Planning, Construction, and Operation & Maintenance of Dermal Contact Exposure Barriers

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Today’s Presenter

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Adam Patton:

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Topics of Discussion

Dermal Contact Exposure Barriers Defined

DC Exposure Barrier Investigation, Planning, and Construction

Maintenance & Record Keeping for DC Exposure Barriers

Dermal Contact Exposure Barriers

What Are They

Barriers constructed of non-contaminated materials that physically separate a potential receptor from contacting underlying contaminated soils.

- Designed based on the actual use/occupancy of the property;
- Designed to last and be protective for as long as the contaminated soils remain in-place;
- Designed to be operated and maintained;

Dermal Contact Exposure Barriers

Why Are They Useful

Under Michigan's Part 201 program, *they are commonly employed to prevent dermal contact exposures to soil contamination exceeding the applicable Direct Contact criteria.*

However, they are also similarly employed under various other scenarios including releases associated with solid and hazardous waste (Corrective Action) and PCBs (TSCA).

Those scenarios are not the subject of today's discussion, but if you have a situation where multiple regulatory programs apply, be aware that different programs may have significantly different requirements for dermal contact exposure barriers.

Dermal Contact Exposure Barriers

Types of Barriers

These barriers fit within two broad categories:

Structural and Non-Structural Barriers

- **Structural Barriers**

  Constructed of durable materials whereby the inherent strength of the material is relied upon as a barrier to contact with underlying contaminated soil;

Dermal Contact Exposure Barriers

Structural Barriers – Examples

- **Structural Barriers**
  - Concrete building slabs;
  - Concrete or asphalt pavement;
    - Sidewalks;
    - Parking lots;
    - Driveways;
    - Roadways;
    - Many Others;
  - Permanently Lined Ponds;
    - Must have protective surface cover;
      - Stone, vegetated soil, etc.

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Structural Barriers – Considerations

- There is no prescribed thickness for structural barriers;
  - In practice, they will commonly have a thickness of four-inches or greater;
- It may be appropriate in some scenarios for structural barriers to be thinner (asphalt walking path), with many, many scenarios calling for much greater thicknesses;
- Regardless of the structural barrier type and thickness, these barriers must be designed and constructed in a way that they can be maintained to preserve their function;

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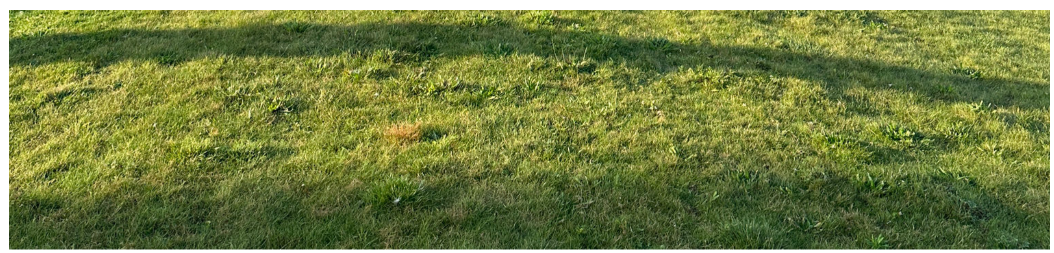
Non-Structural Barriers - Description

- **Non-Structural Barriers**

  Those constructed of non-contaminated soil or other non-contaminated media of the appropriate thickness that are underlain by a demarcation barrier and stabilized to prevent erosion.



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Non-Structural Barriers – Examples

- **Non-Structural Barriers**
  - Clean vegetated soil;
    - Topsoil (ex: lawn);
    - Layered soils (combinations of clay, sand, or organic soils);
  - Gravel or stone (ex: walking trail);
  - Other potential options;

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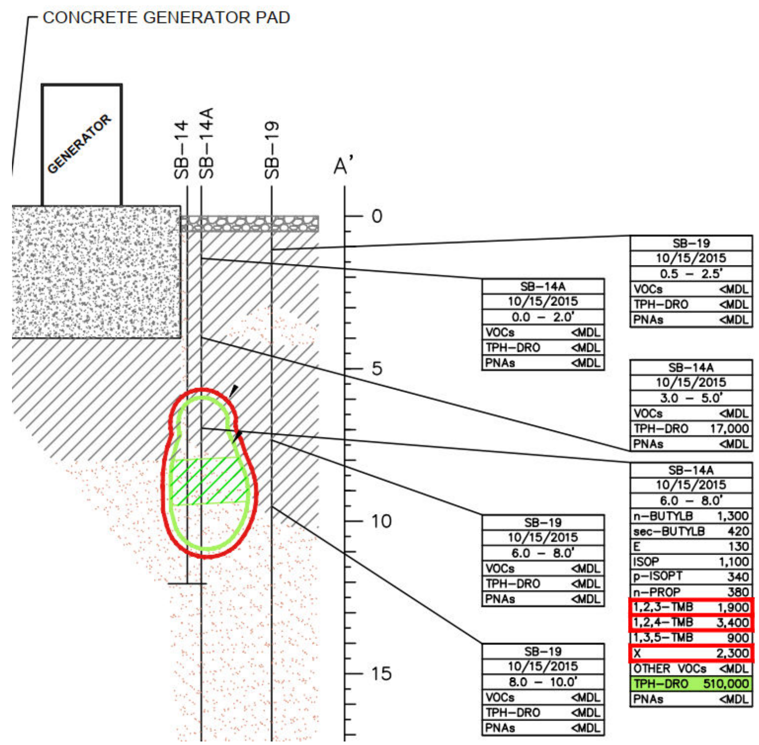
Non-Structural Barriers – Considerations

- Under scenarios where a non-structural barrier is four-feet thick (or more), a demarcation barrier between the contaminated media and the clean cover material is not needed;

- With appropriate characterization, it is also possible to utilize existing (in-situ) soils as a non-structural barrier without the use of a demarcation barrier;
  - No need to excavate those soils just to install a demarcation boundary;

- As with structural barriers, they need to be designed and constructed with operation and maintenance in-mind;
  - For both in-situ and newly installed barriers, this typically includes periodic verification of barrier thicknesses;



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Non-Structural Barriers – Appropriate Thickness

- EGLE's March 2024 Exposure Barrier Guidance does a good job outlining surface cover thicknesses that are appropriate to a variety of scenarios.

- Non-structural barrier thicknesses increase with the intensity that shallow soils are likely to be encountered, used, and manipulated by occupants.

- For larger properties, those with mixed uses, or areas that are used differently, surface barrier thicknesses may be different across a site, with greater thicknesses in areas that have a higher soil use intensity.

- Vegetation and other materials used to stabilize the non-structural barrier are not included in the barrier thickness.

Dermal Contact Exposure Barriers

Appendix A - Minimum Non-Structural Exposure Barrier Thickness Based on Land Use

Site Controls	Residential Single-Family, Owner-Occupied, and Rental **Example:** Single-family and individually owned homes on private or shared lots	Managed Residential / Schools **Example:** Rented or leased apartments, schools, day care	Non-Residential Commercial, Office, Retail **Example:** Commercial, office, hotel, and retail structures without a residential component	Industrial **Example:** Warehousing, manufacturing, and distribution centers	Passive Recreational **Example:** Naturalized greenspace, open park, gravel trails	Active Recreational **Example:** Sports fields, campgrounds, picnic areas, non-motorized dirt trails (such as biking or walking)
Site activities are reliably controlled through land use restrictions, lease agreements or other assurances.		✓	✓	✓	✓	✓
Monitoring and maintenance of the barrier is regularly conducted.		✓	✓	✓	✓	✓
Notices to tenants, construction, and utility workers of restrictions.		✓	✓	✓	✓	✓
Landscaping, yard maintenance, and construction controlled and or contracted.		✓	✓	✓	✓	✓
Activities primarily limited to paved surfaces.			✓	✓		
Minimum Barrier Thickness over Demarcation Material	24 inches	12 inches	6 inches	6 inches	6 inches	12 inches/ Designated Playgrounds 18 in

Dermal Contact Exposure Barriers

Demarcation Barriers – Laying It All Out

Demarcation Barriers

- Must be made from a durable full-coverage material suitable for both their application and installation methods used to construct non-structural barriers;
  - Example: Drainage for landscaped and vegetated areas;
- Brightly colored and readily identifiable if exposed for inspection or due to erosion;
- Not comprised of organic materials that will biodegrade over time;
- Often, they will be comprised of Geotextiles (orange is readily available);
  - Many manufacturers will provide expected material life expectancy documentation for specific applications;

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Demarcation Barriers – Materials Not Recommended

The following are not recommended for use as demarcation barriers:

- Snow Fence;
- Fiber mesh (geogrid, etc.);
- Consumer-grade landscape fabric;
- Burlap;
- Wire Fabric (chicken wire, concrete mesh);
- Plastic Sheeting;

The above materials:

- Don't prevent mixing of c-soils in barrier soils;
- Tend to degrade over time;
- May promote erosion or prevent vegetation growth;

Dermal Contact Exposure Barriers

Investigation, Planning, and Implementation

Presumptive Installation

These barriers can be "presumptively" installed and doing so may make sense in some scenarios:

- Small sites;
- Properties that require or already have comprehensive paved surface cover;
- Sites with buildings;
- New build scenarios where surface drainage can be designed/planned;

Dermal Contact Exposure Barriers

Investigation, Planning, and Implementation

Presumptive Installation

Usually does not account for the extent of contamination, so is implemented across an entire site;

For most sites, presumptively installing these exposure barriers isn't practical, often as a function of cost and lifecycle considerations (i.e., long-term operation and maintenance);

Therefore, a comprehensive site investigation is critical to documenting site conditions, contaminants, and contaminant extents in soil;

Dermal Contact Exposure Barriers

Assessing the Dermal Contact Pathway

That assessment should:

- Be based on a historical review of prior property uses that could lead to a release or that involves the placement of potentially contaminated "fill" or waste material from an offsite or unknown source.

- Account for areas that may be differentially contaminated and/or differentially used.

- Include soil sampling that documents the extent of soil contamination that exceeds the applicable Dermal Contact criteria.

Although an initial Phase II ESA is often the starting point in these evaluations, many enhanced investigation methods may be employed to assess the dermal contact exposure pathway.

Dermal Contact Exposure Barriers

Getting Creative – Alternate Investigation Methods

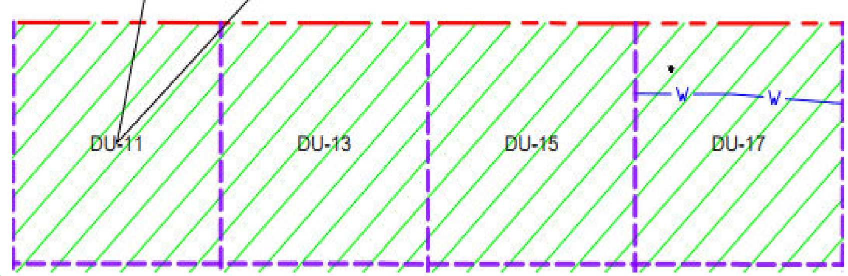
- This includes incremental sampling, bioavailability evaluations, and some statistical sampling methods that in many cases have the potential to significantly reduce or even eliminate the need for dermal contact exposure barriers.

- Frequently these evaluations are far less expensive or disruptive than the cost to design, install, and maintain an exposure barrier.

- ***Determining that no dermal contact exposure barrier is needed is much better than needing to install, operate, and maintain one.***

As	3,280	As	3,700	As	3,230
Ba	40,800	Ba	41,500	Ba	36,800
Cr	9,030	Cr	15,700	Cr	9,560
Cu	16,800	Cu	16,400	Cu	12,700
Pb	31,900	Pb	32,100	Pb	25,700
Se	<400	Se	<400	Se	<400
Zn	50,700	Zn	55,900	Zn	43,600

As	4,070	As	4,280	As	3,230
Ba	48,500	Ba	47,300	Ba	59,000
Cr	11,800	Cr	13,700	Cr	10,500
Cu	17,200	Cu	14,300	Cu	14,200
Pb	44,600	Pb	52,800	Pb	35,900
Se	<400	Se	<400	Se	<400
Zn	62,000	Zn	53,900	Zn	49,800



Dermal Contact Exposure Barriers

Planning it Out

Once the areas requiring dermal contact exposure barriers are defined:

- Evaluate whether Structural or Non-Structural exposure barriers can/will be installed;
- Determine the appropriate barrier thicknesses based on likely soil use intensity;
  - May vary across the exposure area;
- Pay attention to existing ground, pavement, and building pad elevations;
  - Will determine how much excavation is required to install the barriers;
  - Also established how much clean material will need to be used to construct non-structural exposure barriers;
    - Factor in compaction for compressive soils or those that will degrade over time;

Dermal Contact Exposure Barriers

Planning it Out

- Avoid situations where rain or meltwater will sheet flow towards buildings;
  - Can cause foundation issues or basement flooding;
- Consider existing or needed drainage/stormwater conveyances;
  - Unless you are installing a barrier in a planned pond area (liner), avoid constructing barriers that will impound water;

Dermal Contact Exposure Barriers

Planning it Out

- Think ahead to how the exposure barriers will be built and maintained in the future;
  - Excavated soils will require disposal or relocation, possibly with controls of their own;
  - May require survey elevations prior to non-structural material placement and post-installation surface elevations after the barrier is constructed;
  - Construction equipment and installation means/methods need to be factored
    - Avoid Cross Contamination;
  - Field verification methods should be established to document that barrier construction/thicknesses were achieved;
    - Also applies to stabilization cover like established vegetation, much, etc.;

Dermal Contact Exposure Barriers

Planning it Out

- Consider weather and seasonal conditions that affect material availability, compaction, and the ability to establish vegetation;
- What inspections will be used to verify the integrity and performance of the installed barrier, or the need for maintenance;
  - Visual Inspections to verify conditions are almost always employed;
  - Periodic elevation surveys are more useful for large areas than test pitting to document non-structural barrier thicknesses over time;
- The goal is to develop a plan and documentation process that will facilitate future exposure barrier O&M and recordkeeping activities, based on as-built conditions.

Dermal Contact Exposure Barriers

Keeping it Clean

Use Clean Soils/Materials to Construct Non-Structural Exposure Barriers

- Verbal assurances or "virgin source" certificates are not sufficient for soil;
- Testing is required to document that the materials used to construct non-structural barriers are not contaminated and do not exceed the applicable Dermal Contact criteria;
  - Requires testing at the borrow source/area, prior to relocation or import to the site;
  - Should include a suite of analyses sufficient to determine whether the material is contaminated;
  - Sampling methodology and number of samples to collect is project specific;
  - Each soil type needs to be sampled separately;
- Wood mulch should be sourced from non-recycled materials;
- Stone should be washed/graded and imported without fine materials (i.e., other soils), unless also tested;
- This documentation should be maintained by the owner/operator of the site;

Dermal Contact Exposure Barriers

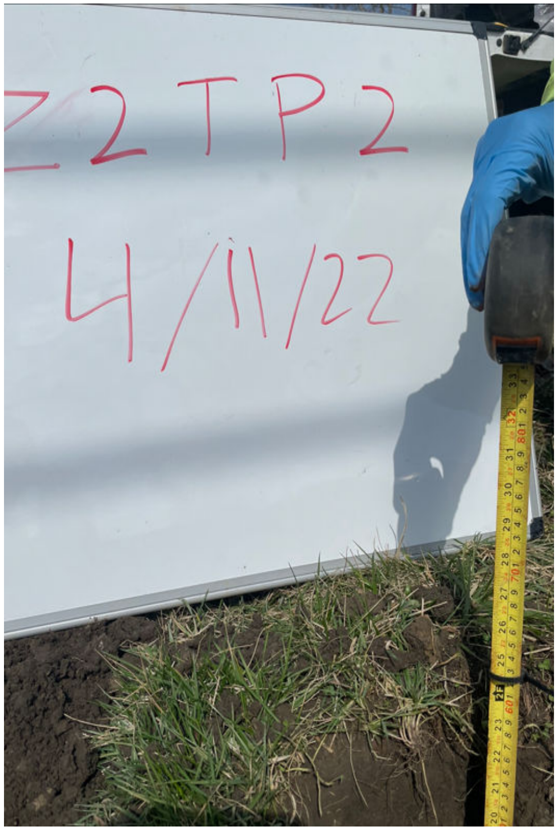
Getting it Done

- Follow the established plan;
- Document the steps used to install the exposure barriers using photos and/or video correlated to specific site locations;
  - Include field quality assurance documentation;
  - Soils characterization data for imported or relocated soils;
  - Characterization, disposal, or soil relocation documentation for excavated soils;
  - Survey elevations;
- Verify as-built conditions once construction is complete;
  - Ties in to both due care and/or various remediation/closure/NFA goals;
  - Often also relates to tenant/occupant and other notices regarding the presence of exposure barriers at contaminated properties;

Dermal Contact Exposure Barriers

Maintenance and Recordkeeping

- Based on the outcome of the planning and construction documentation phases, periodic inspection activities are completed to:
  - Verify the integrity;
  - Condition; and
  - Performance of the dermal contact exposure barriers;



Dermal Contact Exposure Barriers

Maintenance and Recordkeeping

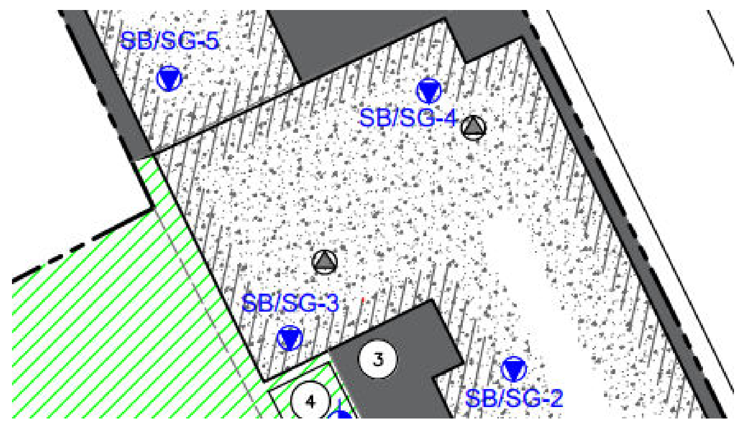
- Often this is a visual inspection for both structural and non-structural barriers, which is coupled with a combination of survey, invasive inspection, or similar activities;
  - May vary based on property use and the soil use intensity of the site;
    - For residential or school/day care property uses, visual inspections may be monthly or quarterly;
    - For industrial or other similar property uses, visual inspections may have longer inspection intervals;
    - Survey or invasive inspections may be more frequent during the first year or more, and may graduate to a longer interval;
      - This is because changes tend to be the most significant within the first year or so following construction;

Dermal Contact Exposure Barriers

Maintenance and Recordkeeping

- It is recommended that a Dermal Contact Barrier Operation and Maintenance Plan be prepared to assist property managers with those activities;
  - Should include description/location information for each exposure barrier;
  - Outline required inspection activities and schedules;
  - Include conditions that trigger the need for barrier maintenance, and contingency actions if immediate maintenance is not possible;
  - Provide forms for use in documenting inspections and any maintenance activities;

Dermal Contact Exposure Barrier Type	Y	N
Areas of Pavement or Building Foundation Cover (Quarterly Inspectic		
Are any pavement or generator base/foundation exposure barriers pitted, cracked, or damaged such that underlying soils are exposed?		
Do any pavement or generator base/foundation exposure barriers contain significant cracking such that underlying soils are exposed?		
Are any other pavement or generator base/foundation exposure barrier conditions present that affect their integrity such that underlying soils are exposed?		



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