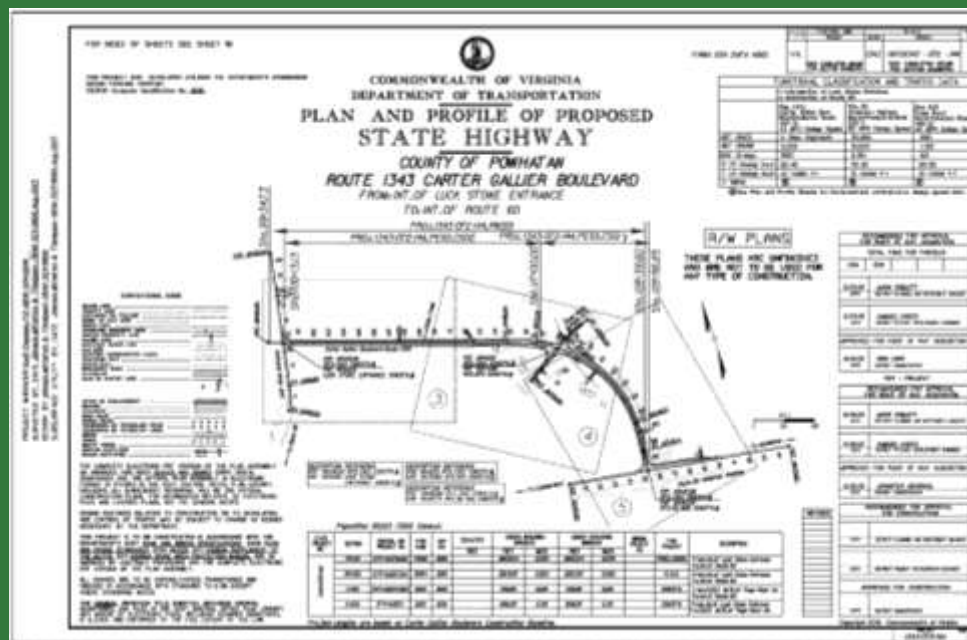


# A MULTIPLE-LINES OF EVIDENCE APPROACH & MEDIA REUSE GUIDANCE TO EVALUATE TPH & CADMIUM IMPACTED SOIL IN A PROPOSED VDOT ROADWAY IMPROVEMENT CORRIDOR



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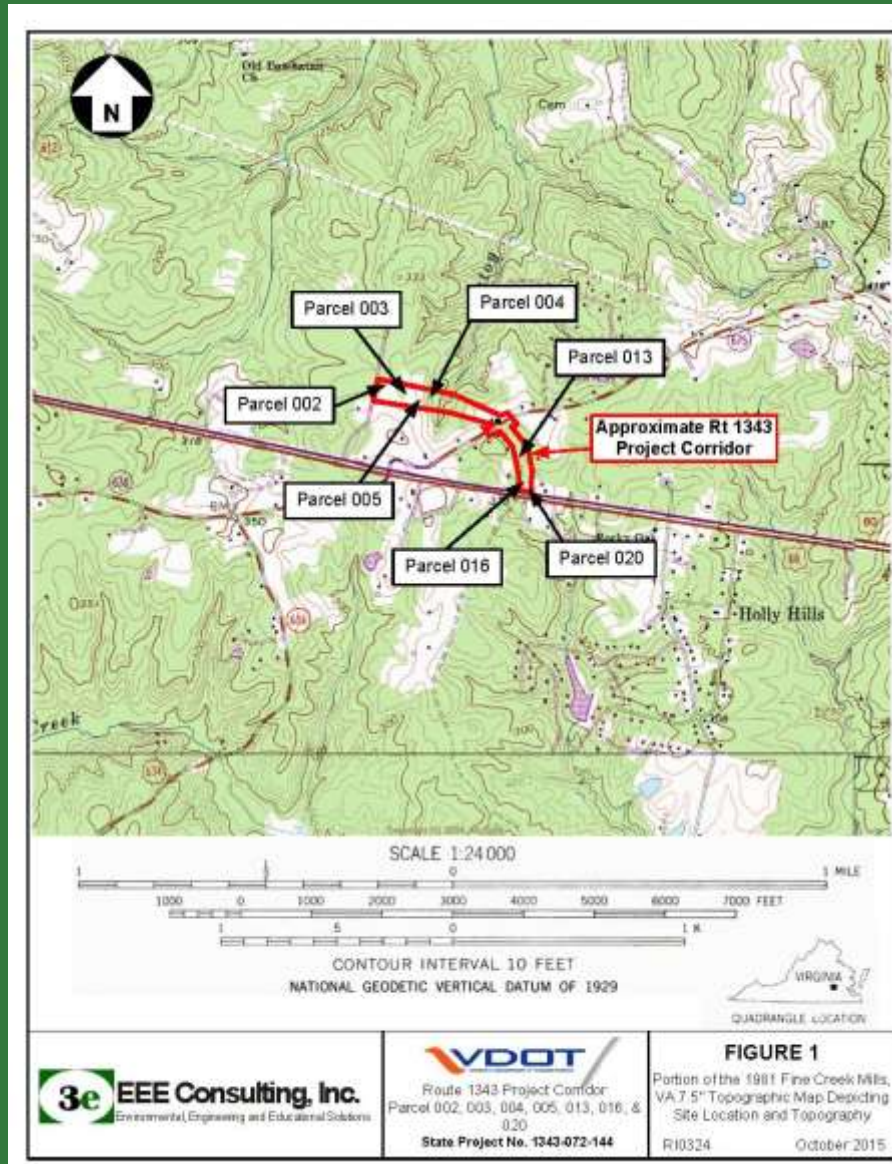
# Corridor Overview

- ❖ Approximate 0.5-mile new roadway alignment in Powhatan County, Virginia.
- ❖ New Rt. 1343 alignment to connect State Route 60 to Luck Stone Road.
- ❖ Total Project Valued at ~\$6 million.
- ❖ Land use – Industrial, Commercial, & Residential
- ❖ Right-of-Way acquisition necessary for the proposed roadway and drainage improvements.

# Project Overview

- ❖ Phase I Corridor Study Completed to identify RECs and/or Environmental Considerations.
- ❖ Phase II Investigation to assess the potential for adverse affects to proposed R/W acquisition and soil disturbance areas from identified RECs.
- ❖ Soil management considerations & recommendations based on concentrations detected in soil samples and applicable regulations/guidance.

# Roadway Corridor Limits



# Phase I – Identified REC's

- ❖ Steel Fabrication Facility (Parcel 002) – improper waste & bulk chemical/solvent storage.
- ❖ Two properties (Parcels 002 & 003) - reportedly received large volumes of fill material from a circa 1960 roadway improvement project.
- ❖ Residence (Parcel 009) – No. 2 fuel oil UST.
- ❖ Construction Company (Parcel 016) – Diesel Fuel & Used Oil ASTs w/underground supply/return piping. Fill/solid waste piles on-site from various construction projects.
- ❖ REC's located in or adjacent to proposed R/W acquisition areas.

# REC Photographs



ASTs - Parcel 016



ASTs - Parcel 016



Steel Fabrication -  
Parcel 002



Drums - Parcel 002



# Phase II Investigation Methods

- ❖ 16 direct push borings to collect representative soil samples from six parcels.
  - Advanced in proposed R/W and/or disturbance areas.
  - Sample parameters based on proximate RECs.
  - Sample collection depths based on proposed construction elevations (i.e. 0-12-ft BGS).
  - Analyzed for TPH-GRO, DRO, ORO, VOCs and total RCRA 8 metals.
    - 30 samples for TPH ranges: GRO, DRO, or ORO.
    - 30 samples for total RCRA 8 metals.
    - 4 samples for VOCs (Parcel 004 only); proximate to outdoor paint area at Parcel 002.

# RECs & Phase II Boring Locations





# Phase II Investigation Results

- ❖ Residual-Phase TPH concentrations
  - Concentrations detected in excess of laboratory reporting limit (i.e. 10-mg/kg) in 9 samples.
  - TPH-ORO concentrations in 8 of the 9 samples at Parcels 003 and 016 were < 50-mg/kg.
  - TPH-DRO & ORO concentrations at Parcel 013 > 50-mg/kg.
  - Parcel 013 – only sample that contained field evidence of petroleum impact.
- ❖ Total Cadmium Concentrations
  - Total concentrations detected in 26 samples, which ranged from 0.281-2.31-mg/kg.
  - 14 samples from Parcels 003, 004, & 016 contained concentrations greater than 1.0-mg/kg.

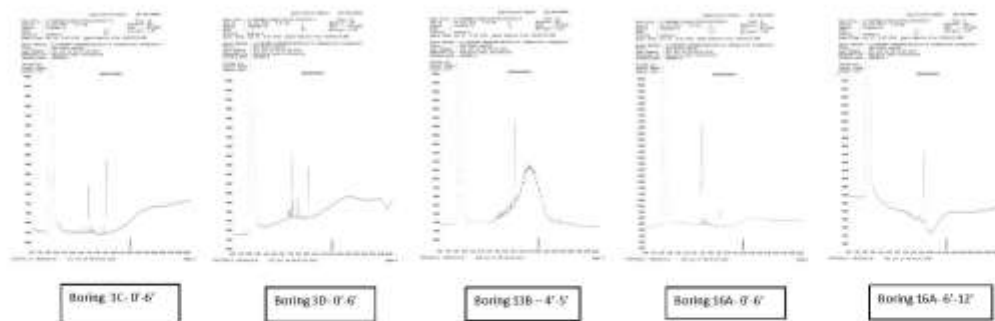
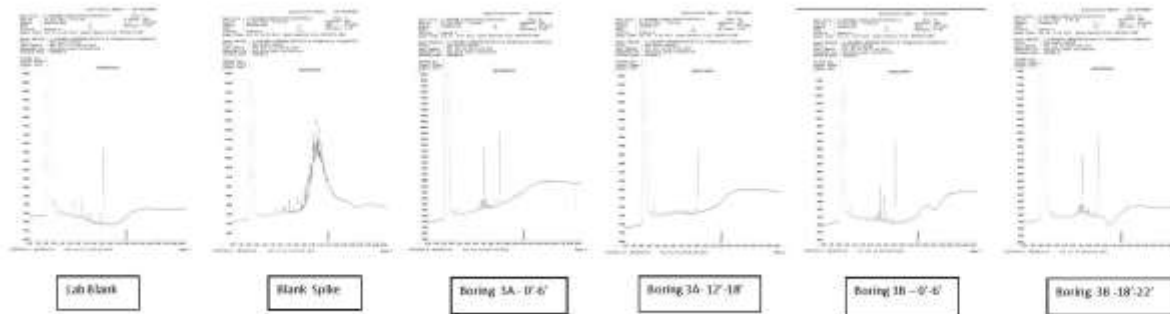
# Phase II Data Interpretation

- ❖ Residual-Phase TPH concentrations
  - Detected concentrations compared to the Virginia Solid Waste Management (VSWMR) TPH fill material limit of 50-mg/kg.
  
- ❖ Total Cadmium Concentrations
  - Detected concentrations compared to the background concentration of 1.0-mg/kg in Eastern U.S. soil as established by the EPA in the Ecological Soil Screening Levels for Cadmium (EPA, 2005).
  - Piedmont Physiographic Province of VA Draft Metals Background Study.
    - Draft values reviewed for comparison to detect concentrations.
    - Mean cadmium concentration of 1.091-mg/kg.
    - Upper prediction limit at the 95-% confidence interval of 3.52-mg/kg.

# TPH Soil Management Considerations

- ❖ Fill proposed in construction limits at Parcel 013. Plan changes requiring excavation - require soil management as a non-hazardous petroleum waste stream.
- ❖ Multiple lines of evidence indicated that the concentrations detected at Parcels 003 & 016 were non-petroleum based:
  - Chromatograms of detected ORO concentrations did not match the chromatogram of the laboratory spike (i.e. known concentration of oil-based petroleum).
  - Detected concentrations were not proximate to an identified petroleum-based REC.
  - TPH analytical methods subject to false positives from non-petroleum organics that elute in the specified retention time.

# Blank, Spike, & ORO Chromatograms



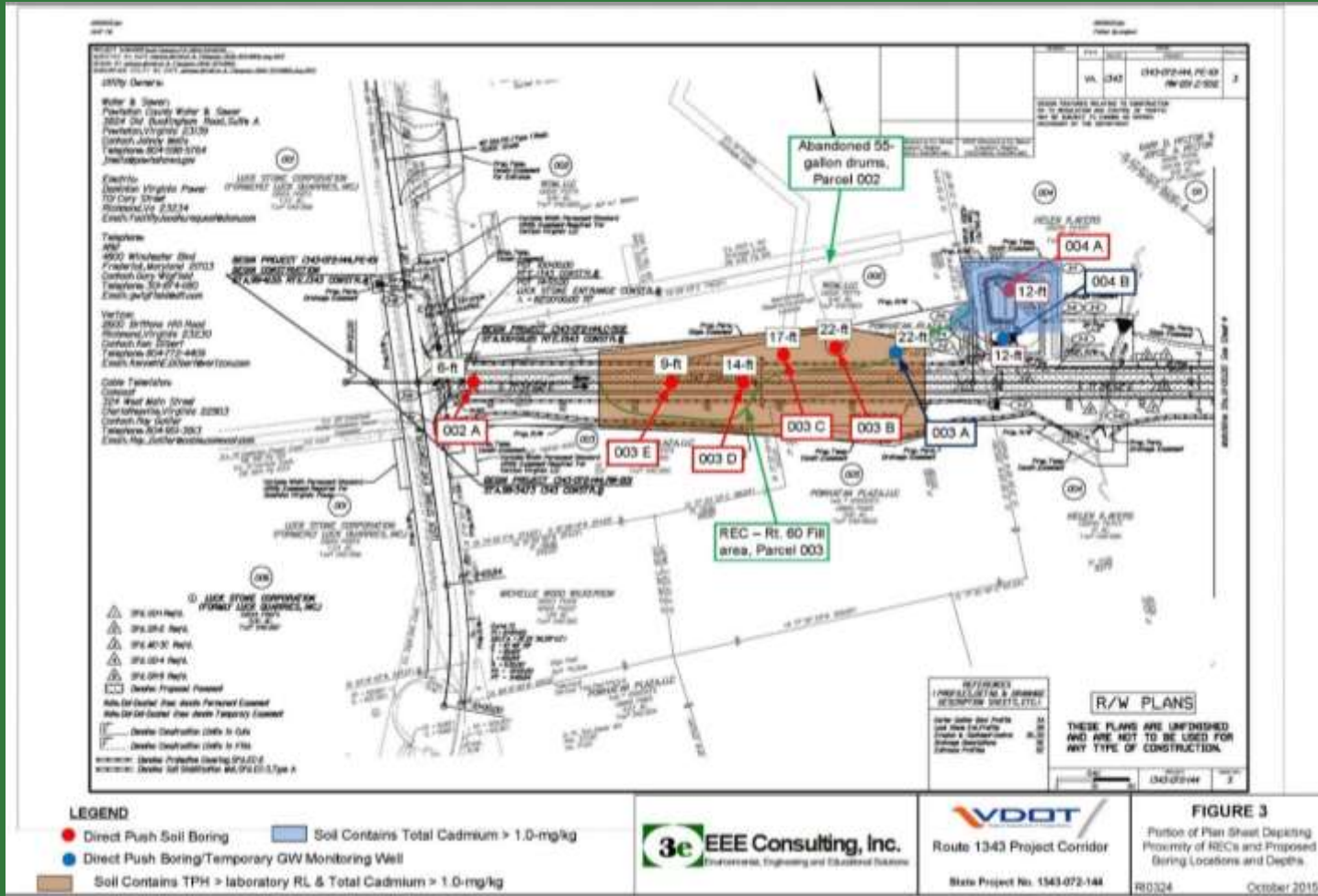
# Cadmium Soil Management Considerations

- ❖ Soil cuts proposed across large areas of Parcels 002, 003, and 016 that contained cadmium concentrations  $> 1.0\text{-mg/kg}$
- ❖ Total volume of soil that required removal was  $\sim 11,000$  tons.
- ❖ Cost to manage, transport, and dispose of this soil as a solid waste was estimated at  $\sim \$500,000$ .
- ❖ Cost to secure and transport borrow was  $\sim \$500,000$ .
- ❖ Total cost to project estimated at  $\sim \$1$  million.

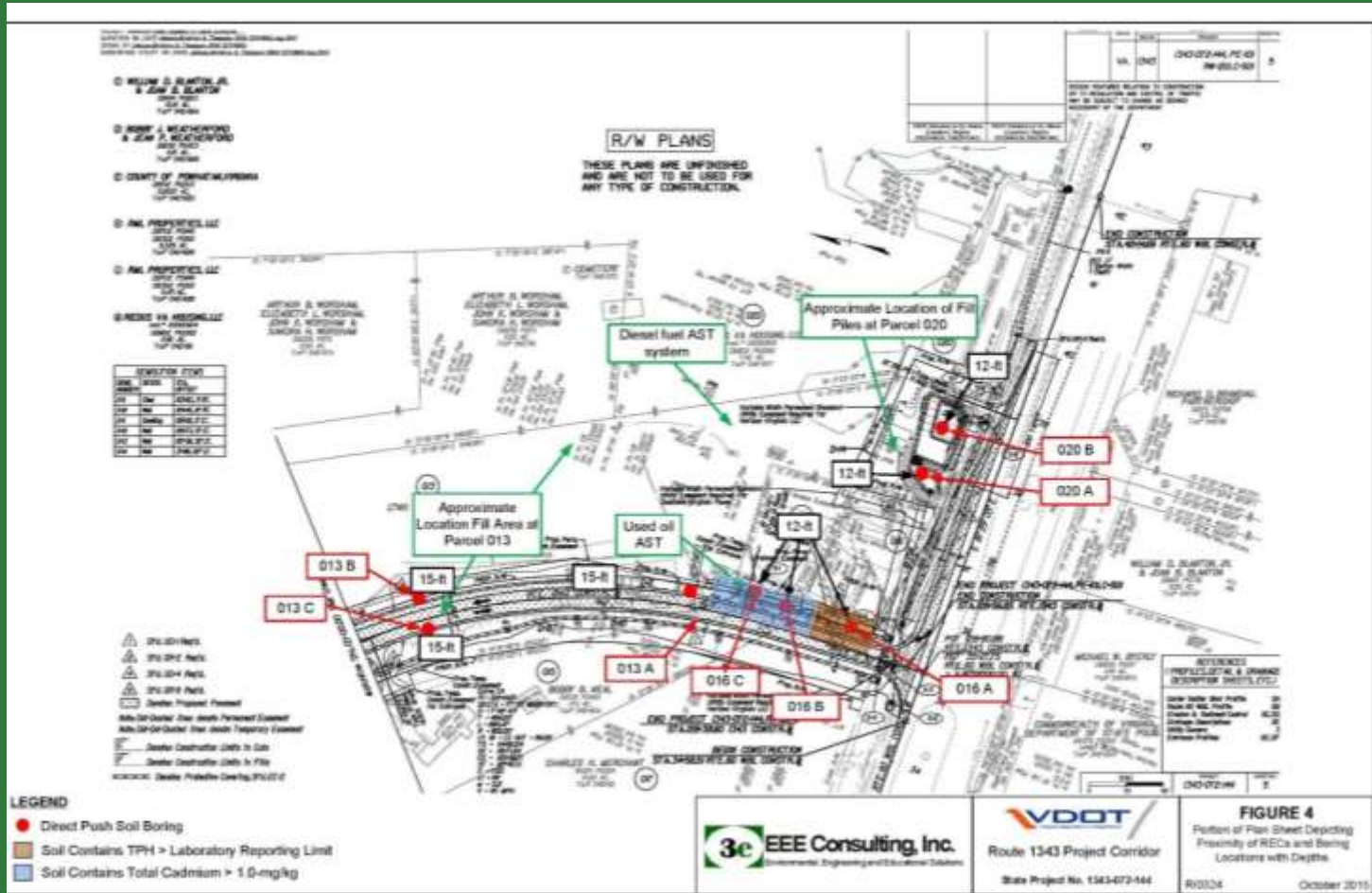
# Corridor Plan View & Cross Section



# Parcels 002, 003, & 004



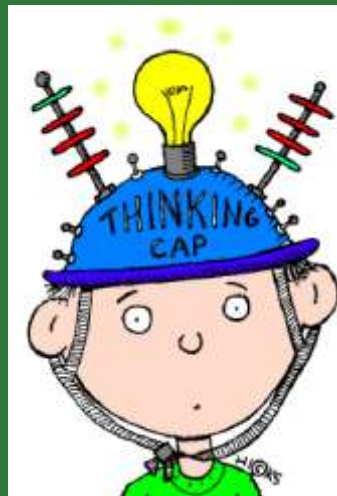
# Parcel 016





# Soil Management Options

- ❖ Multiple lines of evidence indicated that TPH concentrations in the proposed disturbance areas were not petroleum-based. Manage as non-impacted waste stream.
- ❖ Cadmium concentrations associated w/RECs or background concentrations based on local/regional geology?
- ❖ Manage soil w/cadmium in excess of 1-mg/kg as solid waste stream?



# Natural Mineralogy & Cadmium Concentrations

- ❖ Closure examination of the project geology indicated that detected cadmium were likely naturally-occurring.
  - Corridor straddles the western margin of the Richmond Triassic basin and the adjoining Hylas zone.
  - Rocks of the Hylas zone (Maidens gneiss/granitic pegmatites) & black shales of Triassic basin contain elevated cadmium concentrations.
  - Samples recovered west of the project site in test boreholes in Maidens gneiss contained cadmium concentrations of up to 16-mg/kg (Krasen et. al, 1988)

# Additional Evidence Supporting Naturally-Occurring Cadmium

- ❖ Cadmium concentrations were not confined to a specific horizon/soil profile (i.e. randomly distributed at depth).
- ❖ Mean concentration (n=26) of 1.11-mg/kg is consistent with Piedmont Study mean concentration of 1.091-mg/kg.
- ❖ All detected concentrations below the 95-percent upper prediction limit of 3.52-mg/kg.

# Selected Cadmium Management Option

- ❖ VDOT evaluated the data in accordance with the criteria set forth in the DEQ-State-Wide Variance Guidance for the Management & Reuse of Contaminated Media.
- Detected concentrations Met Beneficial Fill Groundwater Protection, Residential, and Industrial Screening Levels (SSLs).
  - Exceed Ecological SSL of 0.36-mg/kg:
    1. Not placed in or adjacent to ecologically sensitive environments (i.e. karst, 25-year flood plain, T&E species, surface waters).
    2. 200-ft set-back requirement to any wells, springs, or surface water providing potable source of drinking water.
- ❖ VDOT will reuse the soil in the project area.

# Project Benefits & Take Aways

- ❖ Cost savings of approximately \$1 million. Converse, a potential project “killer”.
- ❖ Avoided potential costs associated with redesign.
- ❖ Conservation of landfill space by using applicable guidance to evaluate and manage the soil in the project area.
- ❖ Carbon footprint reduction by not having to transport large volumes of soil for disposal and the resulting borrow material.

# References

EPA 2005, *Ecological Screening Levels for Cadmium*, U.S. Environmental Protection Agency.

Krasen, J., Johnson, S.S., Finley, P.D, Marr, Jr., J.D, 1988, *Geochemistry and Radioactivity in the Powhatan Area, Virginia*: Virginia Division of Mineral Resources, Publication 78.

Virginia Department of Environmental Quality, Background Metals Project, Draft August 23, 2012, Fact Sheet – Permit No. VAR05, General VPDES Permit for Industrial Activity Stormwater Discharges.

DEQ, 2012, *Solid Waste Guidance Memo No. LPR-SW-04-2012 – Management and Reuse of Contaminated Media*, Virginia Department of Environmental Quality.

# QUESTIONS?



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