2015 CEAM Spring Conference

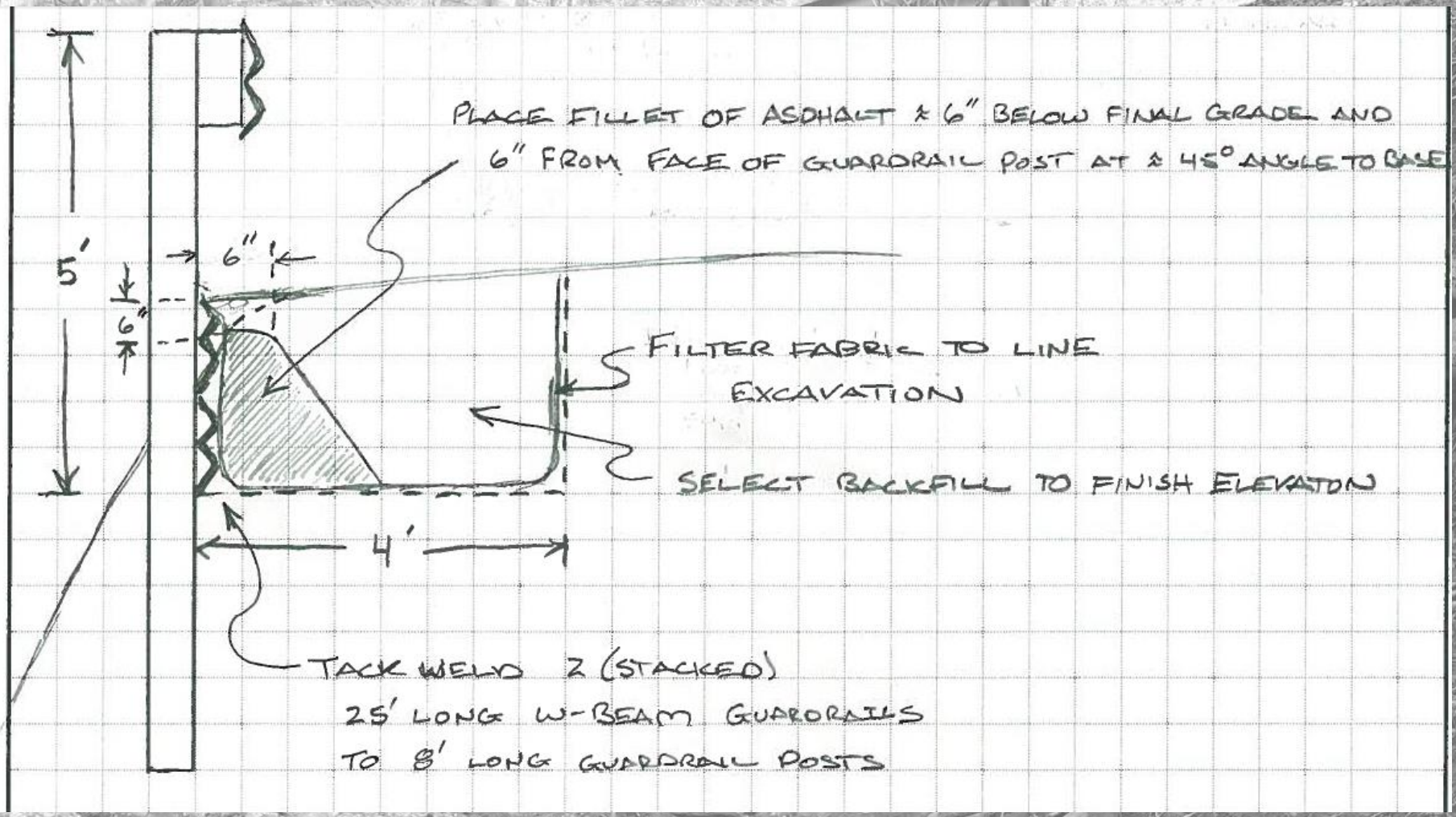
Slope Stability: Case Study using Soil Nailing

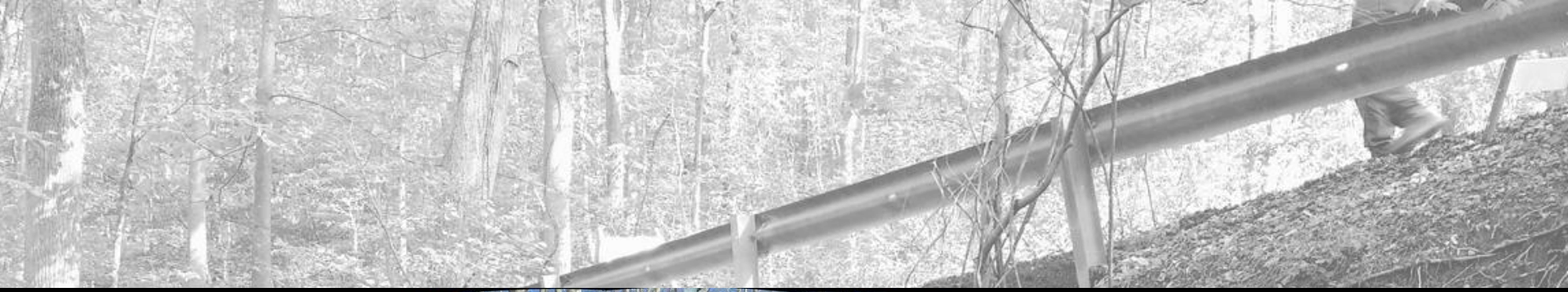
Jeff Stratmeyer


3 12:32PM

Options

- Redirect Surface Drainage
- Guardrail Upgrades
  - Relocation
  - Post Upgrades
  - Structural Support


PLACE FILLET OF ASPHALT ≈ 6" BELOW FINAL GRADE AND
6" FROM FACE OF GUARDRAIL POST AT ≈ 45° ANGLE TO BASE
5'
6"
6"
FILTER FABRIC TO LINE
EXCAVATION
SELECT BACKFILL TO FINISH ELEVATION
4'
TACK WELD 2 (STACKED)
25' LONG W-BEAM GUARDRAILS
TO 8' LONG GUARDRAIL POSTS



Options

- Redirect Surface Drainage
- Guardrail Upgrades
  - Relocation
  - Post Upgrades
  - Structural Support
- Class 2 Rip Rap / Gabion Baskets


20 12:30PM

Options

- Redirect Surface Drainage
- Guardrail Upgrades
  - Relocation
  - Post Upgrades
  - Structural Support
- Class 2 Rip Rap / Gabion Baskets
- Road Relocation


3863
GUANTI
STOP

Options

- Redirect Surface Drainage
- Guardrail Upgrades
  - Relocation
  - Post Upgrades
  - Structural Support
- Class 2 Rip Rap / Gabion Baskets
- Road Relocation
- Retaining Walls


23 2:34 PM


HITACHI
8 11:55AM


25 11:16AM


APR 2 2004

Options

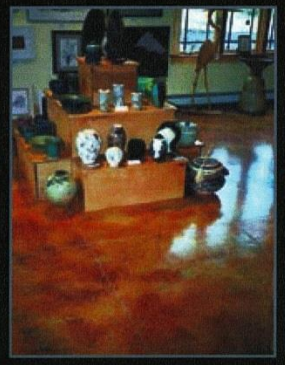
- Redirect Surface Drainage
- Guardrail Upgrades
  - Relocation
  - Post Upgrades
  - Structural Support
- Class 2 Rip Rap / Gabion Baskets
- Road Relocation
- Retaining Walls
- Soil Nails

CHEM-STONE™ Reactive Stain

CHEM-STONE™ Reactive Stain creates a mottled, uneven, translucent coloration effect on cementitious surfaces such as concrete overlays and conventional concrete. The natural, aged-looking coloring process is so authentic that the look rivals that of weathered stone, slate and marble.

Color is achieved when the combination of metallic salts and slightly acidic solution come in contact and react with the minerals in concrete. This color reaction results in a look so unique that it cannot be duplicated by other coloring methods.

Unlike paint, CHEM-STONE™ Reactive Stain is not a coating or film build resin. Therefore, the color becomes a permanent part of the surface which will not chip, flake or peel and only wears when the concrete surface wears.



For additional information visit us online at www.elitecrete.com

For Additional Information Please Contact:

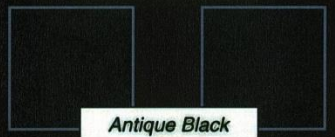
Color samples on this chart represent the color of the finish as closely as possible. Variations can be expected due substrate texture, ambient temperature, product thickness, clear coat and methods of application.

On White *On Grey*

Antique Tan

Antique Brown

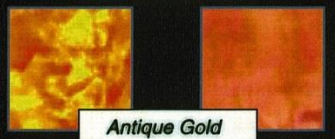
Antique Red



Antique Black

Antique Green

Antique Blue



Antique Gold

Antique Umber


Old Robinhood Road
Soil Nails Project
Condition following several severe
flooding events in the Fall of 2011


Original Condition – Post
Construction July, 2011


After several significant storms – August, 2011


After Hurricanes Irene and Lee - September, 2011


August 2012

SOIL NAILING

FOR

STREAM BANK STABILIZATION

Dan Svrjcek

TYPICAL REPAIR SITES

STREAM FLOW DAMAGE

- ROAD BUILT IN AND FOLLOWING FLOOD PLAIN
- MEANDER IN STREAM IS CLOSE TO ROAD
- STREAM-ROAD BANK IS STEEP
- PRIOR STORM DAMAGE WAS CUMULATIVE
- MAJOR STORM HITS
- UNDERCUT TREES AND STREAM BANKS FAIL

TYPICAL REPAIR SITES

STORM RUNOFF DAMAGE

- DAMAGE FROM TOP OF ROAD
- EROSION FROM ROAD RUNOFF
- OCCURS AT ROAD SUMP

KNPPR-S05 KNOPP ROAD

KNPPR-S05 KNOPP ROAD

KNPPR-S05 KNOPP ROAD

KNPPR-S05 KNOPP ROAD

REPAIR ALTERNATIVES

- EXTRA TRAFFIC BARRIER POSTS W/ RAIL WALL
- ROSGEN: ROOT WADS, ROCK VANES, PLANTINGS
- CLASS 2/3 RIP-RAP
- WALLS – CONCRETE, CRIB, GABION, IMBRICATED
- REINFORCED EARTH
- SHEET PILING W/ TIE-BACKS
- SOLDIER PILES W/ TIE-BACKS AND LAGGING
- SHORT WALL W/ CONCRETE SLAB “TIE-BACK”
- SOIL NAILS

WHAT IS SOIL NAILING?

- **HOLLOW STEEL RODS** DRIVEN INTO SOIL / ROCK
- DRIVEN BEYOND SLIP PLANE - ACTS AN ANCHOR
- **GROUT** PUMPED INTO ROD
- GROUT FLOWS INTO SPACE AROUND RODS
- ROD - EARTH SYSTEM ACTS AS MSE WALL
- **DRAINAGE SYSTEM** BETWEEN WALL AND EARTH
- **REINFORCED SHOTCRETE** FORMS THE WALL FACE
- **RIP- RAP** AT BASE PROVIDES SCOUR PROTECTION

SOIL NAIL WALL ENHANCEMENTS

VINE POCKETS

DYED CONCRETE

KNPPR-S05 KNOPP ROAD

Slope Stabilization Details

Knopp Road Slide 2

Harford County, MD

Harford County Public Works

Sheet Index

Sheet Revision		
Date		By

Cover Sheet	
Project: Knopp Road Slide 2	Drawn By: EDL
Date: October 13, 2014	Checked By: -

Project No./Code: —

Sheet No.: 1

GSI GeoStabilization International

GeoStabilization International
Corporate Address: PO Box 4769
Grand Junction, CO 81502
P: 970.216.6170
F: 970.245.7737
www.geostabilization.com

KNPPR-S05 KNOPP ROAD

Construction Sequence/Work Schedule:

- Herford County or its contractor will clear, excavate, haul off excavated material, and provide traffic control.
- GSI will provide and install the specified soil nails and surface treatment per the construction documents.

Size and Spacing of Nails:

- GSI will mark the locations of the proposed soil nails with survey marking paint.
- The Soil Nails will be injected with grout. The grout will be a Type I,II,or III Portland Cement. The water/cement ratio will be 0.50 to 0.60. No additional aggregate or admixtures will be added to the grout.

Facing and Drainage System:

- Drain strips will be provided and installed between the soil nails every 6-feet along the face of the excavation. The drain strips shall be placed with the geotextile side against the ground. Drain strips will be continuous and any splices shall be made with a one-foot minimum overlap such that the flow of water is not impeded. Drain strips shall extend beyond the face of the shotcrete at the downhill face.

Reinforcing Steel Placement:

- Welded wire mesh will be placed along the face of the excavation with a separation of approximately 2 inches between the wire mesh and the soil.
- No. 4 Rebar will be tied to the wire mesh. Vertical bars will extend for approximately 24 inches and the horizontal bars will be continuous (with overlap splices) in the shotcrete.

Bearing Plate Placement:

- 8" x 8" x 3/8" steel bearing plates will be placed over the nails and attached either with a hex nut or by welding to the nail to secure the wire mesh and rebar during shotcrete placement. If the soil nails extend beyond the hex nuts or welded plates, they will be trimmed using a gas powered demolition saw.

Shotcrete Application:

- Shotcrete will be placed from the lower part of the area upwards to prevent accumulation of rebound. The nozzle will be oriented a proper distance from and approximately perpendicular to the working face so that rebound will be minimal and compaction will be maximized. Care will be taken while encasing reinforcing steel and mesh to keep the front face of the reinforcement clean during placement operations, so that shotcrete builds up from behind, to encase the reinforcement and prevent voids or pockets from forming.

GSI Employee Certifications:

- ACI Shotcrete Nozzlemen Certification
- 10-hour Occupational Safety and Health Training Course in Construction Safety & Health
- American Red Cross Standard First Aid Training
- American Red Cross Bloodborne Pathogens Training: PDT
- Erosion Control Supervisor Training

House Keeping:

- The site will be organized and clear of any trash or debris. All trash will be placed in a proper container and removed at the end of each work day.

Safety:

- All safety plans for lifting, hearing, dust control, PPE etc. are in place and will be followed accordingly. PPE will include safety vest, steel toed shoes, hard hat, safety glasses, and gloves.

Shotcrete Mix Design:

Shotcrete shall comply with the requirements of ACI 506.2, "Specifications for Materials, Proportioning and Application of Shotcrete", except as otherwise specified. Shotcreting consists of applying one or more layers of concrete conveyed through a hose pneumatically projected at a high velocity against a prepared surface.

The wet-mix process consists of thoroughly mixing all the ingredients, introducing the mixture into the delivery equipment and delivering it, by positive displacement, to the nozzle. Air jet the wet-mix shotcrete from the nozzle at high velocity onto the surface.

Material	Weight per Cubic Yard
¾" Rock	850 lbs
Sand	1800 lbs
Cement	750 lbs
Water	300 lbs
Fly Ash	150 lbs
Air Entrainment	6% (1.6 cubic feet)

0.40 to 0.50 water/cement ratio

Grout Mix Design:

Water/Cement Ratio= 0.5 to 0.6

(Batch Weight Per Cubic Yard)

Material	Weight	Volume	
Cement	2063 to 1837 lbs	10.4 to 9.3 Cubic Feet	22 to 19.5 bags (94#)
Water	1031.5 to 1102 lbs	16.6 to 17.7 Cubic Feet	123.5 to 132 gallons
Total		1 Cubic Yard	

(Per 94# Bag of Cement)

Material	Weight	Volume	
Cement	94 lbs	0.48 Cubic Feet	1 bag (94#)
Water	47 to 56.4 lbs	0.8 to 0.9 Cubic Feet	5.6 to 6.8 gallons

Sheet Revision

Date:		By:

General Notes

Project: Knopp Road Slide 2	Drawn By: EDL
Date: October 13, 2014	Checked By: -

Project No./Code: —

Sheet No.: 2

GSI GeoStabilization International

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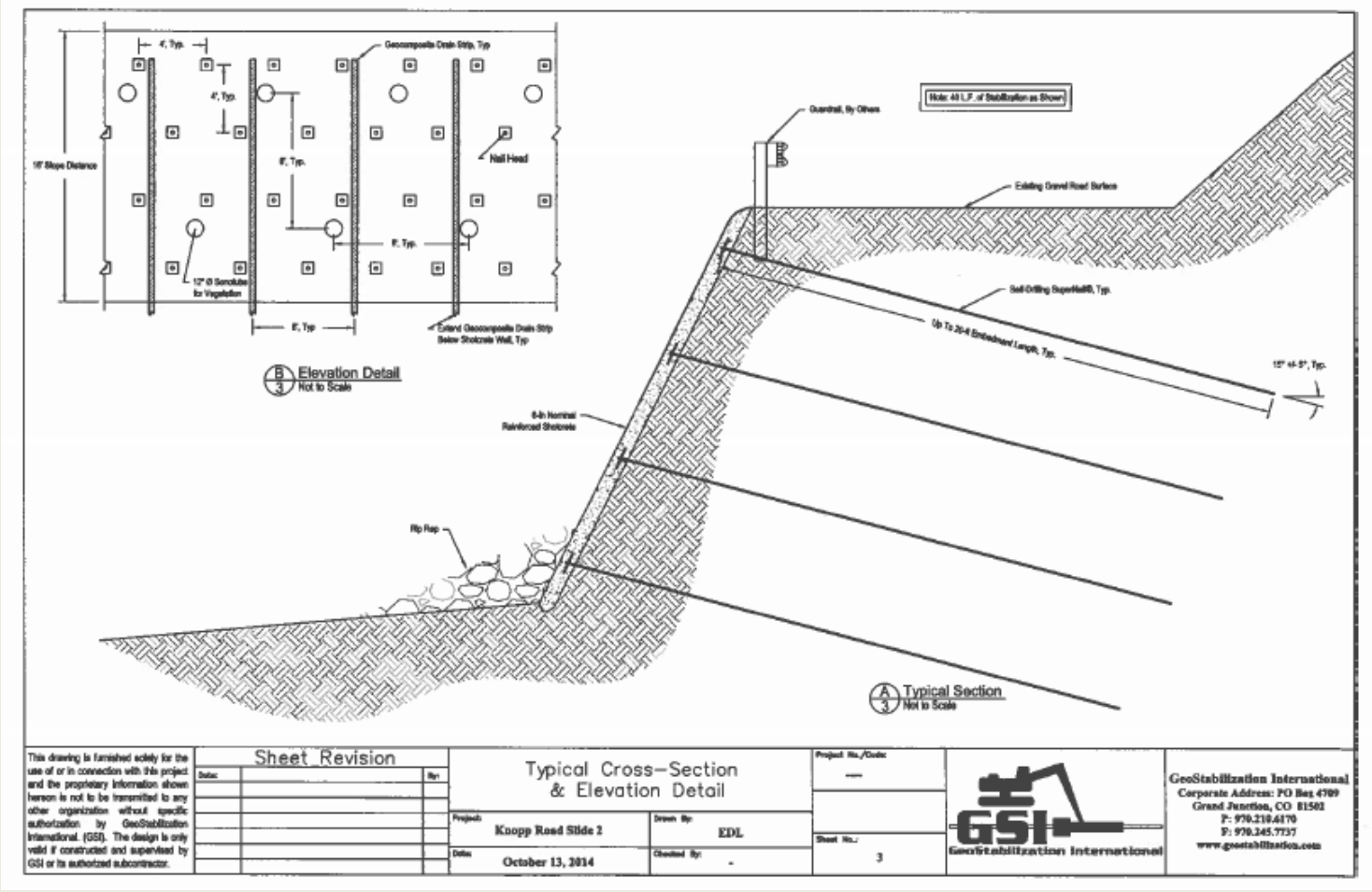
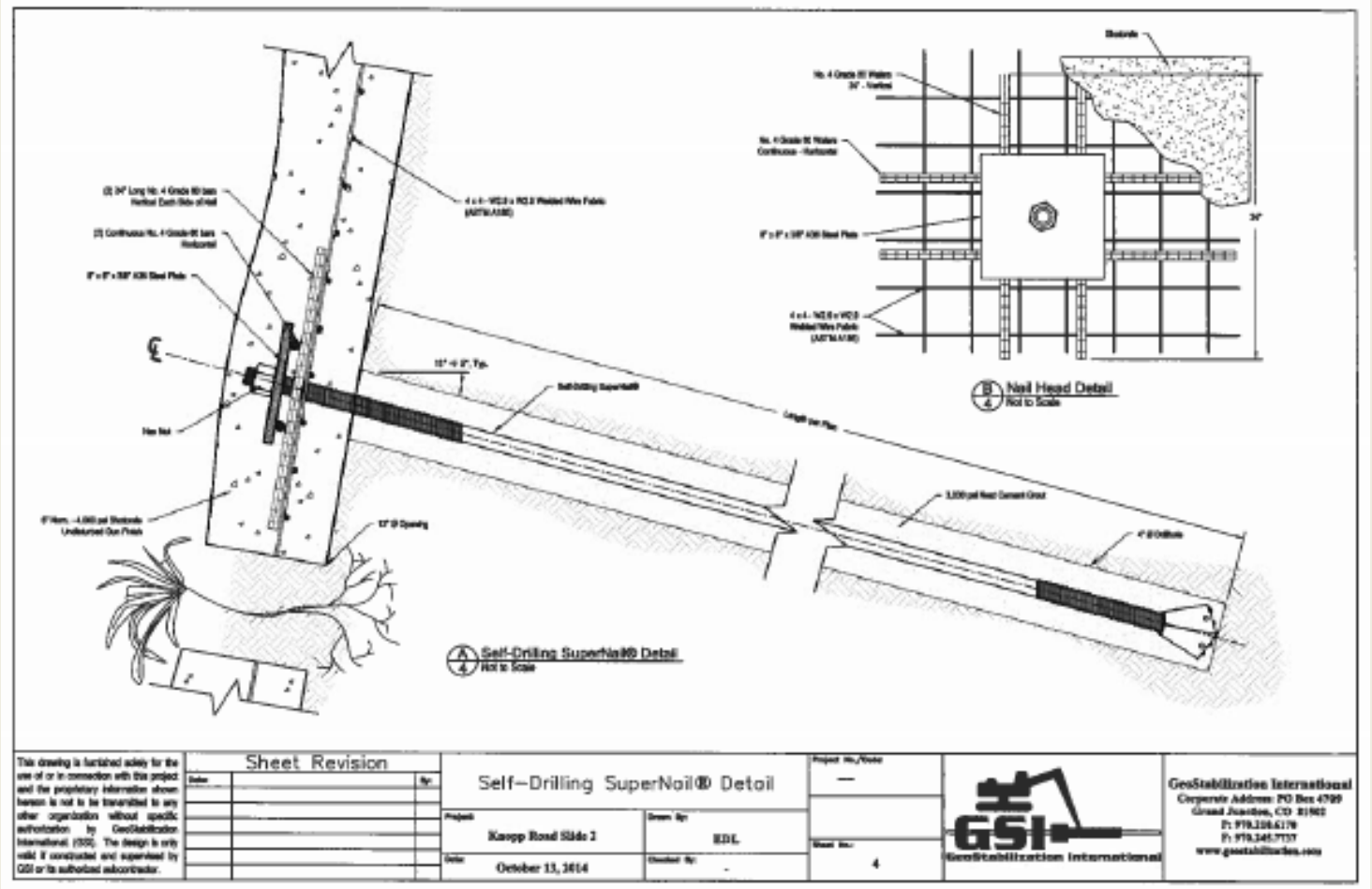
KNPPR-S05 KNOPP ROAD



KNPPR-S05 KNOPP ROAD



KNPPR-S05 KNOPP ROAD

COST PROPOSALS

KNOPP ROAD	$54,880
GLENVILLE 1	$51,584
GLENVILLE 2	$48,384
TOTAL	$154,848

PERMITS & AUTHORIZATIONS

- MDE / USACE PERMITS
  - UNDER 5000 SF
- PROPERTY OWNER EASEMENTS
- ROCKS STATE PARK RIGHT-OF-ENTRY
- MARYLAND HISTORICAL TRUST
- DEER CREEK WILD AND SCENIC RIVER COMMISSION

KNPPR-05 KNOPP ROAD REPAIR

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GLENVILLE ROAD – SLIDE 1

GLENVILLE ROAD – SLIDE 1

GLENVILLE ROAD – SLIDE 1

GLENVILLE ROAD – SLIDE 1

GLENVILLE ROAD – SLIDE 1

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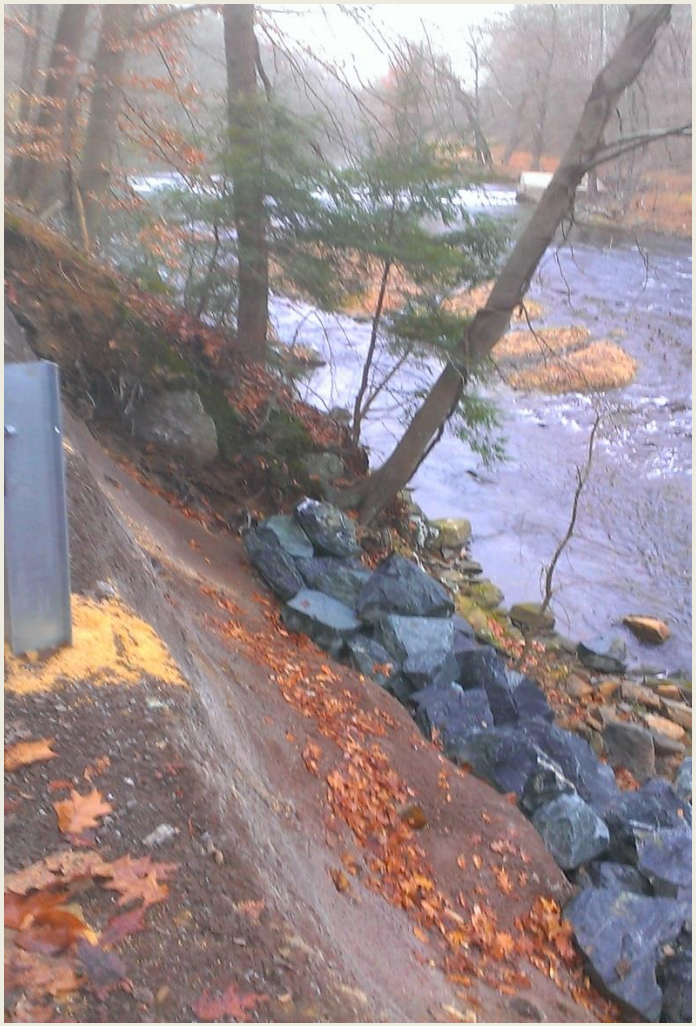

GLENVILLE ROAD – SLIDE 2

KNPPR-S05 KNOPP ROAD REPAIR

FINAL COST

KNOPP ROAD	$51,600	
GLENVILLE 1	$49,084	
GLENVILLE 2	$48,884	
TOTAL	$149,568	
DIFFERENCE	$5,280	LESS

TIMELINE

- 4/28/14 KNOPP ROAD STORM DAMAGE
- 5/13/14 MEET WITH GSI
- 5/19/14 MDE PERMIT APPLICATION
- 6/25/14 MET WITH CAMP WOMETO – NOT THEIR PROPERTY
- 6/26/14 KNOPP ROAD SITE – VERIFIED PARK ISSUE
  GLENVILLE SITES – SENT OUT EASEMENT REQUESTS
- 6/27/14 MEET WITH MDE/ CORPS IN FIELD – USE VINE POCKETS
  GLENVILLE SITES – EASEMENT REQUESTS GRANTED
- 8/1/14 GLENVILLE – HISTORICAL ISSUE – EASEMENT VOID
  MHT – DENIES USE OF SOIL NAILS
- 8/19/14 RESPONSE TO MHT COMMENTS
- 8/27/14 MHT APPROVES SOIL NAIL WALL
- 9/10/14 GSI SUBMITS PLANS
- 9/11/14 2 WEEKS ROAD CLOSURE NOTICE SENT OUT
- 9/17/14 REQUEST SENT TO GET PROJECT PLACED ON BOE AGENDA
- 9/22/14 KNOPP ROAD – PARK RIGHT-OF –ENTRY EXECUTED
- 9/25/14 BOE APPROVED PROJECT –$154,848
- 9/26/14 KNOPP ROAD – RIP-RAP PLACED

- 11/

TIMELINE

- 10/1/14 STREAM CLOSURE DATE
- 10/3/14 MINOR PLAN COMMENTS RETURNED TO GSI
- 10/7/14 MDE APPROVAL – GLENVILLE & kNOPP
- 10/20/14 WORK TO DYE CONCRETE
- 11/3/14 KNOPP ROAD - START
  HIGHWAYS REMOVED EXCESS RIP-RAP, AND
  GRADED THE SLOPE FOR GSI
  GSI DRILLED THE NAILS , PLACED WIRE MESH AND GUNITED THE SLOPE
  USED CURING COMPOUND NO NEED TO COVER
- 11/10/14 GLENVILLE ROAD – START – VERY COLD WEATHER
- 11/12/14 GUNITE WORK – SLIDE 1
- 11/17/14 2 TREES REMOVED FROM SLIDE 2
- 11/20/14 GUNITE WORK – SLIDE 2
- 11/20/14 COLD WEATHER GUNITE CURING
- 11/26/14 GLENVILLE ROAD – OPEN TO TRAFFIC
  WEDNESDAY BEFORE THANKSGIVIING

Thank you

&

Questions