The hypothesis of this project is that soil health indicators capacity to recover their original condition after six years pipeline was installed will vary by parent material, landscape position, and management practices. Based on this, we defined the goal of creating a unique dataset of soil health indicators that covers the requirements to test our hypothesis. For this, two Iowa Physiographic Macro-Regions with distinctive characteristics were selected (Des Moines Lobe, and Southern Iowa Drift Plain). A questionnaire was designed to send to farmers affected by the installation of DAPL (Dakota Access Pipeline) in these two regions. To see the questionnaire access through the following link: https://iastate.qualtrics.com/jfe/form/SV_2rynEiRkmY6C8Mm

However, the efforts of trying to get farmers involved using the questionnaire were not successful. For this reason, an alternative method was applied. Farmers were contacted via phone to arrange a meeting with them on their farm where we explained the project, and we filled the questionnaire together with them. This process was more successful and done individually with each of the 14 farmers involved in the projects in the Des Moines Lobe and Southern Iowa Drift Plain.

The first round of interviews was completed in fall 2021 for farmers in the Des Moines Lobe, and the second round was completed in fall 2022 in the Southern Iowa Drift Plain. After each round of interviews was completed, we georeferenced each of the fields involved in the project. With the georeferenced data, we design the field samples collection along the DAPL path, stratifying locations by soil parent material, landscape position, management practices, and disturbed vs undisturbed areas. Once this information was set to each of the farms, sampling points were uploaded to the GPS before going to the field.

Besides the coordination with farmers, by law we also needed to coordinate with DAPL because we took samples over the pipeline. To complete this process, we needed to register to Iowa One Call and upload one ticket per field where we specify field location, sampling depth, purpose of the sampling, among other information (Fig. 1). Once the tickets were approved, a representative person from DAPL contacted us and together with farmers we coordinated the visit to take samples on the different farms. The representative person of DAPL was present on each of the fields with a scanner that identifies the exact location of the pipeline, which helped us to be more precise by taking the samples from the exact place we planned (Fig.2).

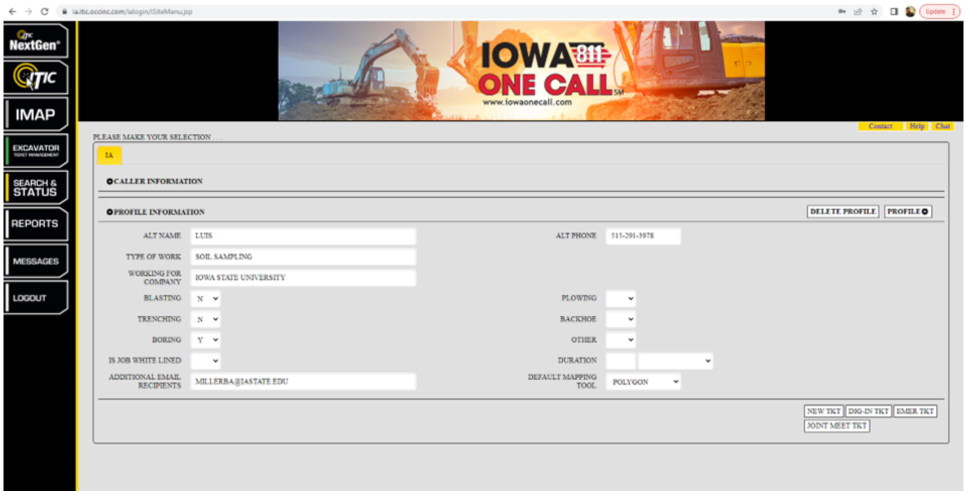

Fig. 1. Example of ticket request for sampling over DAPL.

Fig. 2. Demarcation of pipeline path before sampling

Once in the field, on each selected location, the pipeline path was divided into three parts: pile area, trench area, and traffic area which should represent each of the areas during the construction (Fig.3). Samples were collected for each of those points and on the undisturbed area every 30cm (about 12 in) to a depth of 90cm (about 3 ft) on the different hillslope positions presented on the different fields (Fig. 3). Each sample is duplicated because one was used for chemical, physical, and biological analysis, while the other was taken as a bulk density ring for hydrological measurements. Examples of soil cores with their respective bulk density rings and examples of soil cores of the different areas are represented in Figs. 4 and 5.

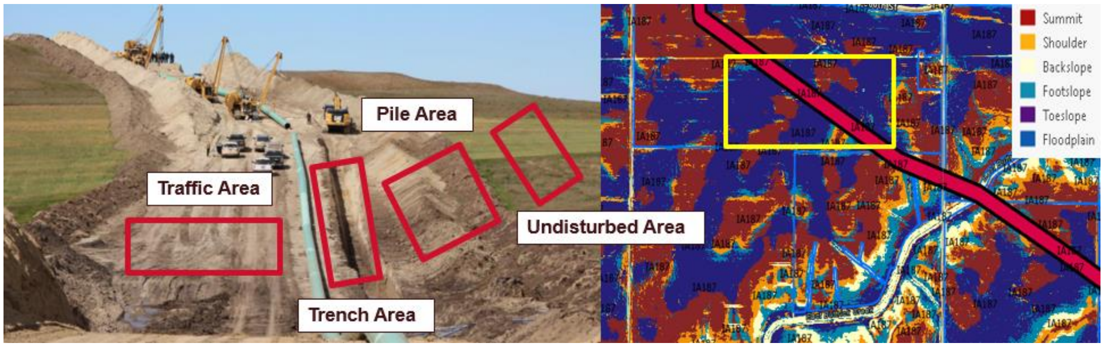

Fig. 3. Field zones within the ROW adapted based on Tekeste et al. (2020) and Digital Hillslope position map.

Fig. 4. Example of soil cores taken with their respective bulk density rings

Fig. 5. Soil core examples from different ROW areas and undisturbed point.

Next, we are going to describe what has been accomplished for each of the regions. For the Des Moines Lobe, field sampling was finished in fall 2021. A total of 192 samples were taken which corresponds to 16 transects times 4 points per transect times 3 depths per point. After field sampling was completed, all samples were dried, grinded, and sieved to 2mm (about 0.08 in). For evaluation of microbial activity, CO_2 burst test (Haney et al., 2008) was completed in November 2022. Soil particle size distribution was completed in December 2022 using a laser diffractometer (Miller & Schaetzl, 2012) for particle sizes' role in hydrologic characteristics and as an indicator of soil mixing. For hydrologic properties, one ring of 3 cm height was taken every 30 cm (Fig. 4) to construct the soil water retention curves until a matric potential of –15.0 bars, using a combination of ceramic plates and pressure chambers (Fig. 6). In this case, the pressures we are measuring for building the water retention curves are: -0.10, -0.33, -1.0, -3.0, and -15.0 bars. On each run, we can measure 36 rings at the same time, using a double ceramic plate per chamber. With this methodology we will assess porosity and relate the release of soil water under different suctions or matric potentials. Plant available water will be calculated as the difference between volumetric water content at field capacity (-0.10 bars) and permanent wilting point (-15.0 bars). On the other hand, bulk density was calculated once each run was completed. To do this, rings were oven dried at 105 Celsius degrees until constant weight. After this, bulk density was calculated using the following formula: (solid mass (gr) / total volume of soil (cm^3), and total porosity was calculated as follows: [1 - (Bulk density / Real density)] * 100], assuming a real density of 2.65 g/cm3. For this region, hydrological measurements were completed in January 2023. By now, all samples are packed and ready to send to Midwest laboratories (Fig. 7) for the following analysis: nitrogen as nitrate, organic matter, available phosphorus (P1 Weak Bray and P2 Strong Bray), exchangeable potassium, magnesium, calcium and hydrogen, pH, buffer index, cation exchange capacity, and percent base saturation of cation element. These samples will be sent to chemical analysis next month once CO_2 burst test results are checked in case, we need to repeat any measurement.

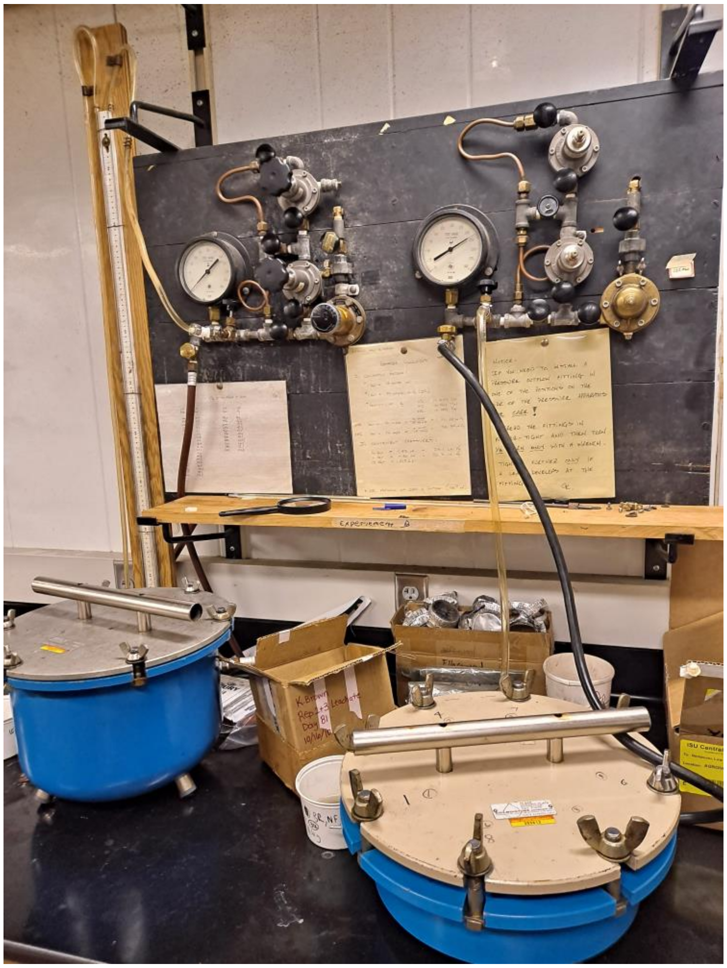

Fig. 6. Ceramic plate chambers (left: chamber for measurements between -0.1 and –3.0 bars; right: chamber for measurements at –15.0 Bars).

Fig. 7. Packaged samples to send to Midwest laboratories for chemical analysis

For the Southern Iowa Drift Plain, field sampling was finished in fall 2022. A total of 276 samples were taken, which corresponds to 23 transects times 4 points per transect times 3 depths per point. As explained for the Des Moines Lobe, each sample also had a bulk density ring for hydrological measurements. After field sampling was completed, all samples were dried, and nowadays we are close to finishing the grinding process. Any lab analysis will be started before grinding is finished. Except for hydrological measurements, where samples were collected on bulk density rings. In this case, measurements started in January 2023 once Des Moines Lobe samples were finished. Right now, the first run of samples is on the –15.0 bars chamber which is the highest-pressure point.