



Technical Memorandum  
VIA EMAIL

**To:** Monica Howard – Dakota Access Pipeline  
**From:** Aaron DeJoia, CPSS/CPAg/ND-PSC – Duraroot Environmental, LLC  
**Date:** March 23, 2017  
**Subject:** Topsoil Salvage Review

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The following technical memorandum was prepared to evaluate the removal of topsoil from the Dakota Access Pipeline (DAPL) ROW in North Dakota. The focus of this memorandum is regarding the topsoil salvage on the subject property located in Morton County, North Dakota. The area in question stretches from approximately milepost 125.0 to 125.5 on Spreads 7/8 of the DAPL right-of-way (ROW). The following information was reviewed and analyzed by North Dakota Professional Soil Classifier, Aaron DeJoia.

This memorandum was based solely on the following information and if additional information is available Duraroot reserves the right to change these opinions:

- 1) Site Inspection Trip Report by Keitu Engineers and Consulting, Inc. dated September 26, 2016.
- 2) Site Inspection Trip Report Pictures dated September 26, 2016 (attached).
- 3) Certificate Relating to Order Provisions – Transmission Facility Siting Dakota Access Pipeline Project (Specifically Condition #16).
- 4) NRCS Soil Survey and Official Soil Series Descriptions.

Topsoil depths can be evaluated differently by different soil scientists. However, for this memorandum and evaluation the following definition and criteria were used to determine if appropriate topsoil depth was salvaged:

- 1) All surface soil material to the first identified horizon and any A soil material beyond the surface soil horizon including the Ap, A, AB, BA, and sometimes Bw soil horizons, could be considered topsoil material. Soil horizons with illuviated or eluviated organic matter or minerals would not be considered topsoil. These illuviated or eluviated layers would include but not limited to the E, Bt, Bn or Bk soil horizons. All layers below illuviated or eluviated soil horizons would not be considered topsoil.
- 2) Soil horizons below the surface soil horizon that contain parent material or have a significant increase in coarse fragments would not be considered topsoil.
- 3) Soil horizons below the A horizon that have a significant decrease in soil organic matter as depicted by a significant change in soil color would not be considered topsoil.
- 4) Per Condition #16 in the Certificate Relating to the Order Provisions, any soil material below 12 inches does not need to be treated as topsoil even if it meets topsoil requirements

Please note that a soil horizon could have similar color as topsoil but does not necessarily indicate that that soil horizon is topsoil.

## **Project Photos**

### **Report Photo #1 “Topsoil Not Completely Stripped”**

It appears that stripping activities are active and ongoing in this photo. There are still small stands of grass that indicate that the surface has not been completely stripped. The appearance of the rounded stone, or glacial till, indicate that subsoil levels had been encountered in places and that the depth of topsoil had been reached. The soil map unit for this location based off the NRCS soil survey is the Cabba soil series. This soil series is characterized as having a relatively shallow topsoil depth, approximately 3.0 inches, before encountering the underlying subsoil which is similar in color but having a higher clay content (Bk in this instance). We believe that topsoil depths are shallow in this region and that although topsoil salvage is not completed it appears that the topsoil will be appropriately salvaged.

### **Report Photo #2 “1+ Foot of Topsoil Not Stripped”**

Based off the trench line soil conditions in the foreground of the photo, it appears that a clayey soil was encountered. Topsoil in this region doesn't typically have a high enough clay content where “smearing” or slicken sides are observed. The soil profile in this photo shows these smeared soil characteristics from the current soil surface down into the trench line. The NRCS soil survey for this particular area shows subsoil horizons with “Bt” designations meaning that the underlying subsoil is argillic with a significant increase in clay content from the overlying topsoil. This Bt horizon would exhibit a smeared appearance when contacted with a piece of equipment such as a trackhoe. It appears from this picture that topsoil depths were appropriately salvaged and that the current surface is the Bt soil horizon. The large topsoil spoil in the background of the photo is indicative that 12” of topsoil likely has already been stripped.

### **Report Photo #3 “1+ Foot of Topsoil Not Stripped”**

This photo also shows the heavier clay content of the underlying subsoil based on the smearing of the soil faces at the soil surface. According to the NRCS soil survey for this area (primarily the Savage and Belfield soil series), the underlying subsoil has very similar color to the overlying topsoil but exhibits properties of higher clay contents (i.e. Bt or Btn designations). Topsoil in this area doesn't always extend to the upper portion of the C horizon, or weathered bedrock level, as observed by the lighter colored subsoil in this photo. It should also be noted that the subsoil horizons change in depths, which is part of the natural soil formation process. This picture indicates that the topsoil was appropriately salvaged at this location.

### **Report Photo #4 “Cutout – Estimate of Topsoil Depth”**

This photo is difficult to characterize given that the photo was taken in the shade and there is not much to contrast the soil profile with. Topsoil depths could have been determined from the 7” depth to the 16” depth per the landowner's measuring tape. This is based off the observed differences in soil structure and color of the soil profile on the right side of the photo. Root mass appears to significantly decrease after the 7” depth indicating different soil horizons also. It is our professional opinion that topsoil depth at this location is approximately 7” inches not 16”. The coordinates for this photo provided in the 3<sup>rd</sup> party inspection report do

not match the centerline or ROW for this particular tract. The depth of topsoil beyond 12" is inconsequential to compliance with the permit condition as segregation of topsoil up to 12" is the condition.

**Report Photo #5 "Center of ROW – Visible Topsoil Layer"**

Based off the condition of the soil in this photo, it is difficult to determine if any topsoil is present. Topsoil is hardly ever encountered directly over C horizons or bedrock. The absence of plant roots also indicates that this soil horizon is neither fertile nor wet enough to support vegetative growth. The coordinates provided in the 3<sup>rd</sup> inspection report for this photo do not match the centerline or ROW for this particular tract.

**Report Photos #6, 7, 8 "Center of ROW – Visible Topsoil Layer"**

The presence of root mass in a soil horizon doesn't always indicate that that particular soil is topsoil. Taproots will often move through the soil profile to find plant available nutrients and soil moisture. This often means that these roots will penetrate deep into the subsoil. In the instance of these three photos, the presence of rocks and mottling indicate that this dark subsoil soil horizon is likely an underlying Bt or Btn soil horizon, not topsoil. There also appears to be rock fragments in the soil horizon being identified as topsoil. Topsoil in this area would not contain rocks and bringing these rock fragments to the soil surface would limit reclamation success. There are no conditions in the Permit that exclude placing subsoil on top of subsoil which we believe is what these photos are indicating.

**Report Photo #9 "Center of ROW – Visible Topsoil Layer"**

The soil horizon in this photo being identified as topsoil has little root mass and appears to have a high clay content based off the presence of smeared soil faces and a blocky soil structure. Subsoils in this area have been surveyed by the NRCS as having these types of soil horizons and are designated as having a Bt or Btn soil horizon. The Cabba soil series is the designated soil map unit for this location per the NRVS soil survey. While the topsoil is shallow in this soil series (approximately 3.0 inches), the topsoil has a similar color to the underlying subsoil while exhibiting very different characteristics. The subsoil has similar color but a higher clay and different soil structure. Based on the photos we do not believe that there was improper backfilling of topsoil in this area.

**Report Photos #10, 11, 12, 12, 14 "Visible Topsoil Layer Topped w/ Subsoil"**

Based off the color, presence of root mass, and observed soil structure, this appears to be buried topsoil. The buried topsoil depth appears to be 1 or 2 inches. However, there is a large rock in the center of the identified soil horizon and there are several sandstones just a few inches below that soil horizon. If a soil scientist were determining topsoil depths with a manual soil push probe, or an automated soil auger, they would likely hit refusal when encountering one of these rocks. It is easy to believe that the topsoil would be determined above that refusal layer if that's where the probe struck during surface penetration. Soil series surveyed by the NRCS at this location have identified topsoil horizons, or A horizons, with depths of 3.0 – 5.5 inches before encountering subsoils with similar colors but higher clay contents. Although it appears that 1 to 2 inches of topsoil may have been buried; the rocks within the profile could exclude this from being classified as a topsoil layer.

## Conclusion

Given the shallow topsoil depths for this location, per the NRCS soil survey, and the similar colors and characteristics of the underlying subsoil, it appears that the topsoil segregation was appropriately handled in the majority of this area. While the topsoil and subsoil in this area exhibit similar characteristics, there are several soil properties that distinguish the two that need to be segregated. It appears in the attached photos that some of the underlying subsoil exhibiting the same characteristics as the topsoil was not stripped and segregated from the overlying topsoil. There are several reasons why this is beneficial to the overall health of the surface soil post-construction. Based on these photographs and topsoil definitions we believe that topsoil was salvaged in accordance with project provisions and requirements. Some of the attached photos show that subsoil identified as BC or C horizons, those with weathered bedrock and not nearly the same characteristics of the overlying subsoil, being placed over the identified Bt or Btn subsoil horizons. This practice is not out of compliance with project requirements and provisions. As long as the appropriate amount of topsoil was stripped and segregated from the underlying subsoil, the sequence of backfill and subsoil replacement does not violate permit Condition #16.

As can be observed by the above evaluation of the data presented, topsoil was salvaged to appropriate depths throughout a majority of the ROW. This evaluation is supported by both the pictures obtained from the ROW and correlates with the NRCS soil survey for the area.

It was assumed for this evaluation that Report Photos #4, #5, #6, and #7 were obtained from the subject property even though the GPS coordinates provided in the 3<sup>rd</sup> party inspection report do not correspond with the subject property. Photo #4 likely helps represent the major issue that is encountered throughout this report. In this photograph, if we agree that the topsoil depth is 16 inches (which is hard to determine from the picture), the conditions of the permit (#16) indicate that only the top 12 inches would need to be removed, thus leaving the other 4 inches of dark soil material in place.

**Site/Project Location:** MP 125 to 125.5 Spread 7-8

**Date of Inspection:** 26 September 2016

**Keitu Inspector:** RJS

**Report Photo #1 “Topsoil Not Completely Stripped”:**

46.70342°N 101.29109°W



**Report Photo #2 "1+ Foot of Topsoil Not Stripped":**

46.70399°N 101.29213°W



**Report Photo #3 "1+ Foot of Topsoil Not Stripped":**

46.70481°N 101.29340°W



**Report Photo #4 "Cutout - Estimate of Topsoil Depth":**

47.70°N 101.29°W



**Report Photo #5 "Center of ROW - Visible Topsoil Layer":**

47.70548°N 101.29469°W



**Report Photo #6 “Center of ROW – Visible Topsoil Layer”:**

47.70548°N 101.29469°W



**Report Photo #7 “Center of ROW – Visible Topsoil Layer”:**

47.70548°N 101.29469°W



**Report Photo #8 "Center of ROW - Visible Topsoil Layer":**

47.70548°N 101.29469°W



**Report Photo #9 "Center of ROW - Visible Topsoil Layer":**

46.70547°N 101.29477°W



**Report Photo #10 “Visible Topsoil Layer Topped w/Subsoil”:**

46.70547°N 101.29477°W



**Report Photo #11 “Visible Topsoil Layer Topped w/Subsoil”:**

46.70547°N 101.29477°W



**Report Photo #12 "Visible Topsoil Layer Topped w/Subsoil":**

46.70547°N 101.29477°W



**Report Photo #13 "Visible Topsoil Layer Topped w/Subsoil":**

46.70547°N 101.29477°W



**Report Photo #14 "Visible Topsoil Layer Topped w/Subsoil":**

46.70547°N 101.29477°W

