Crazy Horse Sanitary Landfill Closure with an Exposed Geomembrane "Hybrid"

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SWANA SOLID WASTE ASSOCIATION of North America

40th Annual SWANA Western Regional Symposium, May 15-19, 2011

Crazy Horse Sanitary Landfill

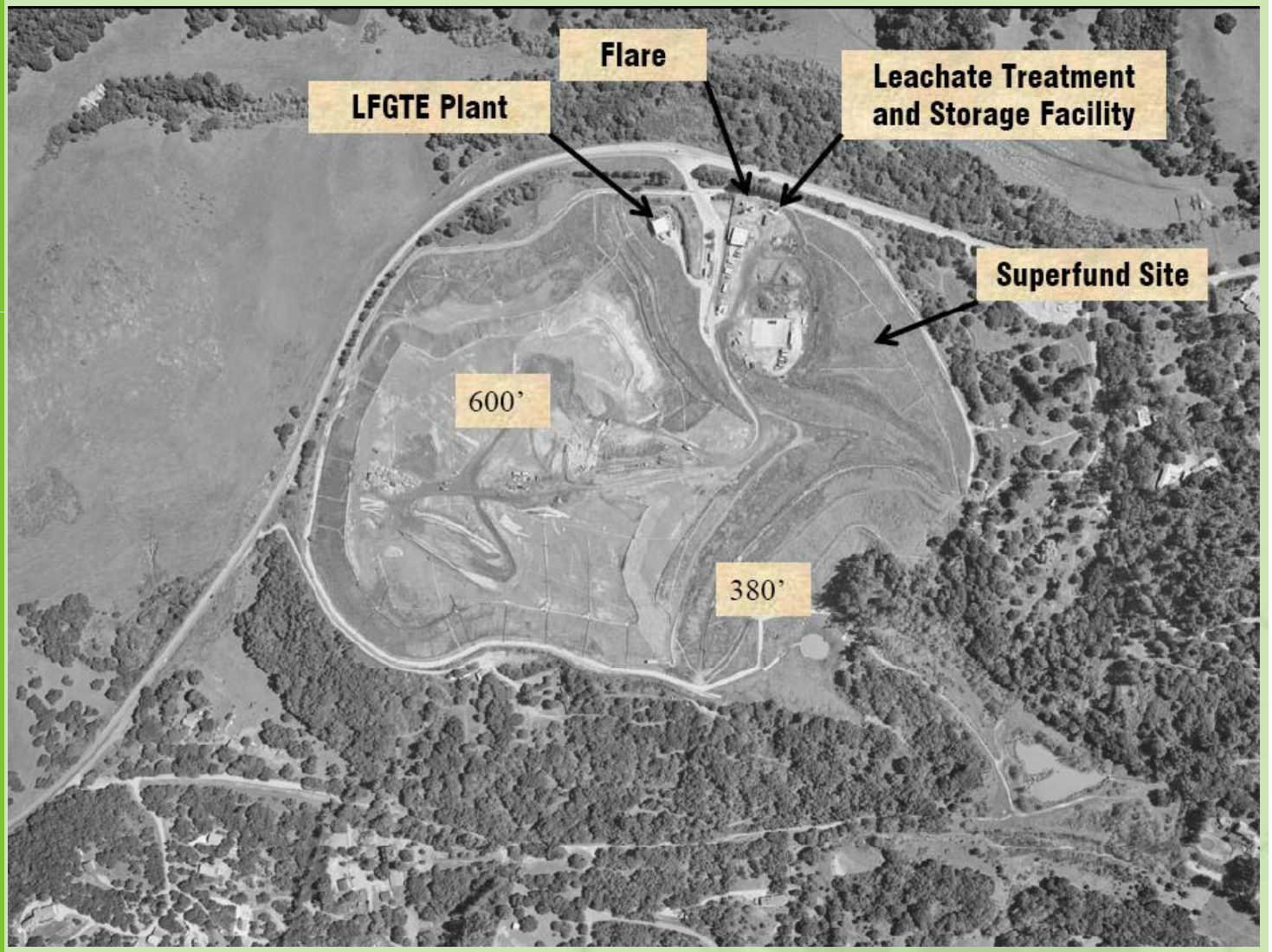
Operational 1934 – 2010

Module 1 was on NPL List. (Closed 1988)

LFG Flare(s) 29-MMBtu/Hr & 72 MMBtu/Hr

LFGTE – 1.5 mW current interconnect.

Leachate Treatment (Recirculation During Postclosure)



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Final Closure Design – Stage 1

Final Cover Original Design

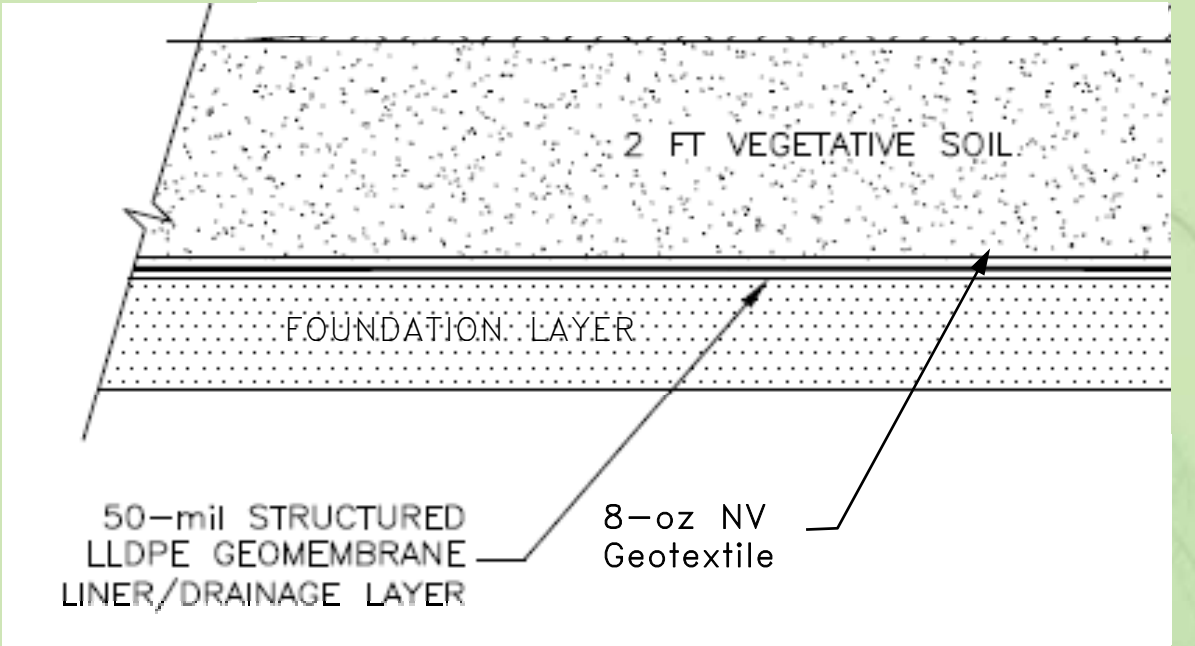
ET Cover – Too Wet.

Foundation Layer

50-mil Structured LLDPE geomembrane (“Supergripnet”)

8-oz NV Geotextile

Vegetative Cover



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Final Closure Design – Stage 1

Design Issues

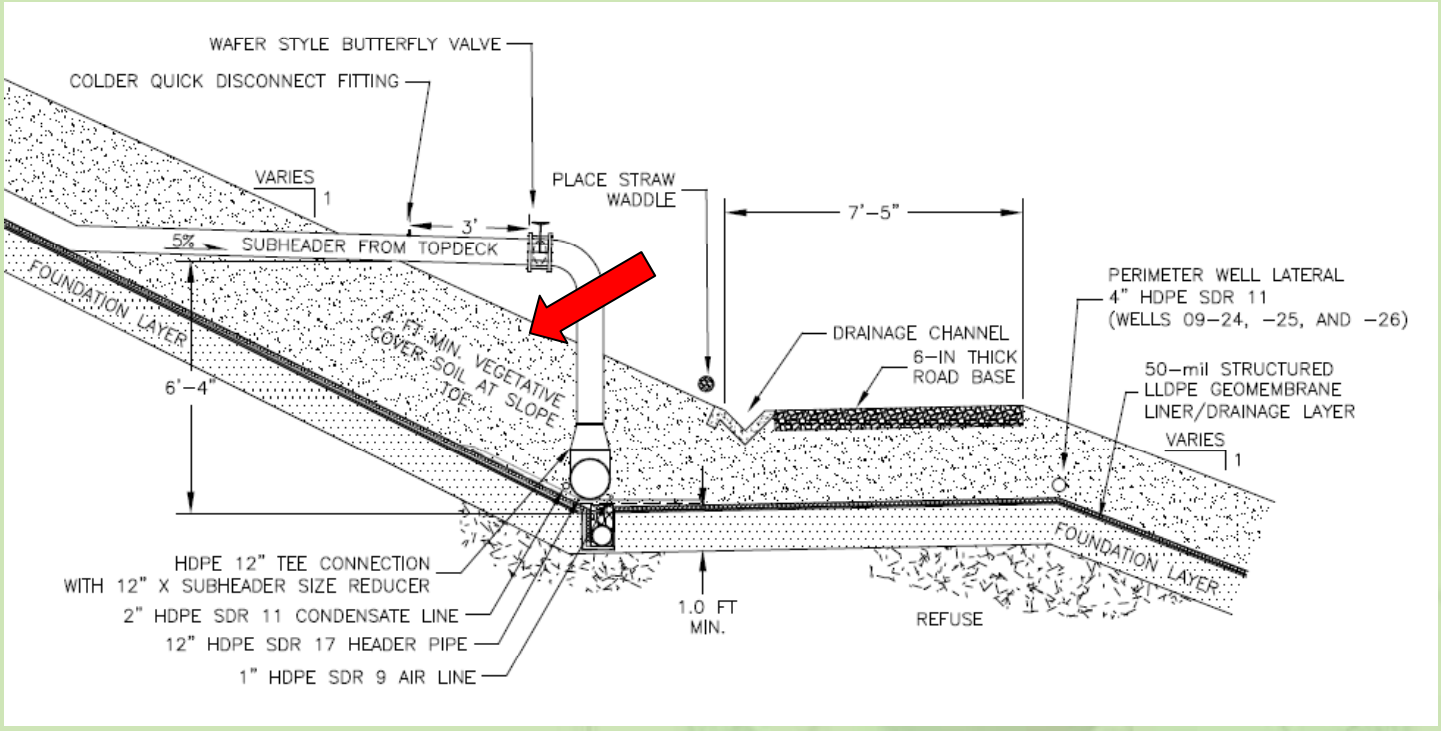
Stability

MHA_{Rock} =0.5 g!

Required Buttressed Fills in Some Locations

Usual Postclosure Maintenance Concerns;

Settlement, Vegetative Cover Erosion



Final Closure Design – Stage 1

Regarding Vegetative Soil Import

Would have been ~200,000 CY,

Between 9,000 and 10,000 Trips,

Up to 600,000 Diesel Miles (JCLF),

Up to 900 MT of eCO_2 Emissions

For CHLF, Poor Access = High Transport $$

More So Today!

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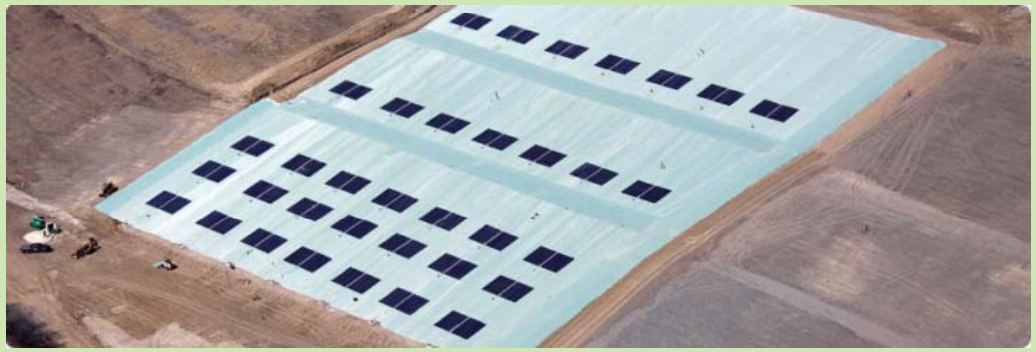
Final Closure Design – Stage 2

Exposed Geomembrane with Solar PV Laminates



Tessmann Road Landfill, Texas

- Wind uplift would have required additional anchor trenching along slopes. (~50 feet C.C.)
- Solar power is expensive (~ $12 million at CHLF)
- Regulators demanded Postclosure Pledge of Revenue include capitalization of exposed geomembrane replacement .

Deal Killer!

- "Next" was a Exposed Geomembrane "Hybrid"

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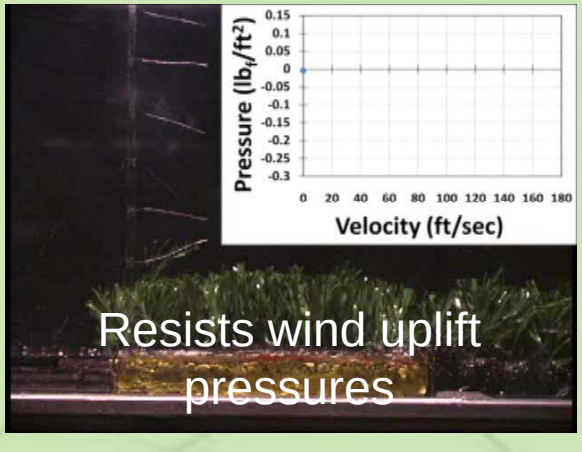
Final Closure Design Stage 3

Exposed Geomembrane Hybrid

Claimed Benefits

Eliminates vegetative cover layer
(Photo LaSalle/Grant Parish Landfill in Jena, Louisiana)



Supports Rigid Solar Panel Installation

Reduces Need for Vertical LFG wells

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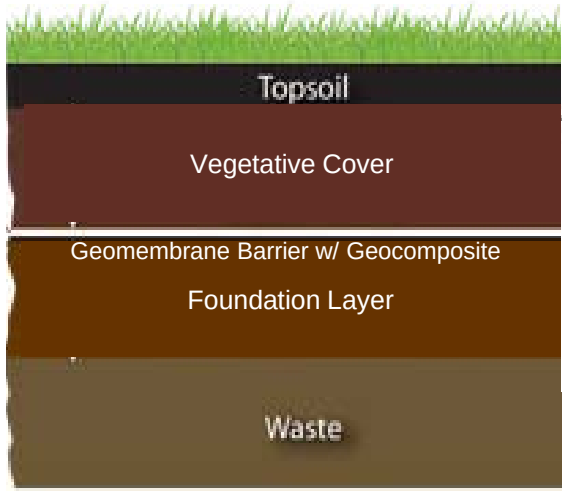
Trade Name = Closure Turf ®

Patented Components

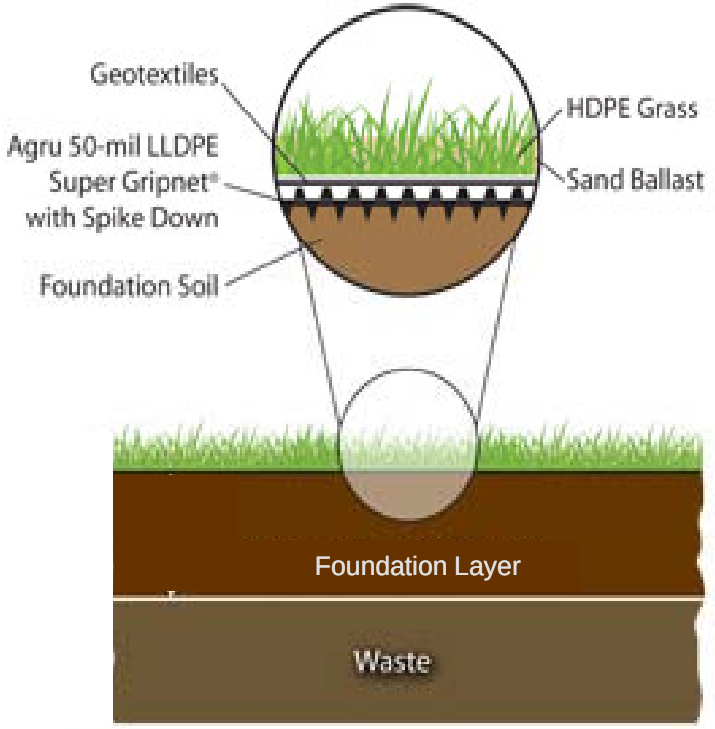
- Structured geomembrane (AGRU's Supergripnet)
- Double layer woven PE geotextile
- Sewn HDPE artificial grass
- Coarse to medium sand ballast

- An Entirely Synthetic Final Cover System
- (Well, except for the sand)



Traditional Final Cover System

VS.



Closure Turf Final Cover System

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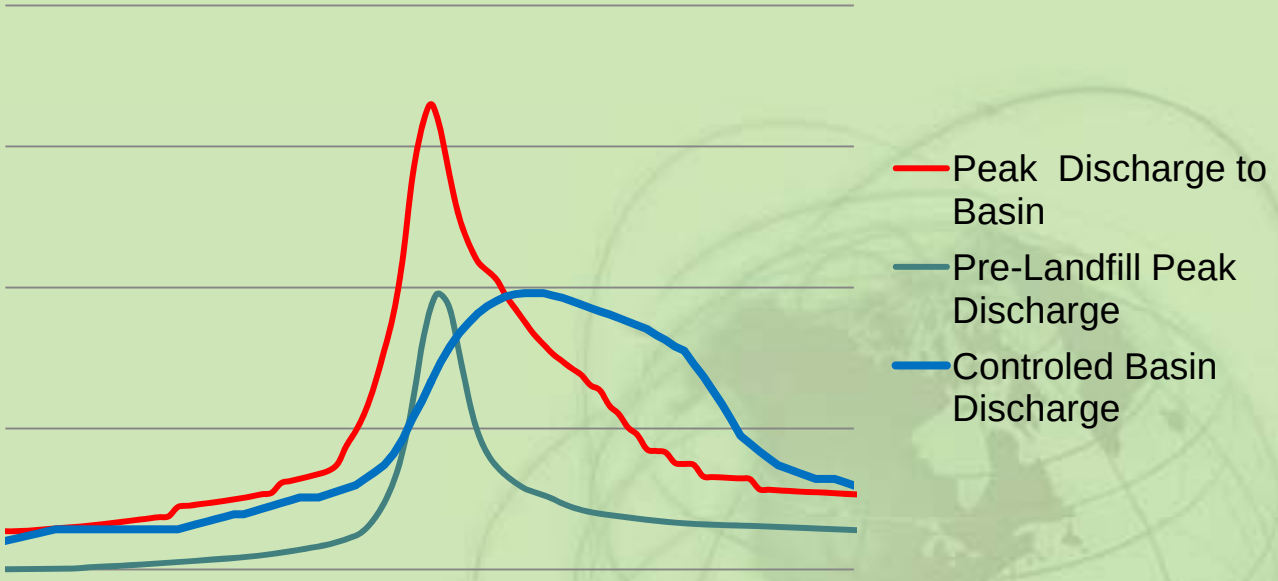
Crazy Horse Design Considerations

Higher Hydraulic Response

No Vegetative Cover =>

Increase in Peak Run-off Discharge

Synthetic Final Cover Curve Number = 95
- With Solar Panels, 98



CCRWQCB subscribes to Low Impact Development (LID) Guidelines.

Peak discharge required attenuation (Sluice Gate over Basin Outlet)

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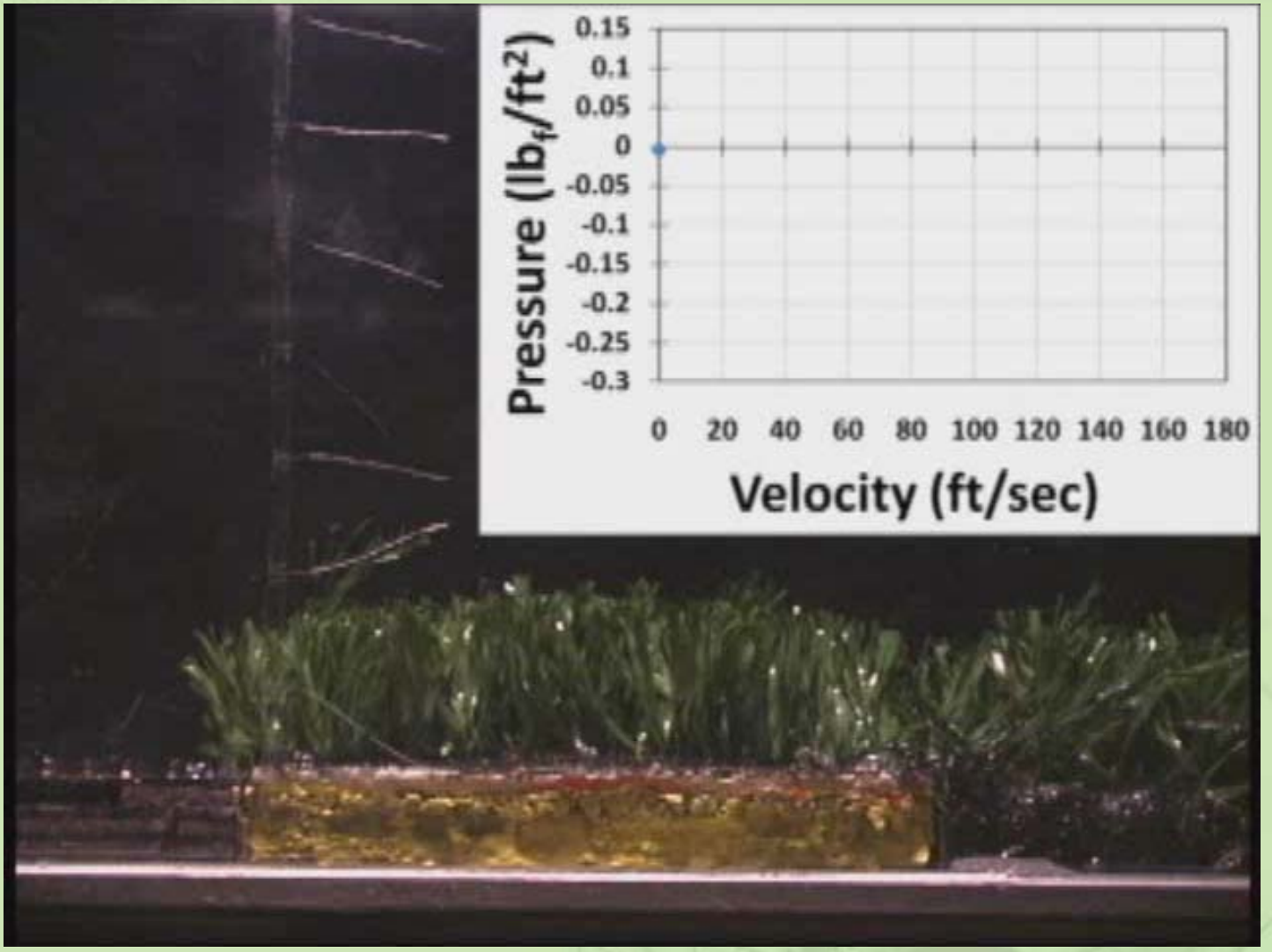
Crazy Horse Design Considerations

Wind Resistance

Exposed Geomembrane Susceptible to Wind Uplift Stresses.

Application of Sand Ballast to Hybrid's Artificial Component Resists Uplift and Shear



Uplift (Normal Force) Response:
Uplift Force Peaks and Then Declines

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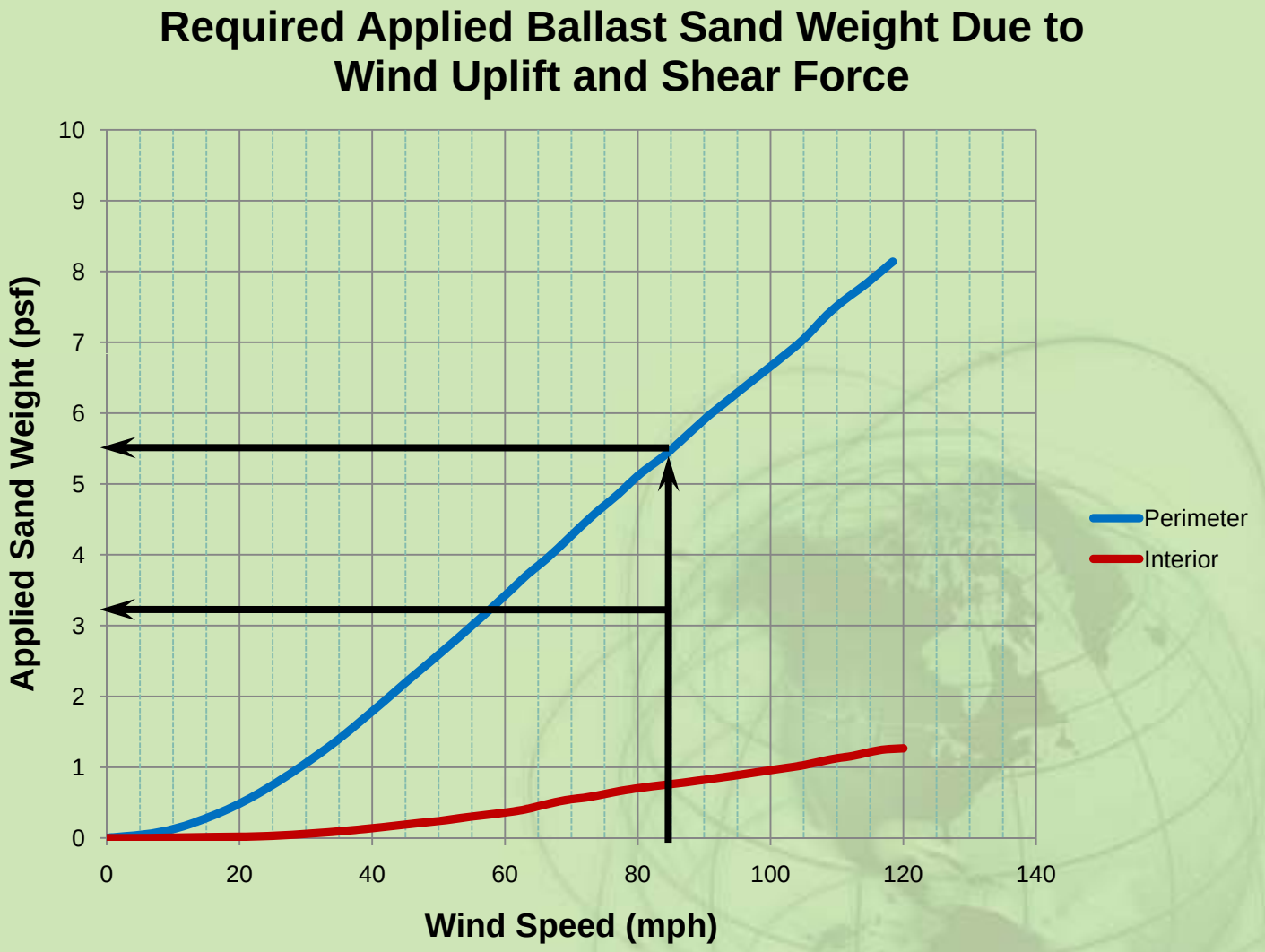
Crazy Horse Design Considerations

Wind Resistance Tested by Georgia Tech

Shear Force Governs. Continues to Increase.

Design Wind Speed for Pacific Coast = 85 MPH (ASCE-07)



$W_{sand} = \tau/\tan\phi_s \times 1.5 + P$ (with $\phi_s = 33°$)

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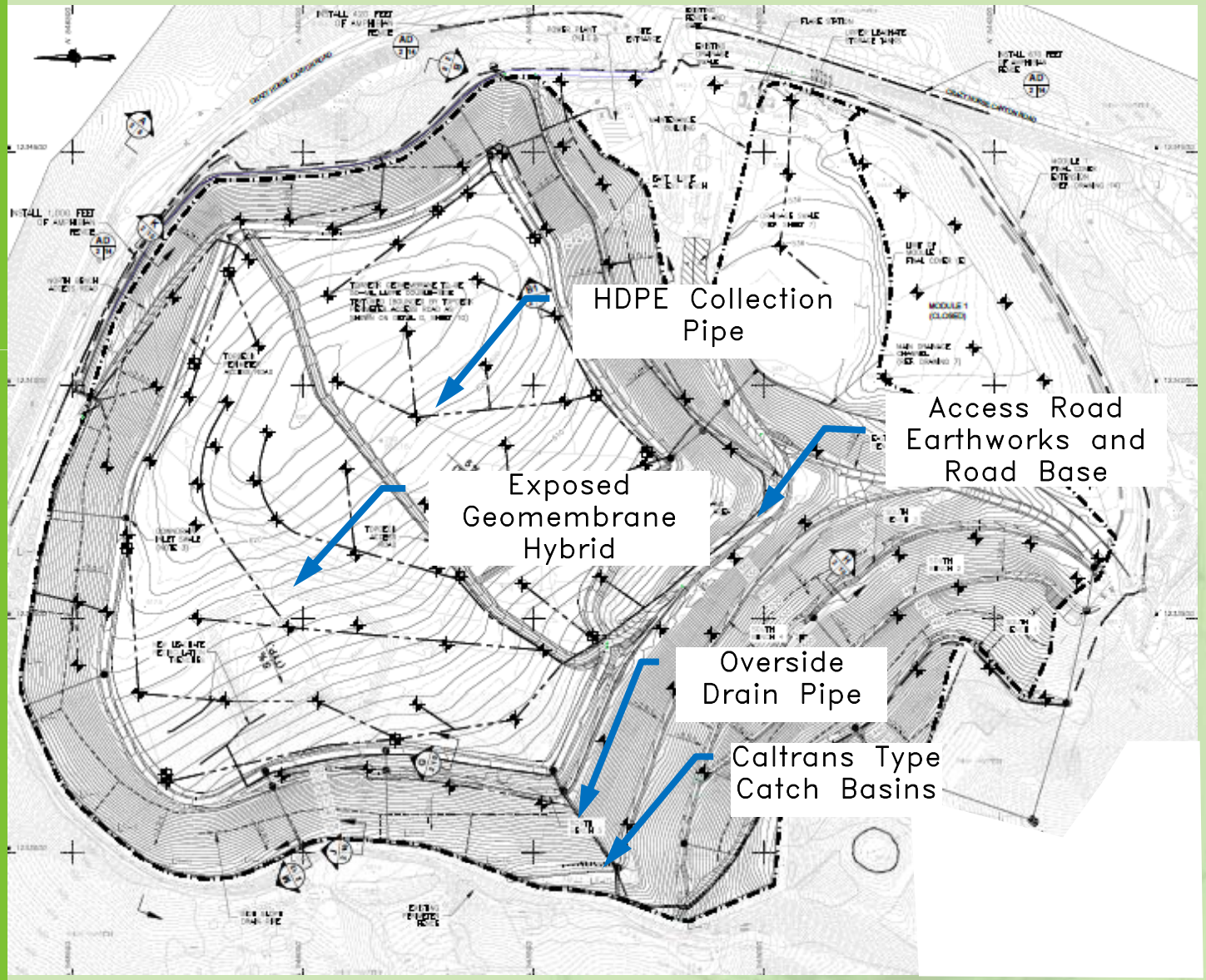
Final Closure Design Stage 3

Final Closure Plan Approved By:

Monterey County Dept. of Health (LEA)

Central Coast Regional Water Quality Control Board

Cal Recycle (formerly CIWMB)



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Final Closure Design Stage 3.1

Revised Project Elements

Exposed Geomembrane Hybrid

Combined with

Vegetative Cover Type Infrastructure?

First

Revised Drainage Infrastructure

Closure Turf product was tested for concentrated flow hydraulics (ASTM D 6460)

- Sand washed out at low shear values (0.6 psf)
- Cemented sand mix (3:1 sand:lime-cement) resisted hydraulic shear forces as high as 15 psf
- Calculated hydraulic shear at Crazy Horse <5.5 psf
- Cumulative cemented sand loss ~ 0.025 inches

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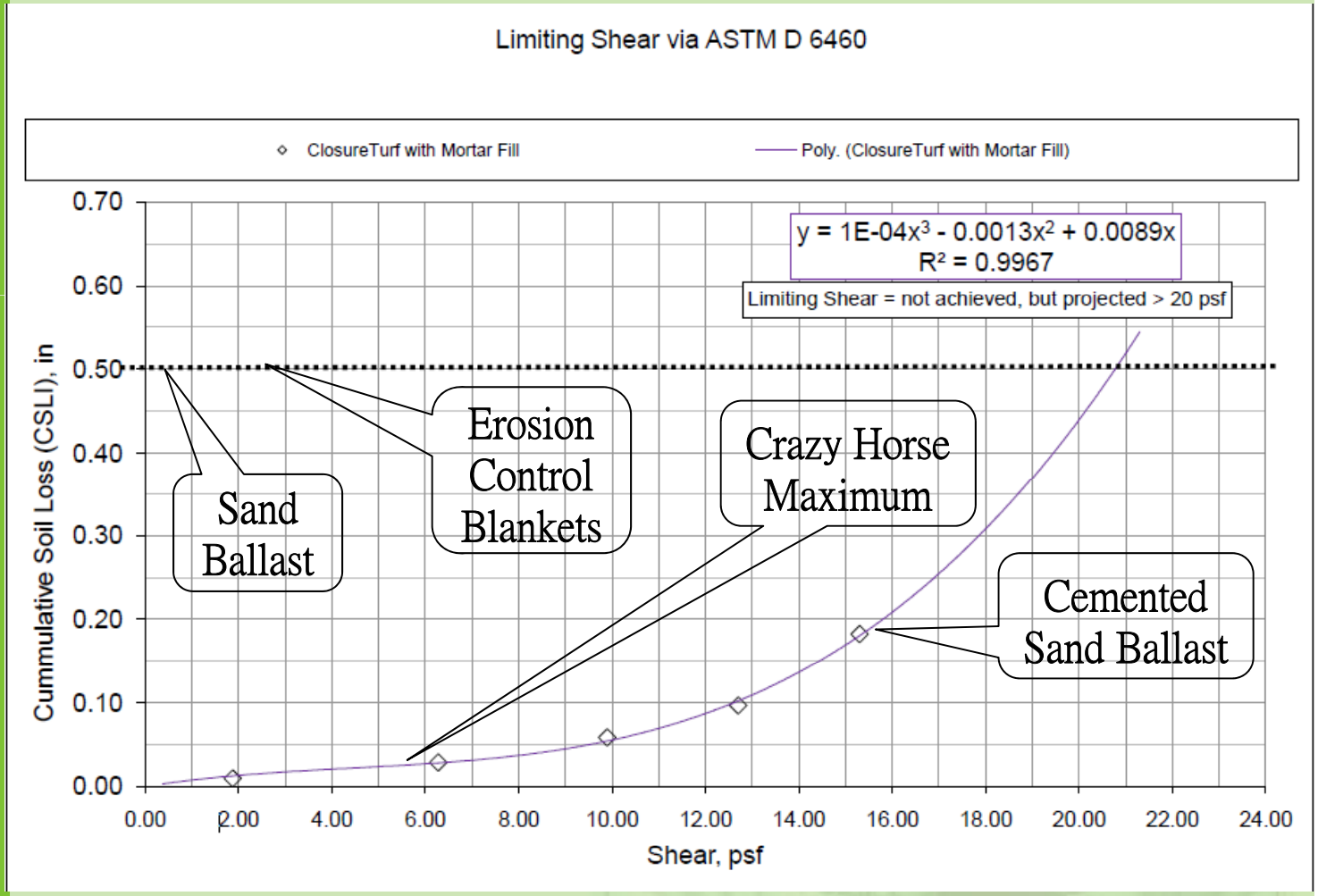
Final Closure Design Stage 3.1

Revised Project Elements

Drainage Infrastructure:

Replaced overside drain pipe with overside chutes

Hydraulic Shear Test Results



Source: TRI/Environmental Inc.

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Final Closure Design Stage 3.1

Revised Project Elements

Second

Exposed Geomembrane Hybrid as Travel Surface

Two Vehicle Scenarios

1. Maintenance Traffic (Pickup Trucks, ATVs)
2. Fire Department Water Tender

45 psi

GVWR = 12,000 lbs

120 psi

GVWR = 55,000 lbs

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Final Closure Design Stage 3.1

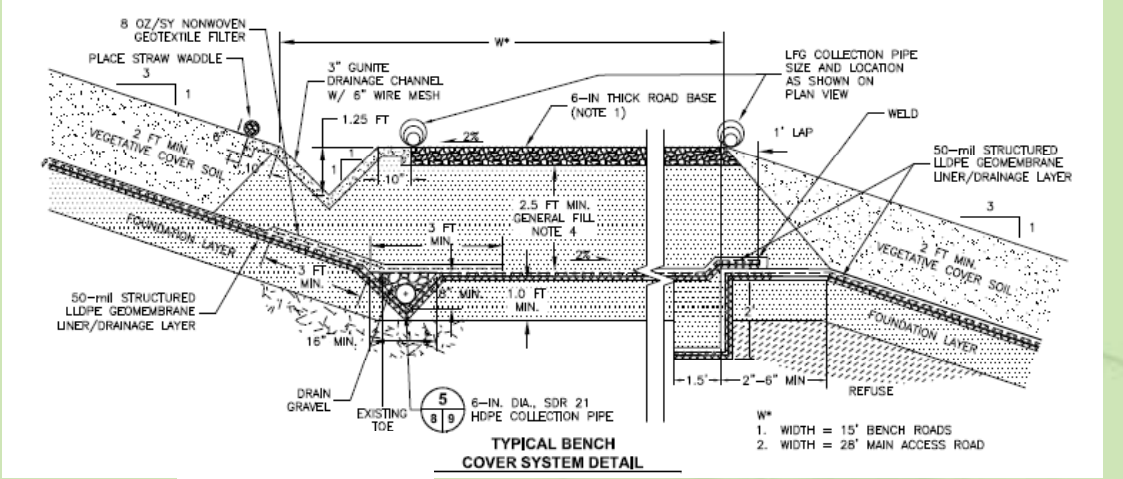
Revised Project Elements

Second

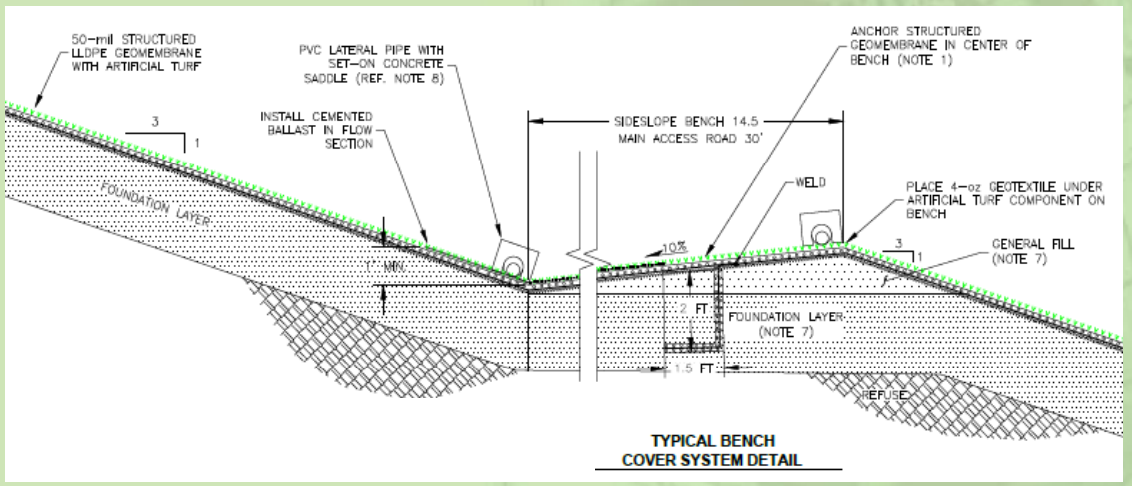
Exposed Geomembrane Hybrid as Travel Surface

Designed for Puncture, Tensile, and Braking Force

Previous roadway design of:



To:



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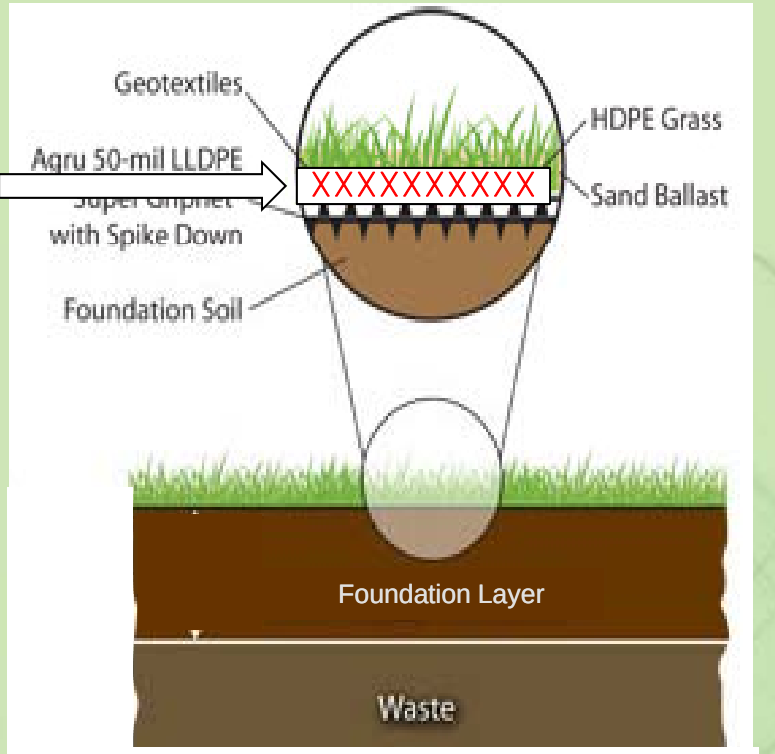
Geotextile Reinforcement - Traffic

Components

- 50-mil LLDPE structured geomembrane (AGRU's Supergripnet)
- Double layer woven PE geotextile
- Sewn HDPE artificial grass
- Coarse to medium sand ballast

- 4-oz Geotextile for Light Vehicle Roads
- 12-oz Geotextile for Fire Dist. Water Tender Roads

Add non-woven geotextile Reinforcement



Closure Turf Final Cover System

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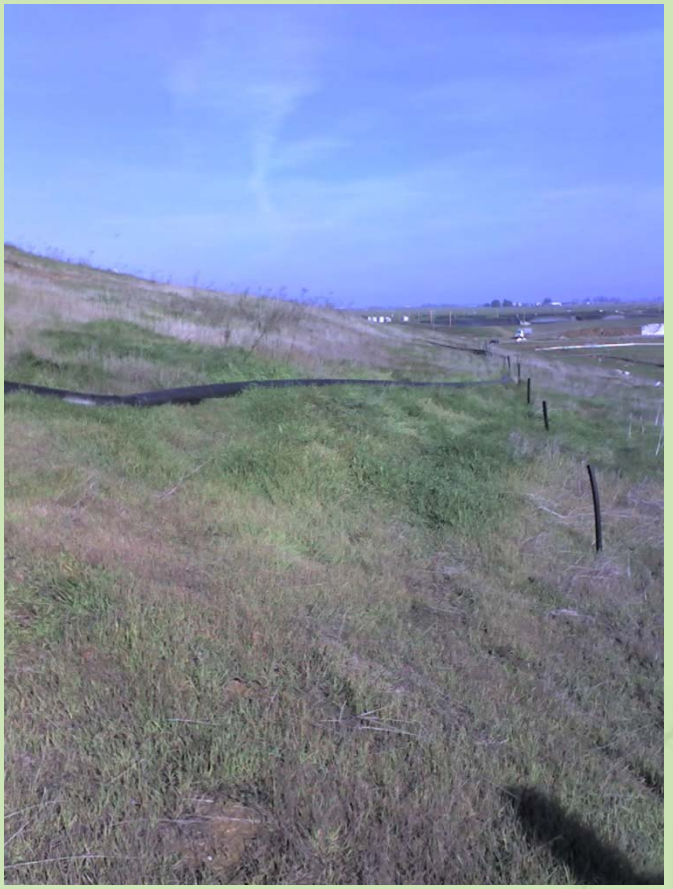
Final Closure Design Stage 3.1

Revised Project Elements

Third:

PVC Pipe on vs. HDPE Pipe



HDPE – Very Tough, but High Thermal Expansion

- Requires extensive anchoring

PVC Pipe – Lower Thermal Expansion

- Currently in Use
- Not UV Resistant - Requires Painting (and Repainting)

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Post Closure Maintenance

"Different" Postclosure Maintenance

Reduce with Proper CQA

Occurs Along Boundary. Get out the Roundup!

Reduce with Proper CQA

Sand Ballast Replacement

Poor Sand Placement = Turf Damage from….

Volunteer Vegetation

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Thank you

Questions?

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