

Design and Construction of an ET Cover System in the Eastern U.S.

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ET Cover Systems in Western U.S.

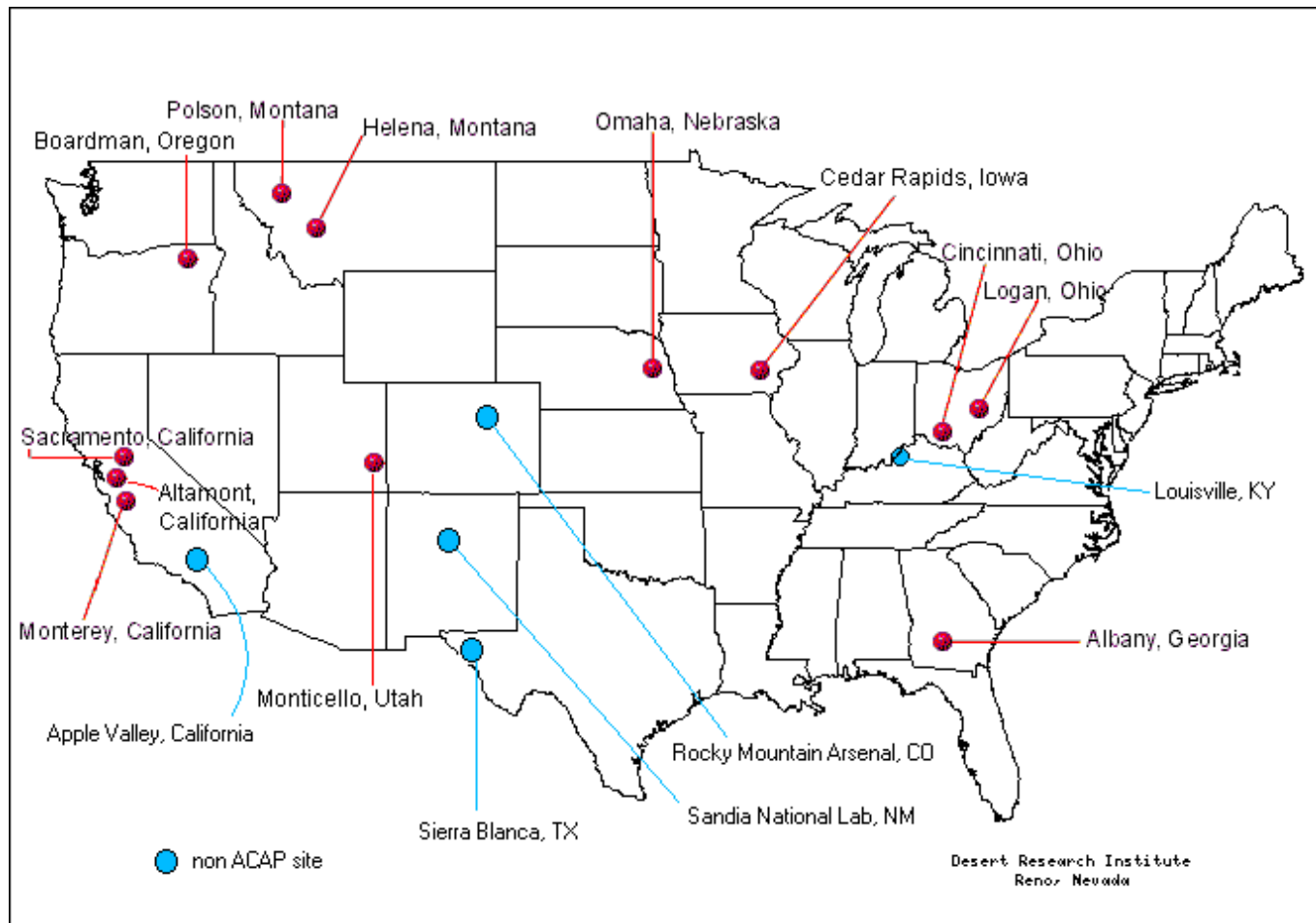
- Becoming more common
- Based on modeling and monitoring results, can achieve very good performance in arid and semi-arid climates (drainage ≤ 1 mm/yr)
- Field measurements
 - Roesler, Benson, and Albright (2002): for 6 ACAP test plots at 5 sites with ET covers, drainage ≤ 1 mm/yr ($\leq 0.3\%$ of precipitation) [excludes two ET cover test plots in Sacramento, CA with drainage = 3.1 and 48 mm/yr, respectively]
 - Dwyer (2003): for Albuquerque test plot, 0.05 mm/yr (0.02% of precipitation)
 - Scanlon et al. (in preparation): for Sierra Blanca test plot, 0 mm/yr; based on soil water content measurements with depth, drainage of irrigated site would increase from 0 to 7 mm/yr if soil thickness was decreased to 1.1 m

ET Cover Systems in Eastern U.S.

- Currently much less common than in west
- Based on modeling and monitoring results, ET covers in humid climates may exhibit 50 to 100 mm/yr of drainage.
- Can be engineered to achieve an even higher level of performance by careful vegetation design. But requires greater reliance on vegetation
- Roesler, Benson, and Albright (2002): for 5 ACAP test plots at 4 sites with ET covers, drainage 37 to 143 mm/yr (4.8 to 15.6% of precipitation). At the Albany ACAP site, 91 mm/yr of drainage over 24-month monitoring period, with most drainage occurring in first 10-months after construction. After that time, when popular trees were better established, 6 mm/yr of drainage.

ACAP Sites

(<http://www.acap.dri.edu/>)



Background

- 180-ha (440-acre) former synthetic fiber manufacturing facility located in foothills of Blue Ridge Mountains along the Shenandoah River
- Plant disposed of wastes in on-site surface impoundments
 - sulfate sludges: 6
 - fly ash (on-site power plant): 4
 - other waste: 11
- Impoundments and 2 on-site landfills occupied about 90-ha (220 acres)
- Impoundments located within 100-yr flood plain



1998 (S)



Background

- Added to NPL in 1986
- Selected remedy for sludge and fly ash impoundments is capping
- Cleanup, demolition, and restoration costs estimated at \$150 million
- Site in EPA's Superfund Redevelopment Initiative Program
 - 100-ha (240-acre) river conservancy park
 - 10-ha (25-acre) active recreation area
 - 67-ha (165-acre) eco-business park





Key Regulatory Requirements

- Provide positive drainage and accommodate post-closure settlements
- Hydraulic conductivity of cover system $\leq$ that of underlying soils
- Erosion layer thickness ≥ 0.6 m

Design Issues

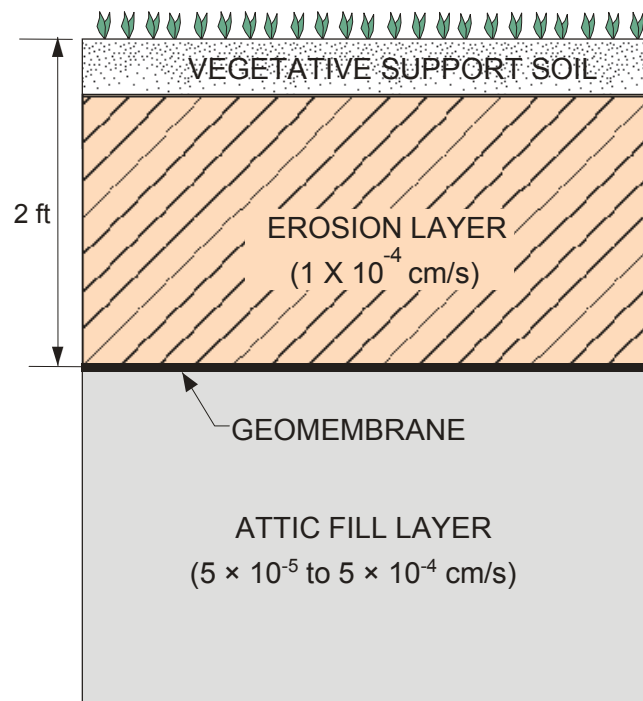
Issues

- Grading
- Settlement
- Hydraulic conductivity
($\leq 1 \times 10^{-8}$ cm/s)

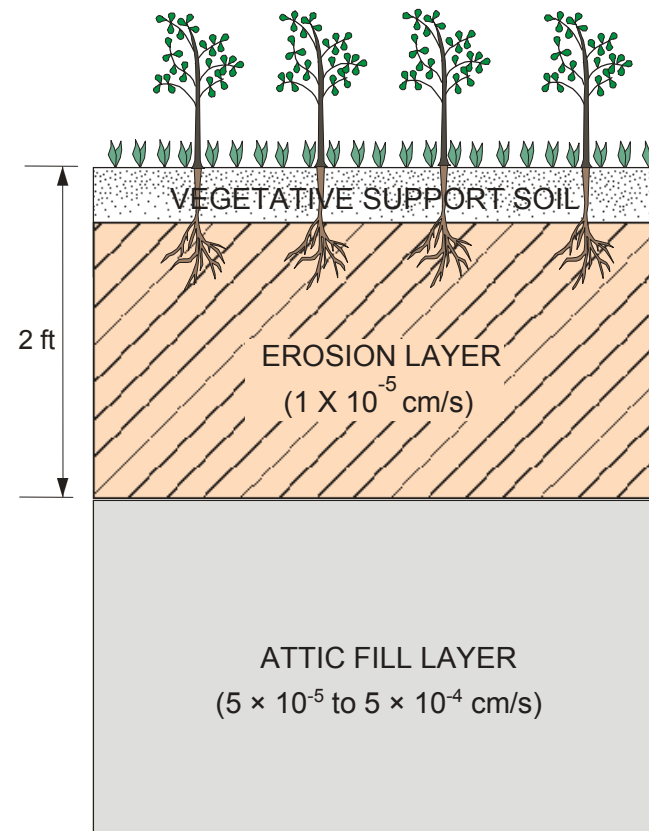


Cover System Designs

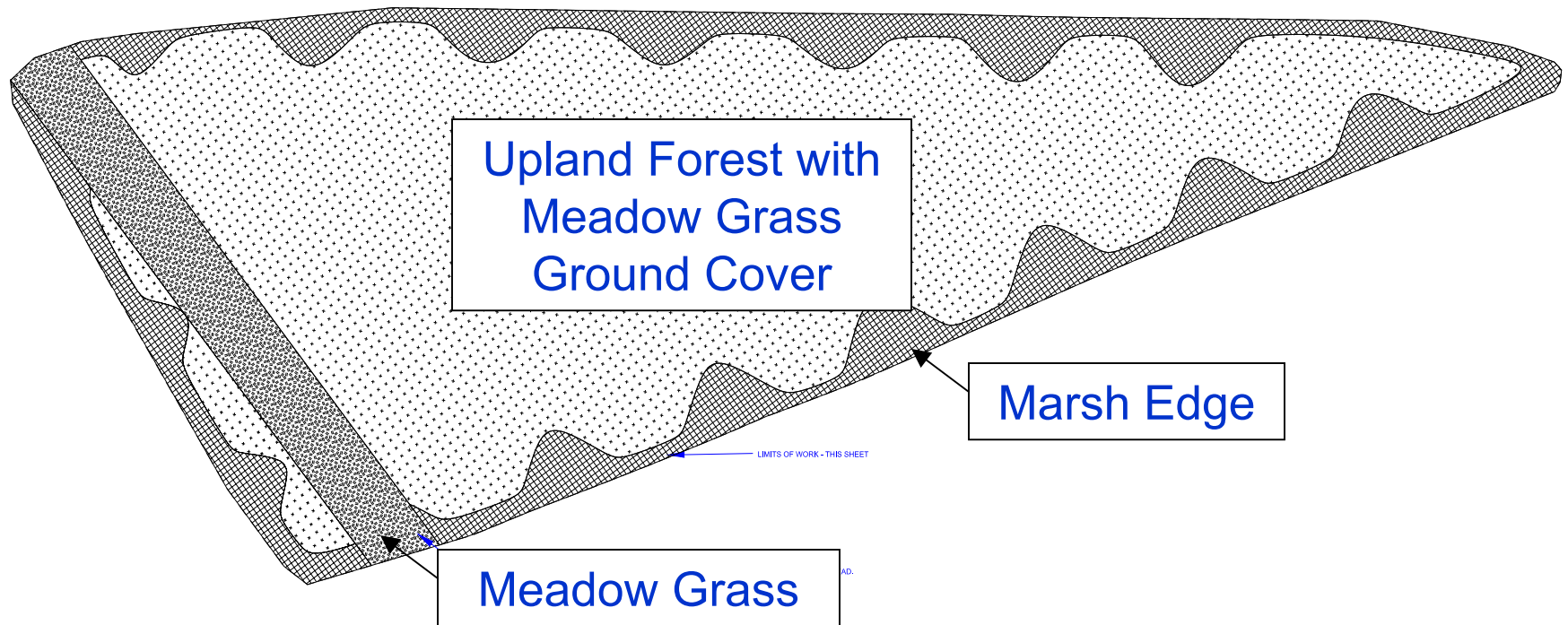
Sulfate Impoundments



Fly Ash Impoundments



Planting Schemes



300 plants/acre

Plant List

- Upland Forest
 - American Hornbeam
 - Hornbeam
 - Eastern Hophornbeam
 - Red Bud
 - Hickory (Pignut, Shagbark, and Mockernut)
 - Oak (White, Northern Red, Sawtooth)
 - Flowering Dogwood
 - White Ash
 - Elm (American, Slippery)
 - Black Willow
 - American Holly
- Marsh Edge
 - Common Alder
 - Buttonbush
 - Red Osier Dogwood
 - Eastern Rosemallow
 - Inkberry
 - Winterberry
 - Virginia Sweetspire
 - Black Willow
 - Highbush Blueberry
 - Arrowwood Viburnum

Plant Testing

Greenhouse and field testing of plants to evaluate:

- Ability to sustain growth in fly ash and sulfate sludge
- Dewatering effects



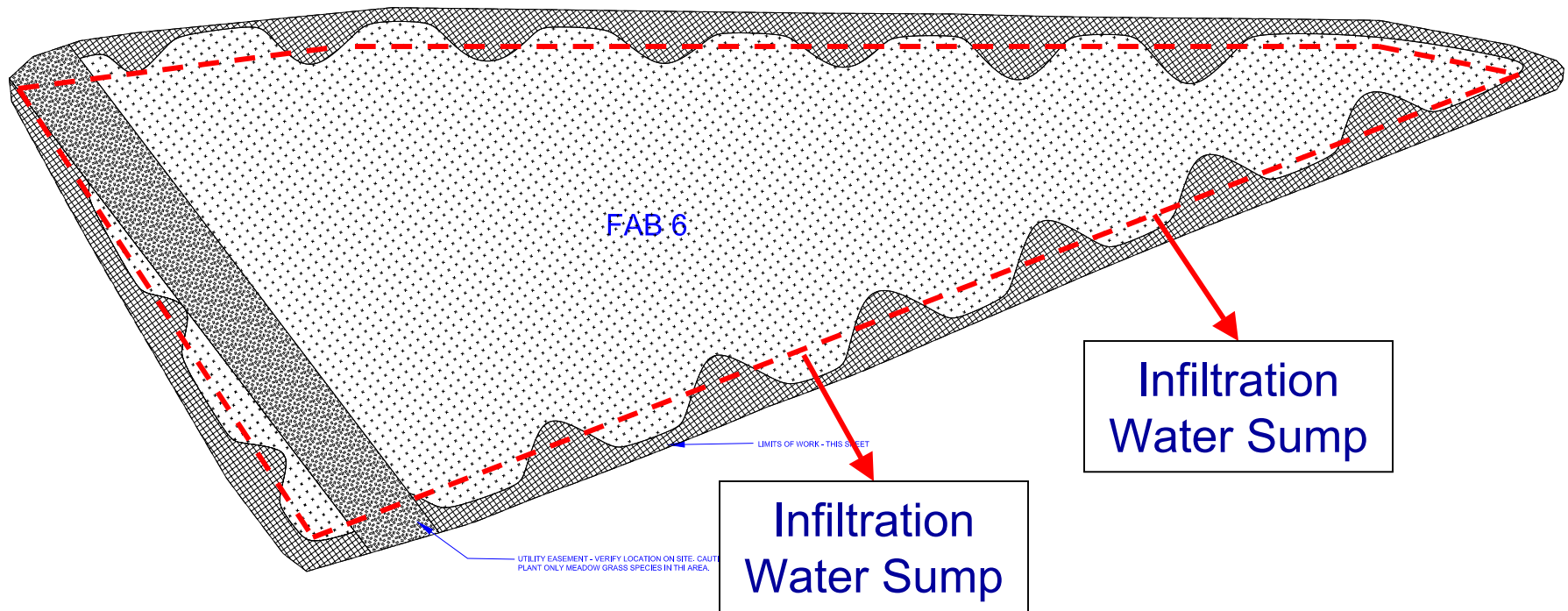
ET Cover Design

- UNSAT-H, Version 3.0
- Performance after 5 years, when vegetation is “operational”
- Cover profile: 15 cm topsoil, 45 cm site soil, and 60 cm attic fill
- Simulated weather data from HELP; wettest 30-yr period during 100-yr simulation with mean monthly precipitation for site
- Calculated PET using HELP weather data with HELP method
- Unsaturated soil properties based on index testing of site soils and pedotransfer function
- LAI based on published plant data
- Growing season based on expert opinion
- Root depth based on published plant data and cover thickness
- Root lateral length (for plant spacing) based on published plant data on root length and on and relationships between root length and plant height; lateral root length is used to assess plant spacing

Results (mm/yr)

	Upland Forest	Marsh Edge
Avg. Prec.	937	937
Avg. PET	1171	1171
Avg. Runoff	241	107
Avg. Trans.	351	292
Avg. Evap.	249	406
Avg. Drainage	91	132

Cover System Underdrain Beneath Attic Fill



1998 (S)



Grading Attic Fill



October 2001



ET Cover Construction (FAB6)

- Borrow area soil
 - Silty clay, little to some sand and gravel (USCS)
 - Clay loam (USDA)
 - Remolded k_{sat}
- Placed with dozer
- No compaction criterion
- In-place soil (Shelby tube samples)
 - Dry Density: 1.72-1.75 g/cm³
 - k_{sat} : 1.1×10^{-6} to 3.0×10^{-6} cm/s
- Soil tested to assess need for amendments, and nitrogen has added

April 2002





April 2002



May 2002



June 2002 (S)



April 2003

An Eastern Bluebird sits on one of the new trees that was planted on Former Fly Ash Basin No. 6 during Spring, 2002.
29 April 2003



June 2003 (N)



