployed for a range of applications above and below ground
- Needs to be suspended vertically
- Can be saturated in high concentration environments
- Strongly sorbed chemicals displace weakly sorbed chemicals
- Solvent desorption requires multiple preparation steps that can create analytical interferences

Waterloo Membrane Sampler™

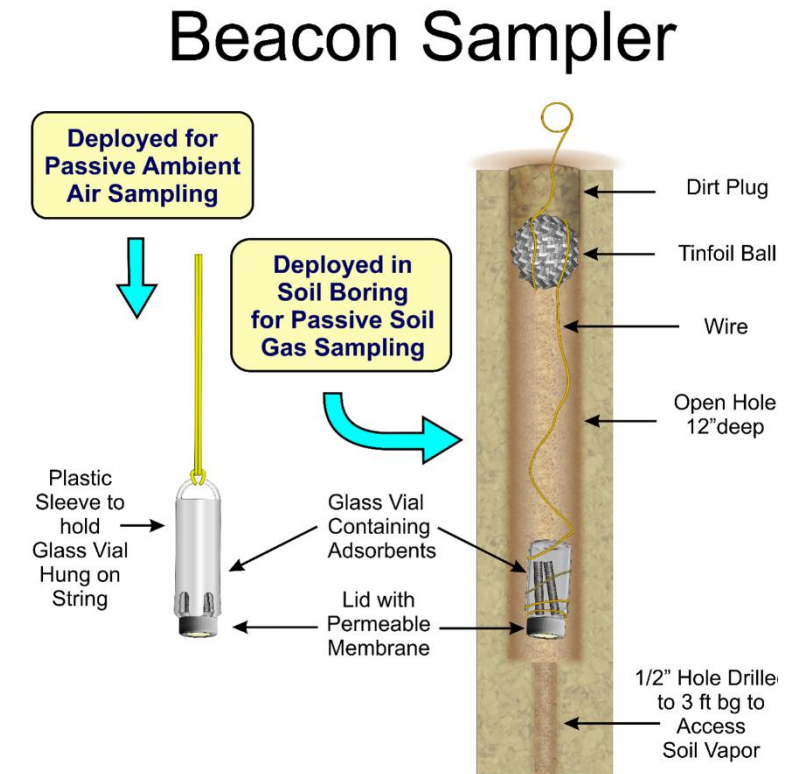


Source: NJDEP, figure used with permission.

Beacon Sampler

Accumulation
Sampler

- Primary Media Application: Soil Gas, Indoor Air, and Outdoor Air
- Simple to install and retrieve
- Samples a wide range of VOCs and SVOCs
- Low, pptv, detection limits achievable
- Minimal field handling
- Extended sampling residence time may be needed to achieve low detection limits
- Single source supplier and laboratory
- Uptake rates based on only 13 CVOC and petroleum contaminants: other rates based on Graham's law



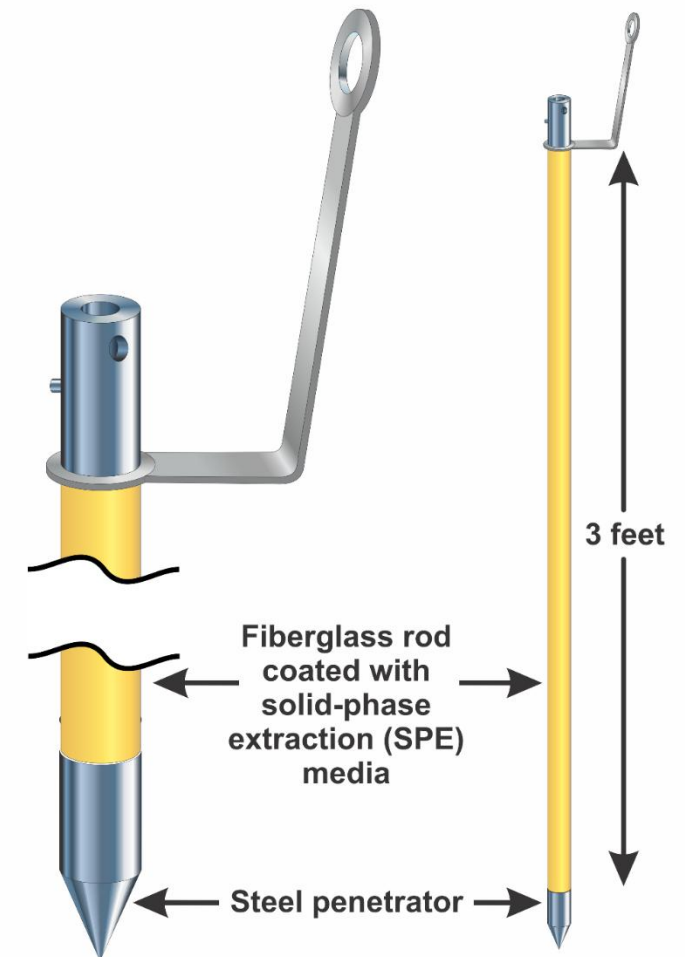
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Dart Sampler

Accumulation
Sampler

- Primary Media Application: Sediment, Soil, LNAPL
- No preservation required
- Location and depth specific NAPL characterization
- No soil or groundwater sampling waste
- Soil matrix can influence results
- Low PAH NAPLs may not transfer in 24 to 48 hour residence time
- Results cannot be converted to concentrations

Dart System

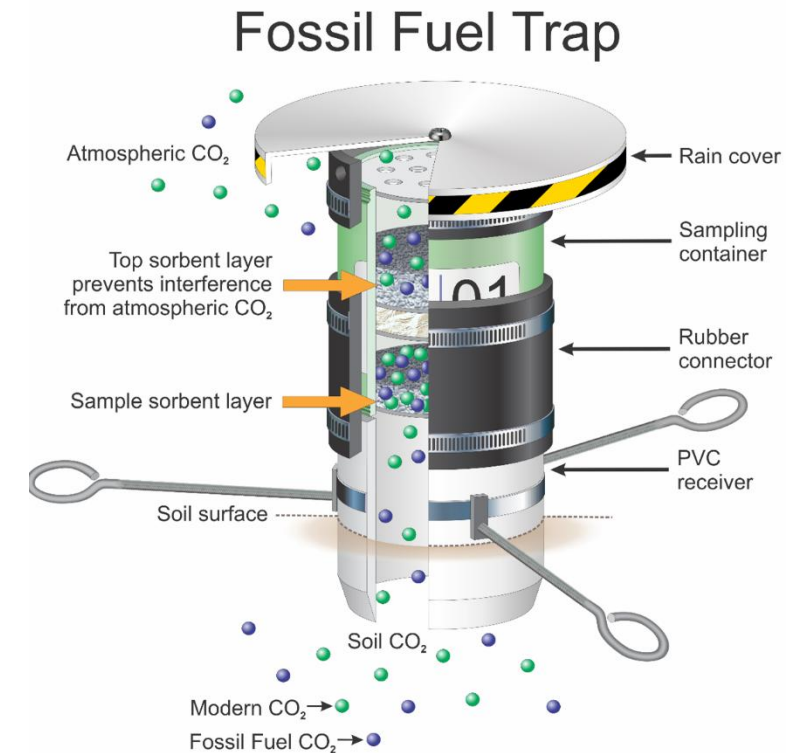


Source: NJDEP, figure used with permission.

Fossil Fuel Traps

Accumulation
Sampler

- Primary Media Application: Soil Gas & NAPL
- Easy to use
- Can be deployed to remote locations
- Produce time integrated flux measurements
- Use C^{14} data to differentiate between fossil fuel CO_2 from recent organic sourced CO_2
- Must be returned for analysis by manufacturer
- Water saturated soils limit CO_2 transport to sampler
- Cannot be used in areas with impermeable surfaces



Source: NJDEP, figure used with permission.

Questions



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