U.S. DEPARTMENT OF ENERGY | Legacy Management

2018 Long-Term Stewardship Conference

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Grand Junction, Colorado

Are natural processes transforming conventional disposal cell covers into evapotranspiration covers?

Should we enhance beneficial processes?

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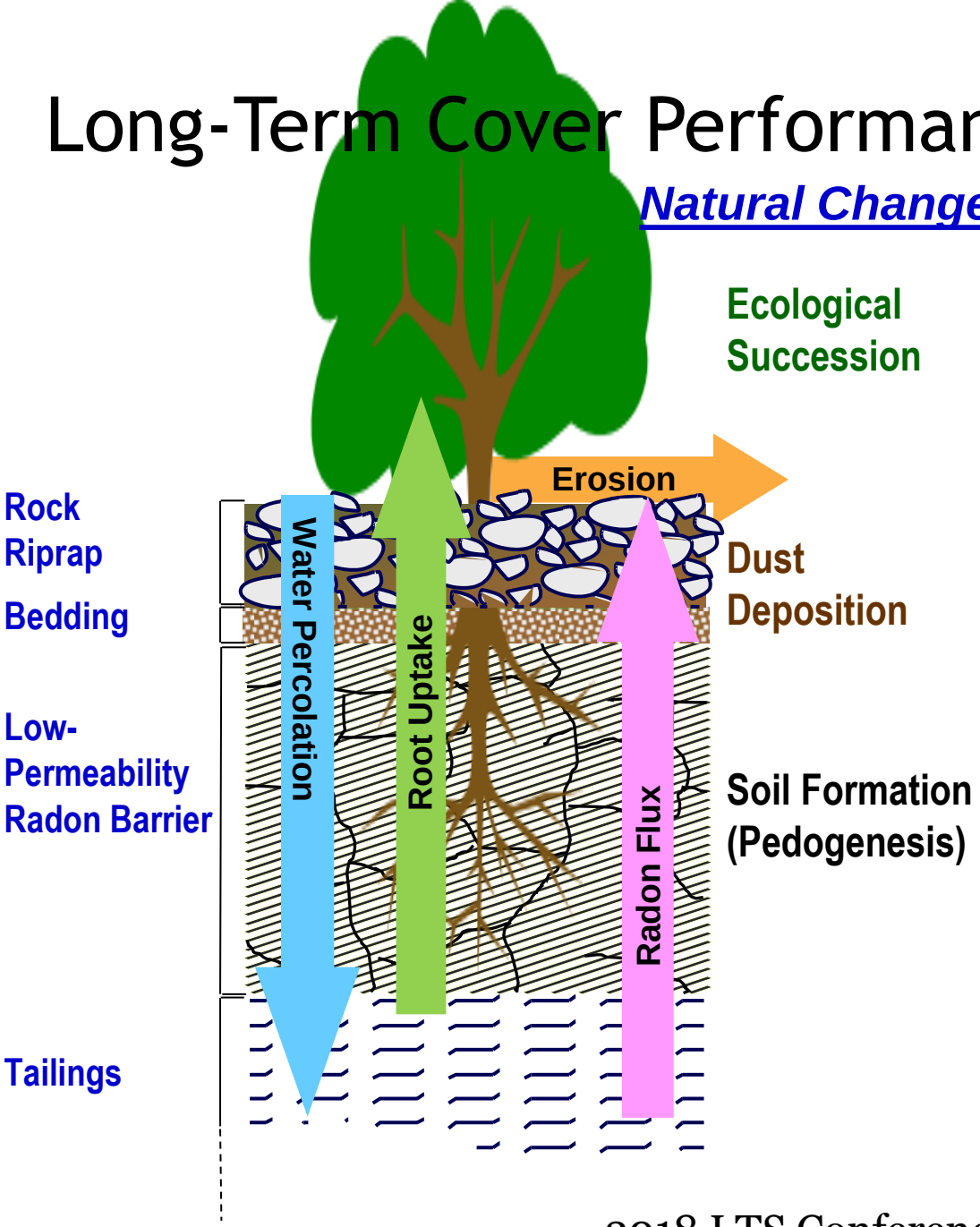
Long-Term Cover Performance

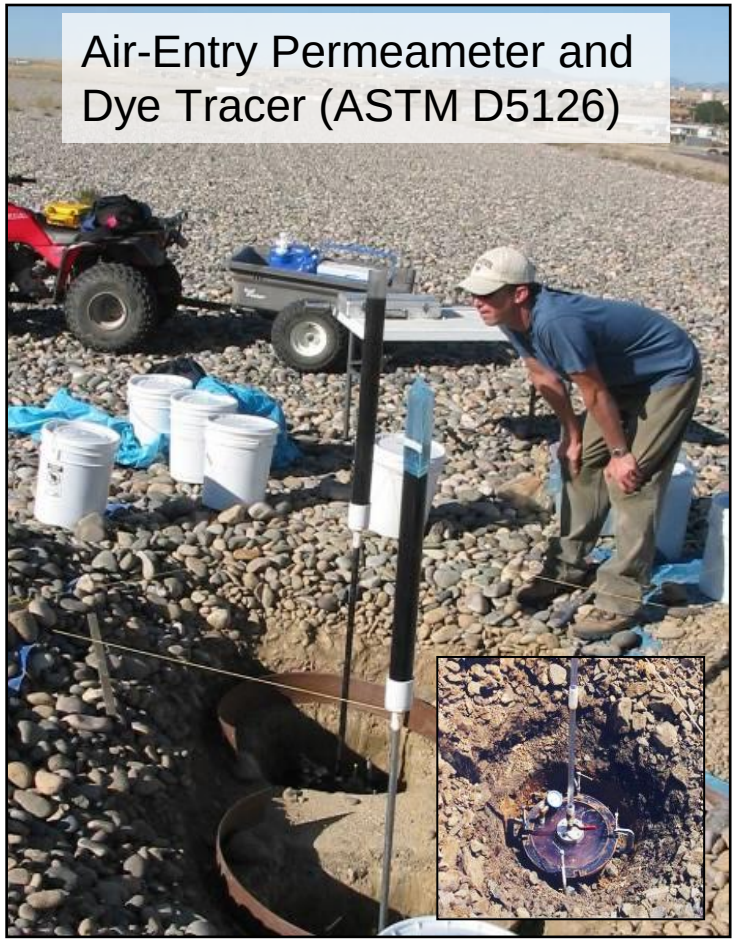


Questions

1. Will soil formation increase permeability and percolation?
2. Will plants take up and accumulate contamination?
3. Will soil formation and ecological succession increase radon diffusion and flux?
4. Will dust deposition influence erosion and ecological succession?
5. Are evapotranspiration (ET) covers a sustainable alternative?
6. Is Mother Nature transforming conventional covers into ET covers? Can we enhance this?

1. Will soil formation increase permeability and percolation in the radon barrier?

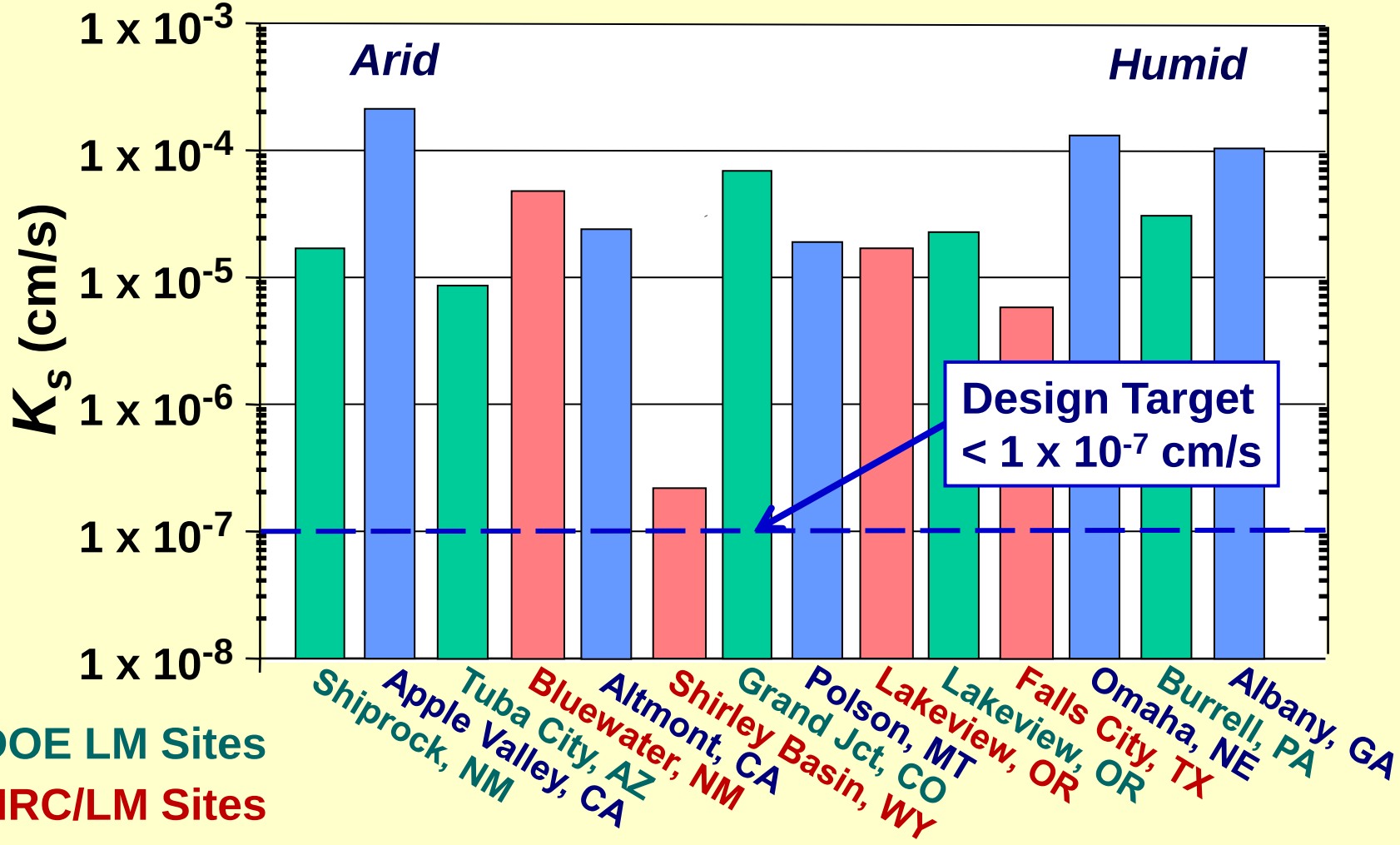
Ks – saturated hydraulic conductivity



Shiprock, New Mexico

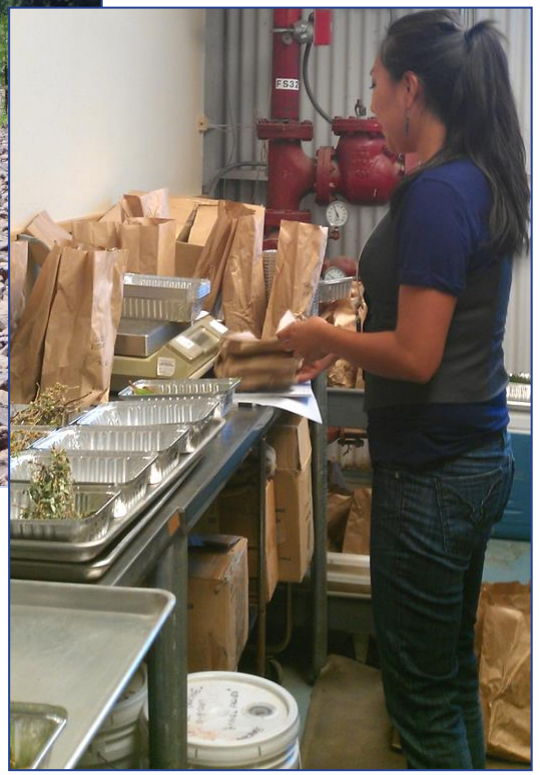
Lakeview, Oregon

Low-Permeability Radon Barrier
K_s – Geometric Means



2. Will plants take up and accumulate contamination?

- Sampled 10 plants on cover and 10 plants in reference area
- Dried, weighed, and ground-plant material in a Wiley Mill, and sieved on a 40 mesh screen
- Microwave acid digestion, ICP MS for elements of concern
- Ra-226 measured as emanation of Rn-222 after in-growth in a scintillation cell



Lowman, Idaho: ponderosa pine and redosier dogwood

Plants and Contaminants at Selected UMTRCA Sites

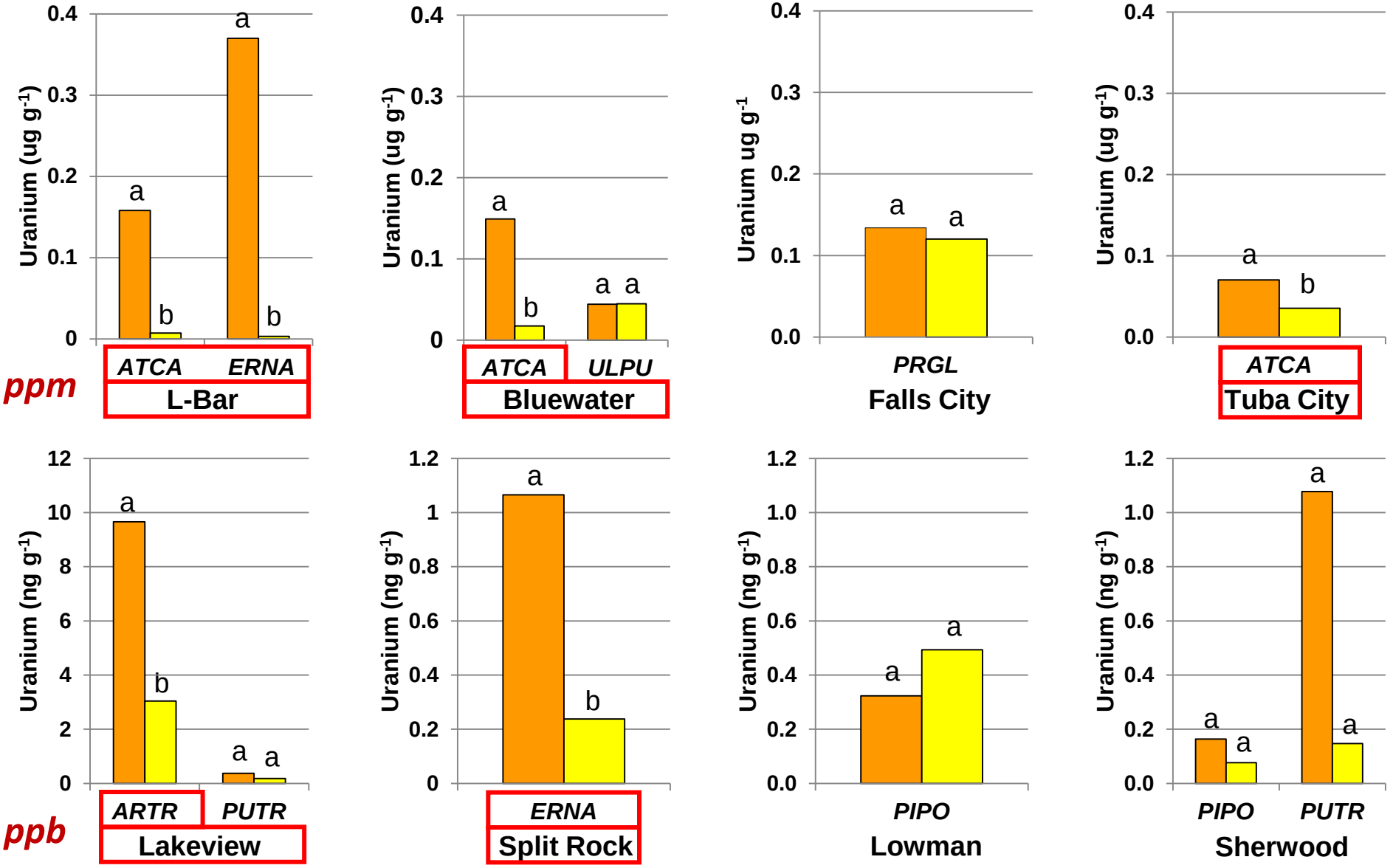
UMTRCA Site	**Plants sampled: *Genus species***	**Elements of Concern**
Tuba City, Arizona	*Atriplex canescens* (ATCA) *Bassia scoparia* (BASC)	As, Mo, Pb, Se, ^{226}Ra, Th, U
Lowman, Idaho	*Pinus ponderosa* (PIPO) *Cornus sericea* (COSE)	Th, U
Bluewater, New Mexico	*Atriplex canescens* (ATCA) *Ulmus pumila* (ULPU)	Mo, ^{226}Ra, Se, Th, U
L-Bar, New Mexico	*Atriplex canescens* (ATCA) *Ericameria nauseosa* (ERNA)	As, Mo, Pb, Se, ^{226}Ra, Th, U
Lakeview, Oregon	*Artemisia tridentata* (ARTR) *Purshia tridentata* (PUTR)	Th, U
Falls City, Texas	*Prosopis glandulosa* (PRGL)	As, Cd, Mo, Se, U
Sherwood, Washington	*Pinus ponderosa* (PIPO) *Purshia tridentata* (PUTR)	Th, U
Split Rock, Wyoming	*Ericameria nauseosa* (ERNA)	Mn, U

Uranium

Disposal Cell
Reference Area

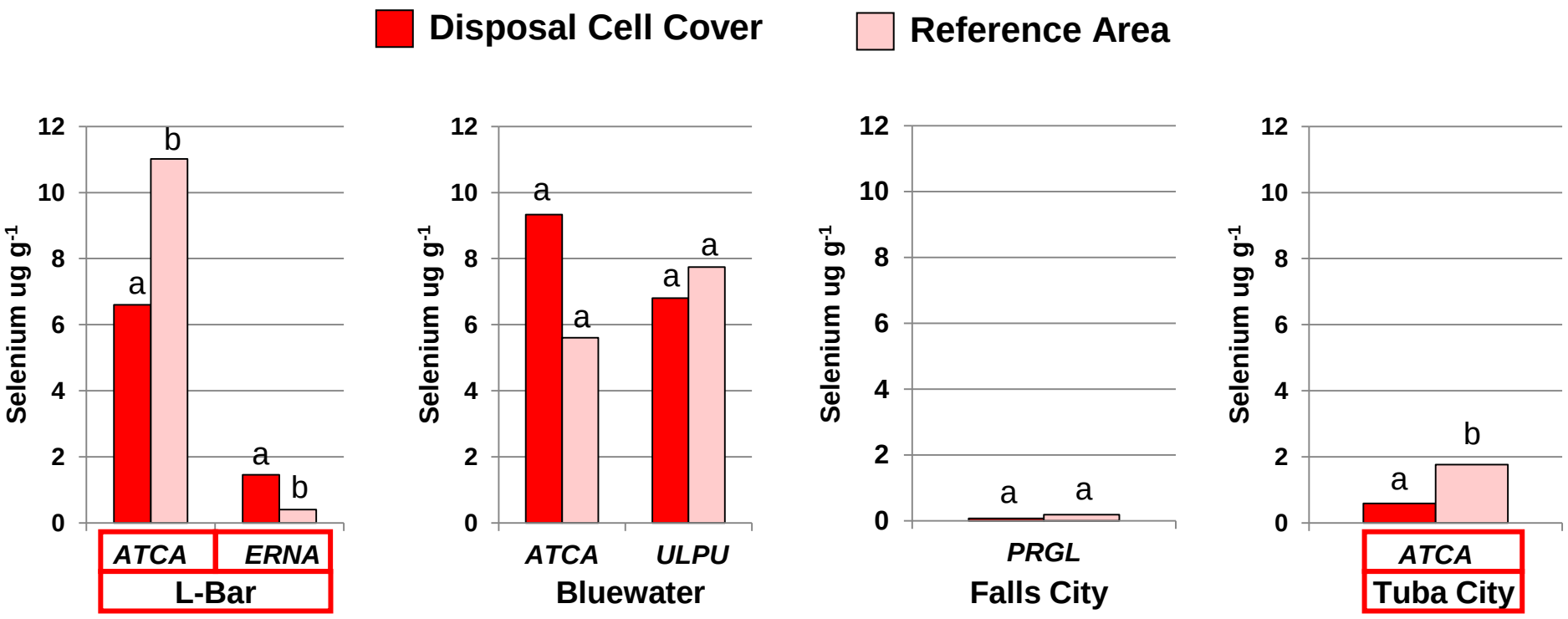
Mean bars labeled with different letters are significantly different (P<0.05)

National Research Council (2005)
Maximum Tolerance Level
in Animal Diets: 100 ug g^{-1}



Selenium

Mean bars labeled with different letters
are significantly different (P<0.05)



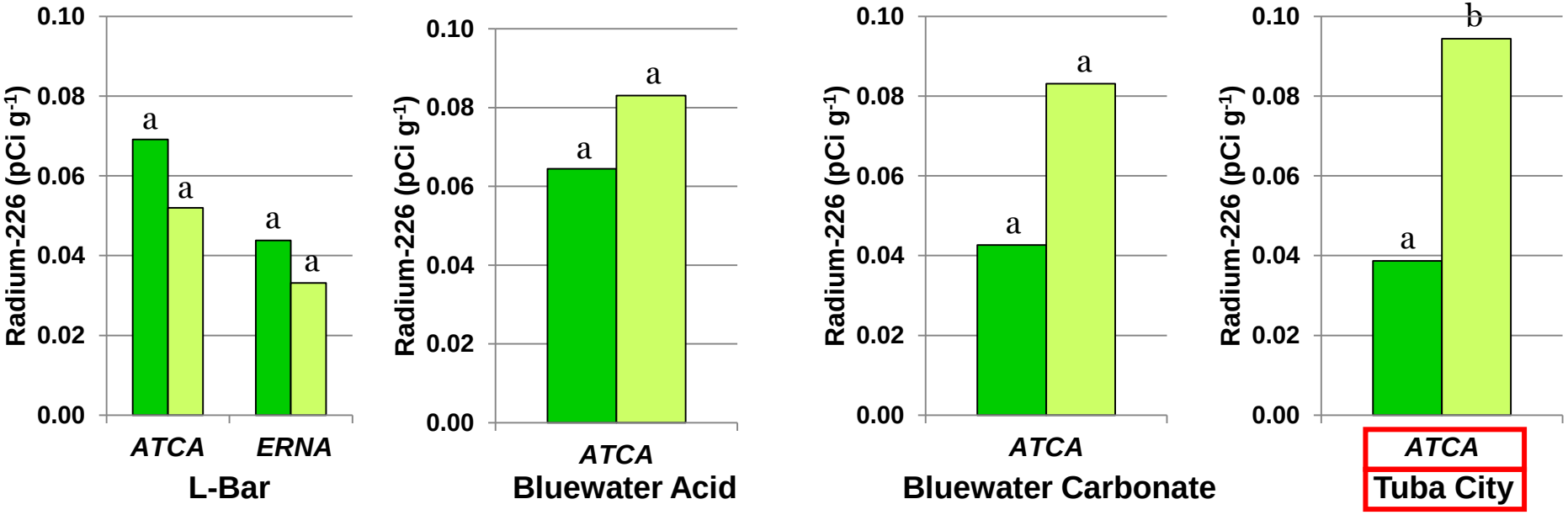
National Research Council (2005)
Maximum Tolerance Level
in Animal Diets: **5 ug g^{-1}**

Radium-226

Disposal Cell

Reference Area

Mean bars labeled with different letters are significantly different (P<0.05)

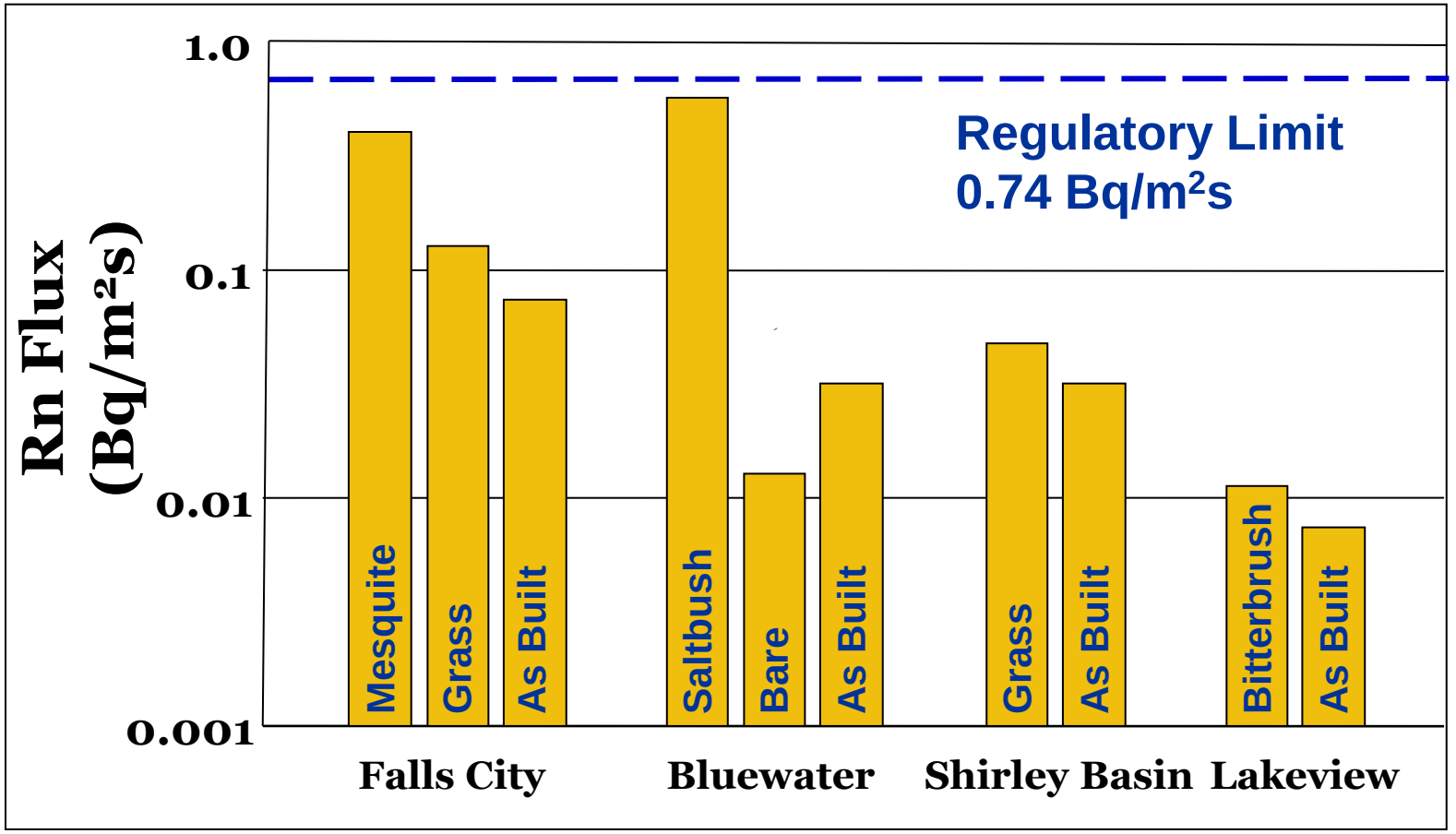


UMTRCA Soil Standard: 5 to 15 pCi g^{-1}

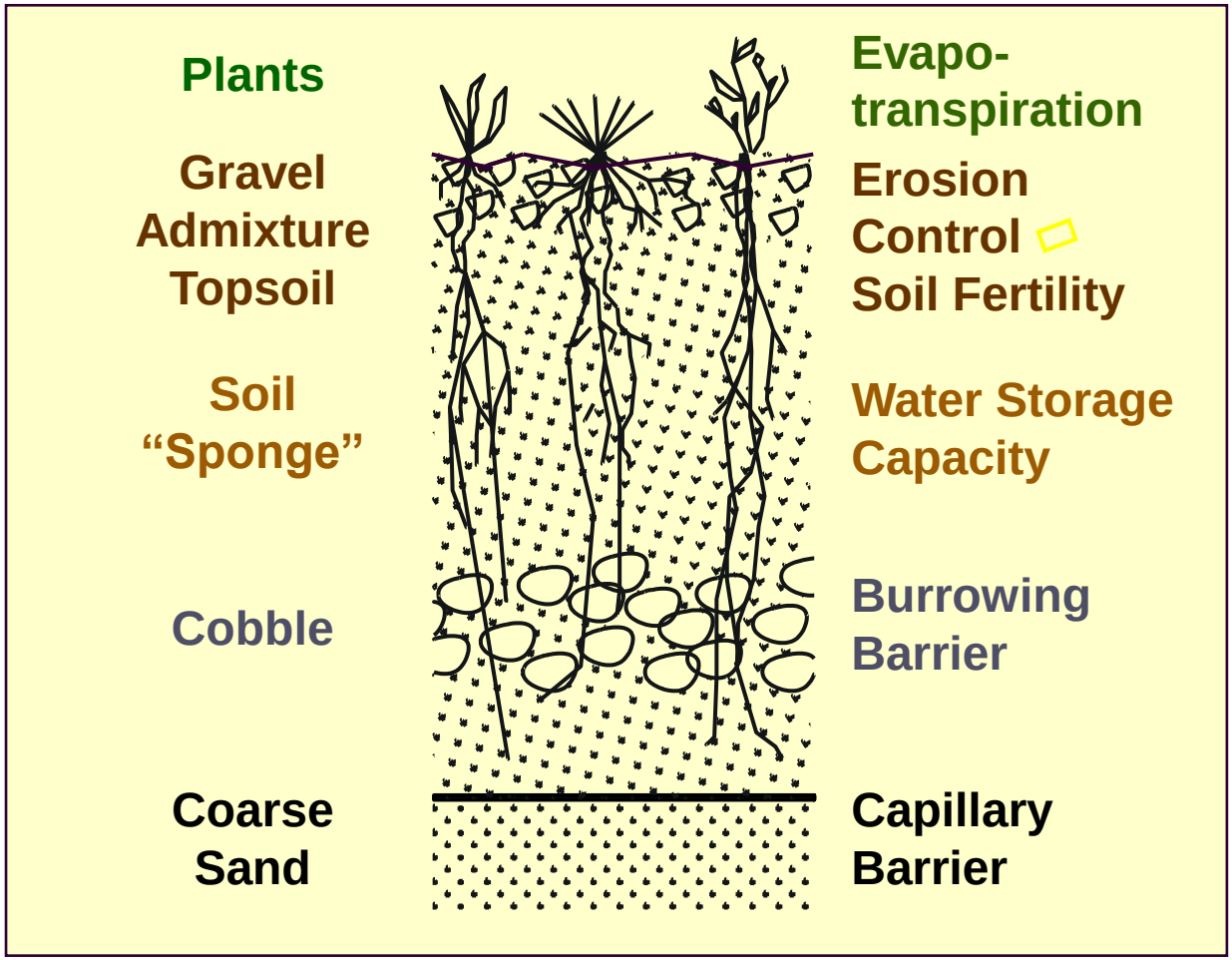
3. Will soil development and ecological succession increase radon diffusion and flux?

- Measured radon flux in paired plots of contrasting conditions (e.g., with and without vegetation)
- Radon flux measured with activated charcoal and a solid-state α detector (RAD7)
- Four flux chambers sizes used to evaluate potential scale effects

Radon Flux (Bq/m^{2}s)



5. Are evapotranspiration (ET) covers a sustainable alternative?



Monticello Embedded Drainage Lysimeter

Soil Moisture Nests

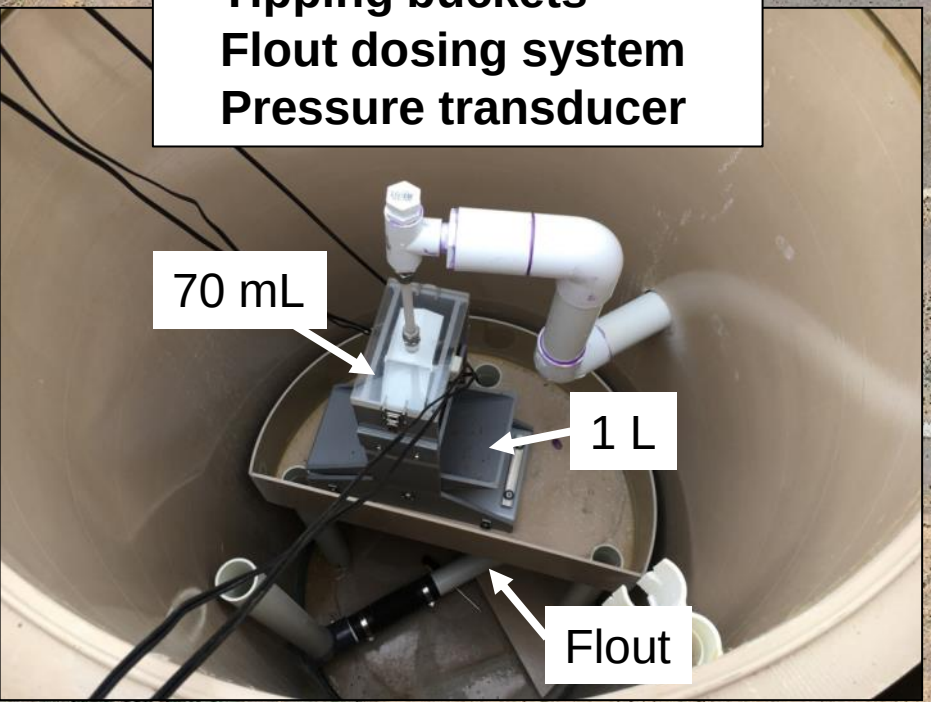
Drainage Basins

Runoff Plot

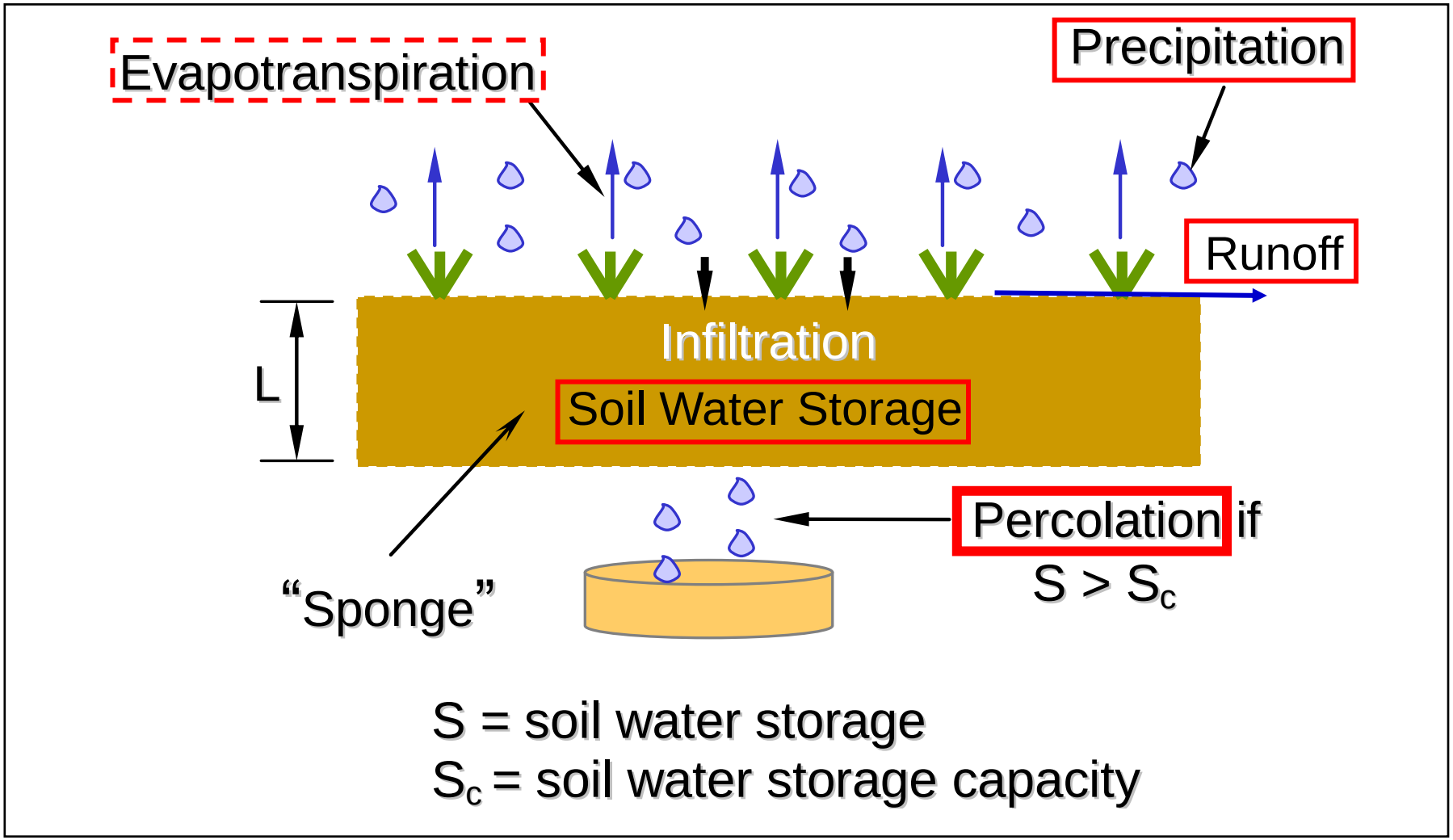
3-ha (7.5-acre) Lysimeter

Percolation Basin:

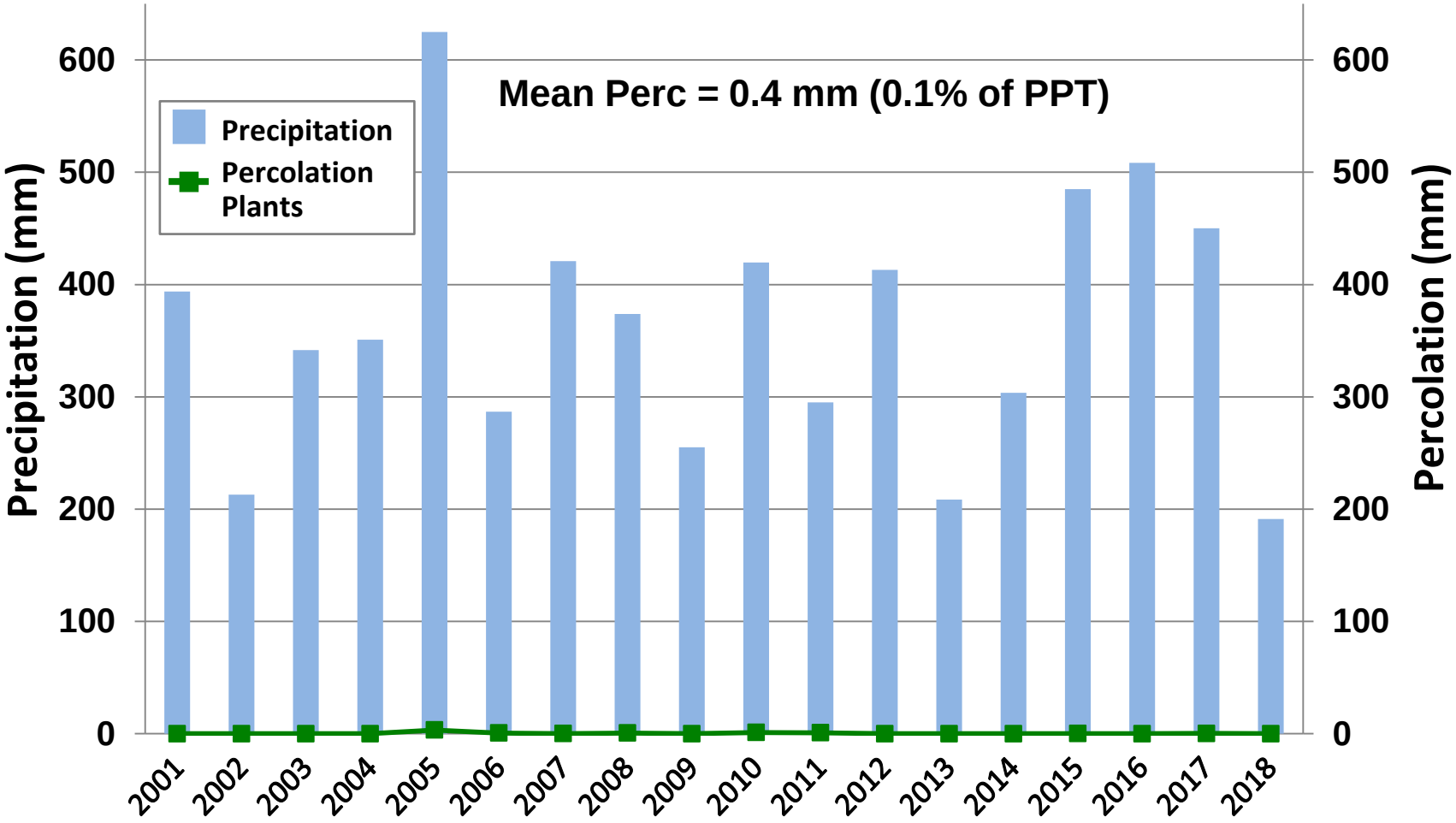
- **Tipping buckets**
- **Flout dosing system**
- **Pressure transducer**



Lysimeter Water Balance Parameters

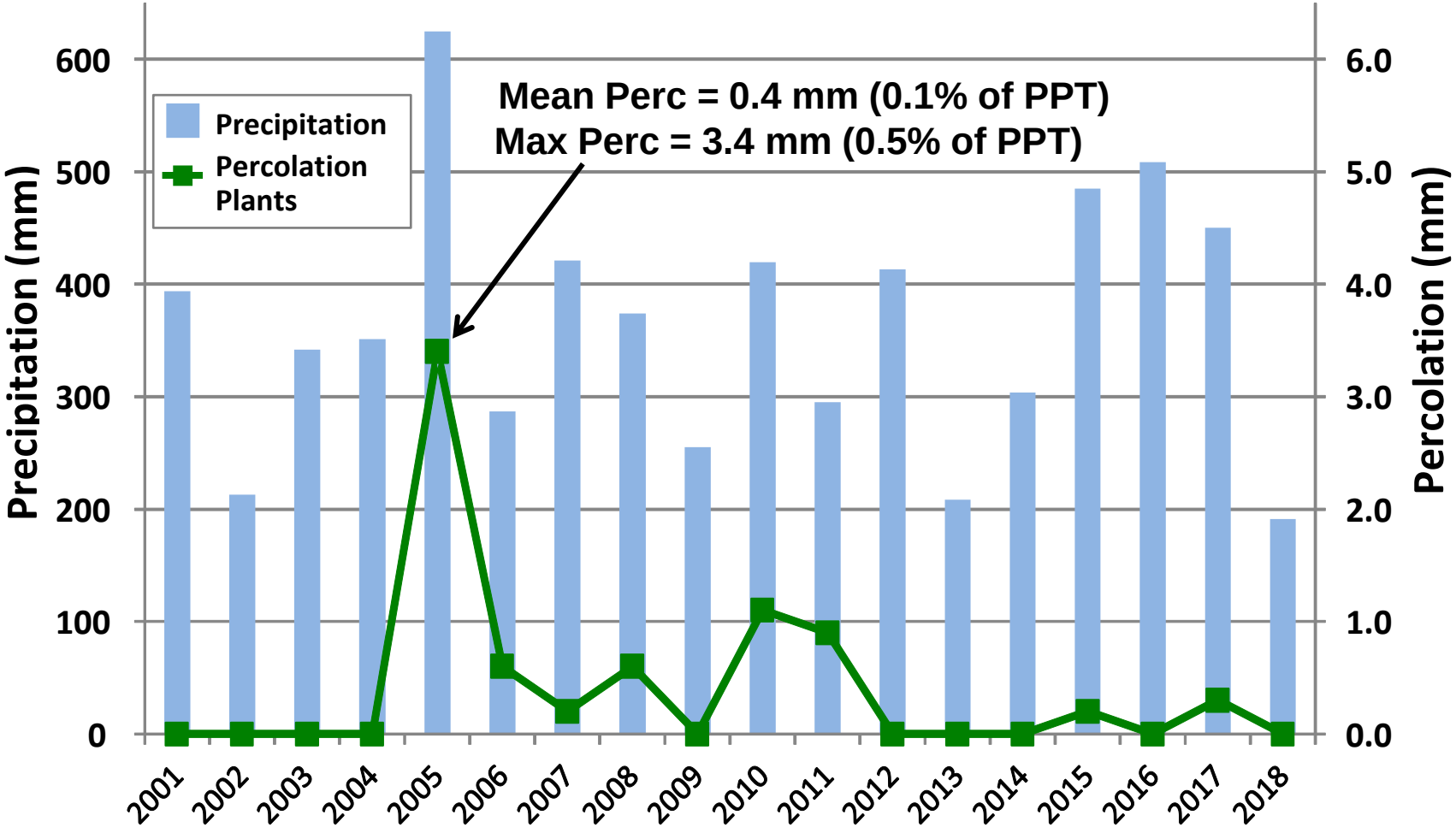


Evapotranspiration Cover Percolation



*Years are July – June.
**2018 data are July 1, 2017 – March 30, 2018.

Evapotranspiration Cover Percolation



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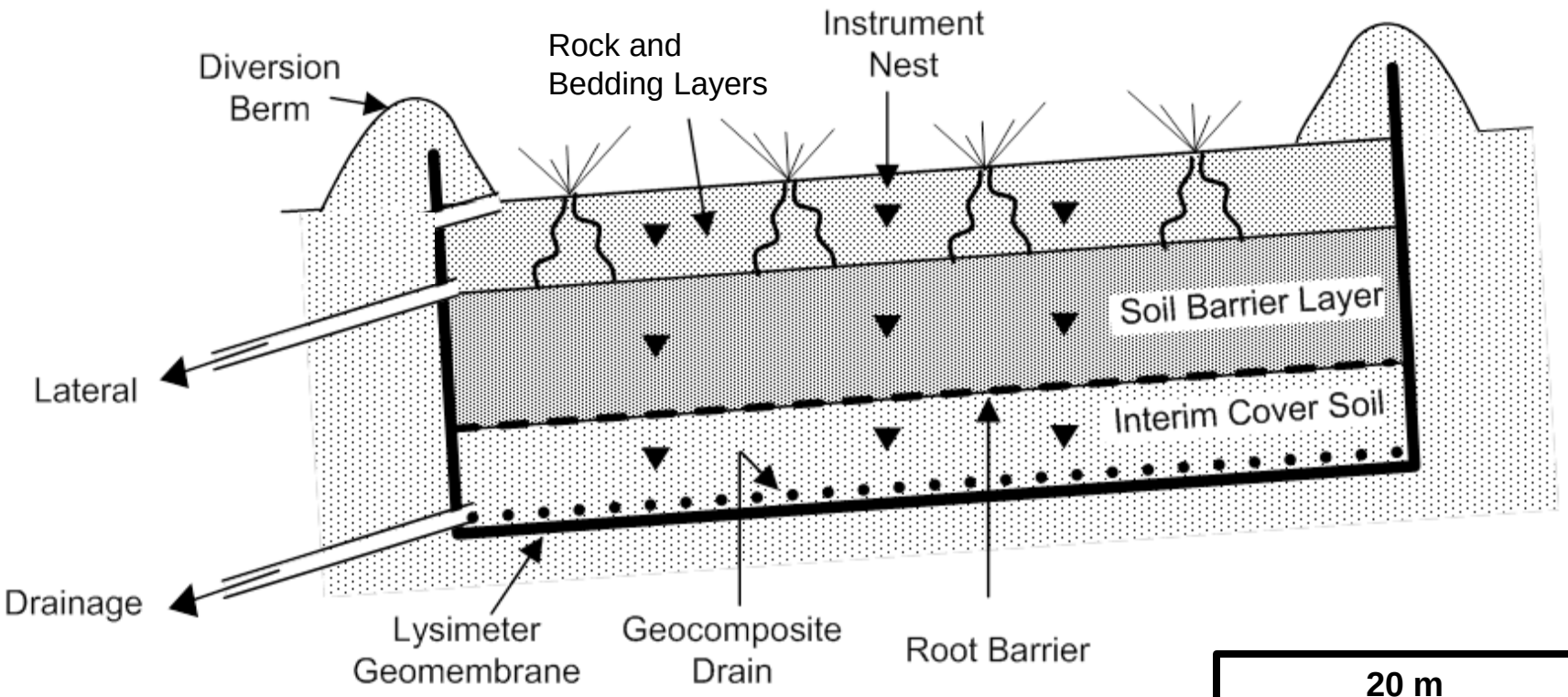
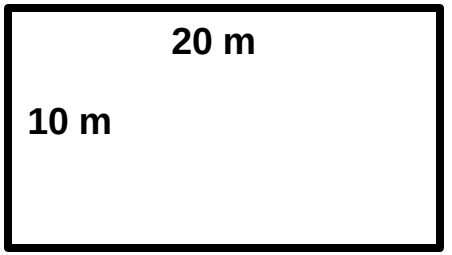
6. Is Mother Nature transforming conventional covers into ET covers? Can we enhance this?

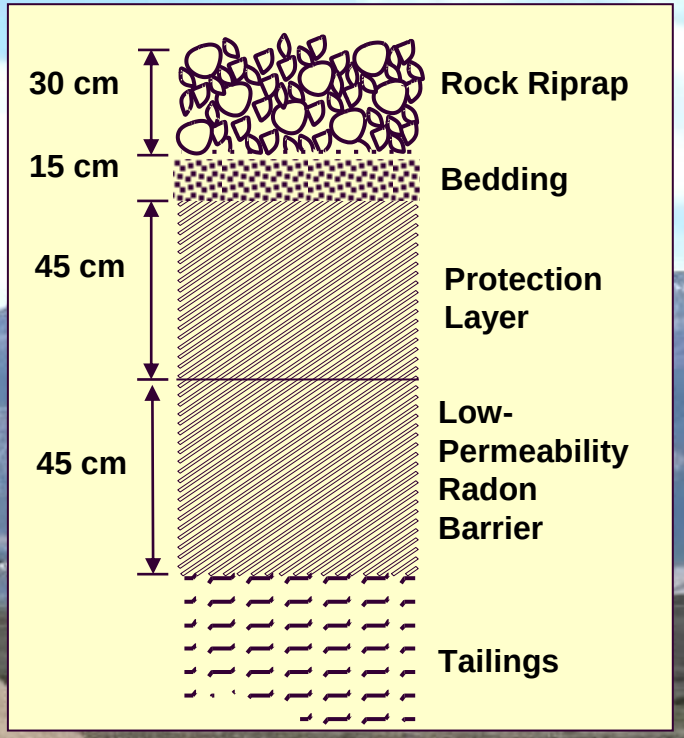


Lysimeter Test Pad Cross Section



Plan View

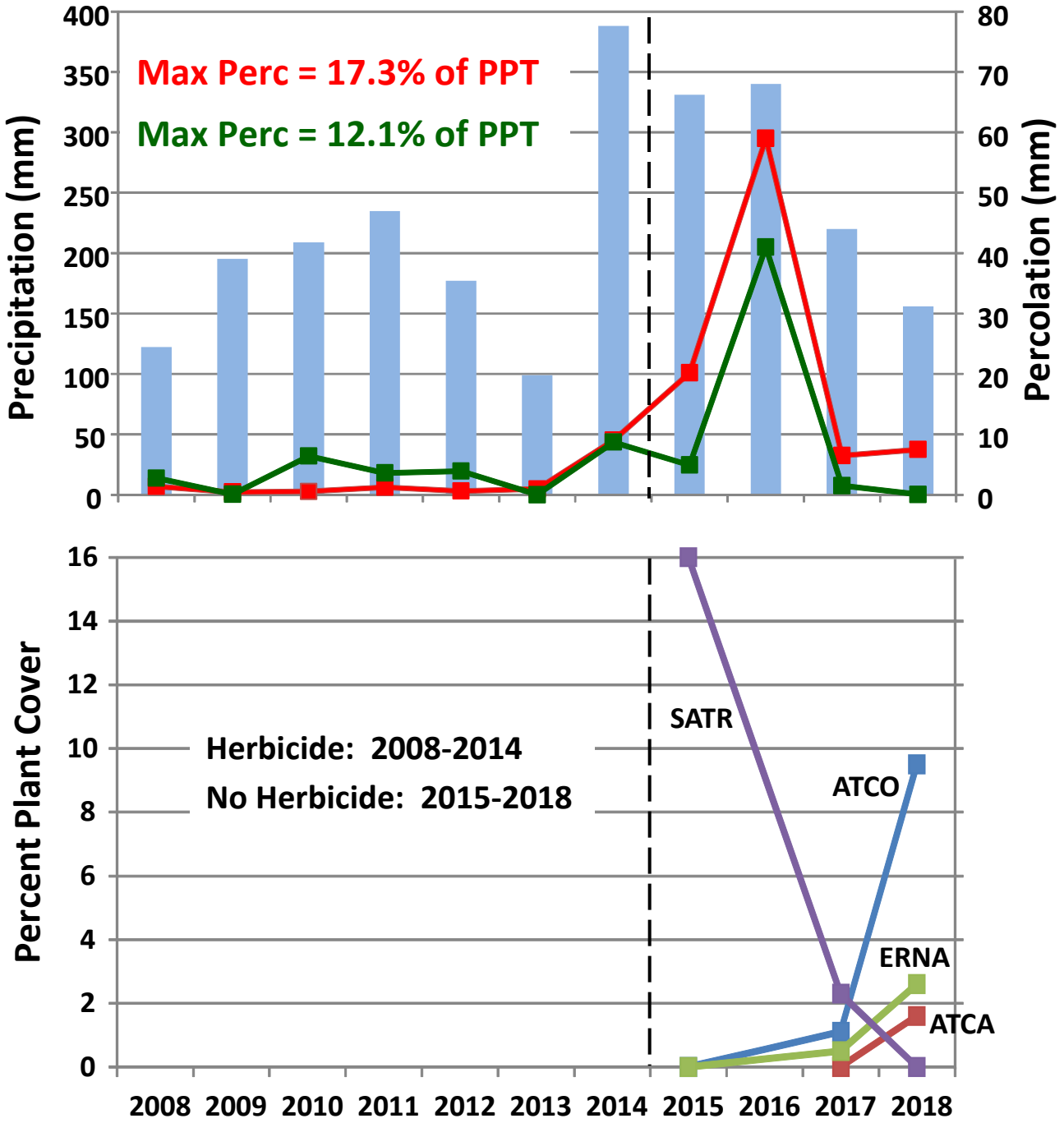
Lysimeter Test Facility
Grand Junction Disposal Site



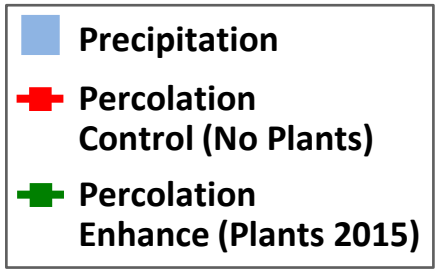
Control

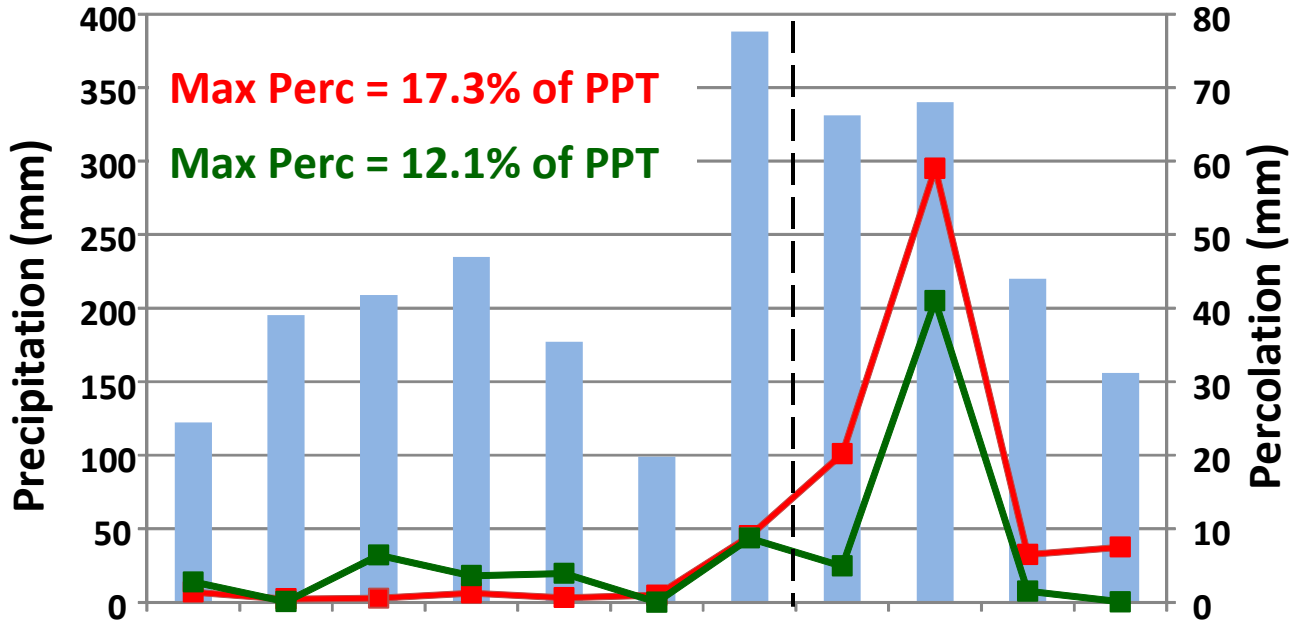
Enhance

Low-Permeability Cover Lysimeter (Grand Junction)

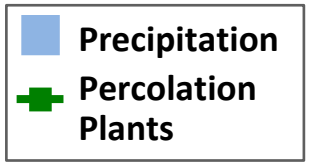


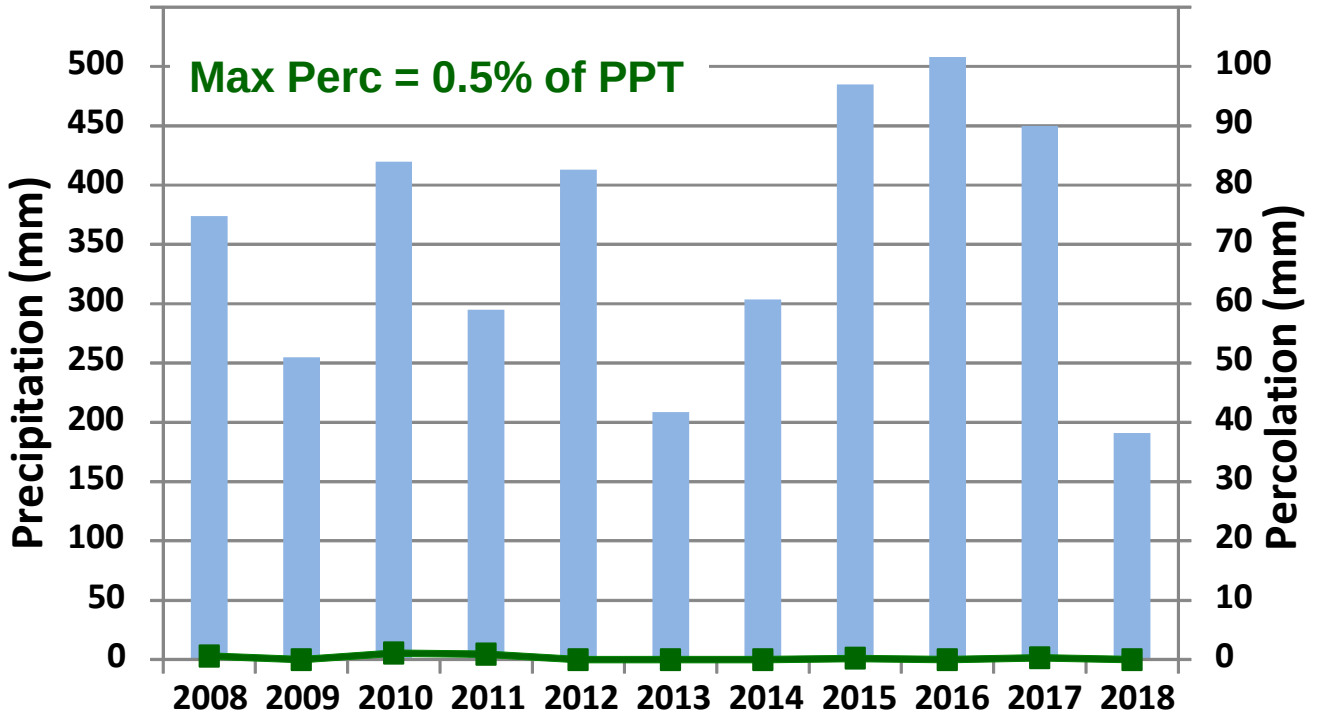
Low-Permeability Cover Lysimeter (Grand Junction)





ET Cover Lysimeter (Monticello)





Summary and Conclusion

- Saturated hydraulic conductivity is 10^2 to 10^3 greater than the design target for conventional covers
- Mean radon fluxes remain below the 0.74 Bq/m^{2}s regulatory standard
- Concentrations of uranium and other elements are higher in woody plants growing on vs off some conventional covers, but remain well below risk-screening thresholds
- Maximum annual percolation was 17.3% and 0.5% of precipitation for conventional and ET covers, respectively
- Enhancing plant succession increased ET and helped reduce percolation flux in a conventional cover from 12.1% to 0.1% of precipitation within three drier years
- Results so far support the premise of allowing or enhancing ecological conversion of selected conventional covers into ET covers