Using GIS Applications to Monitor the Environmental Impact of the Ohio Train Derailment

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Introduction

The purpose of this research is to comprehensively examine the impacts of the East Palestine, Ohio train derailment that occurred on February 3rd, 2023, utilizing GIS applications for post-event analysis. By integrating geographical information systems (GIS) technology with environmental data, we aim to assess the extent of the accident and its aftermath. Our methodology involves overlaying the locations of the accident, smoke plume, and soil, sediment, and water samples collected by the EPA onto detailed basemaps depicting topography, stream flow, and cropland for both 2022 and 2023. Through this approach, we construct a visual representation of the accident's scope and its implications on the surrounding environment. This research contributes to our understanding of post-disaster analysis and aids in informing future mitigation and cleanup efforts.

Study Area

The study area is defined by the location of the derailment and the subsequent spread of chemicals, taking into account both the physical geography and the direction of environmental factors such as water flow and wind patterns. The streams within East Palestine, including Coalbank Run, Leslie Run, Bull Creek, North Fork Little Beaver Creek, Little Beaver Creek, South Branch Brady Run, and Raccoon Creek, are of particular interest due to their southward flow toward the Ohio River. Additionally, the direction of the smoke plume resulting from the controlled burn is considered, with potential implications for ash settling in the surrounding area, including streams and cropland. The EPA's extensive sampling efforts, comprising over 100,000 samples of air, water, soil, and sediment, follow the path of chemical travel. This research focuses specifically on understanding the impacts on water, soil and sediment sampling locations.

Methods and Data

The methods employed in this research project involved a series of steps to gather and layer relevant data for mapping purposes. Initially, a Digital Elevation Model (DEM) of the topography was obtained from the USGS website for the East Palestine area, which was then projected into the Albers Conic Equal Area projection system. The image was exported to a grid format, and geoprocessing tools were utilized to create a hill shade representation. Next, the grid and hillshade layers were clipped to display only the area of interest. Additional data layers were sourced from the Living Atlas and ArcGIS Online, including sampling locations, the derailment site, smoke plume direction, and downstream routes. To analyze agricultural land use, data from the USDA website was utilized to generate boundaries for the area of interest and obtain cropland data for 2022 and 2023 using the Crop Scape app. This data was downloaded in both CSV and TIFF formats for comparison of acreage. Cropland images were uploaded, and attribute tables were edited to focus on relevant crop types (leaving out crops such as rice, oranges, and others not grown in the area, and crops resulting in less than 2 total acres in the area). All data layers were exported to grid format and projected into the Albers Conic Equal Area coordinate system to ensure consistency and perform analysis. These methodological steps facilitated the creation of comprehensive maps for analyzing the impacts of the Ohio train derailment.

Table 1. Samples taken by the EPA

Sample Type	Count
Air	155,655
Groundwater/Potable Well	378
Sediment	635
Soil	2,610
Surface Water	1,837
Vapor Intrusion Sampling	363

Table 2. Acres used for cropland 2023 vs 2022

Crops 2022	Total Acres	Crops 2023	Total Acres	Difference (2023-2022)
Alfalfa	7951.1	Alfalfa	7250.7	-700.4
Apples	53.4	Apples	3.3	-50.1
Barley	50.9	Barley	128.3	77.4
Christmas Trees	7.1	Christmas Trees	2	-5.1
Clover/Wildflowers	22	Clover/Wildflowers	17.8	-4.2
Corn	25195.5	Corn	25315.4	119.9
Dbl Crop WinWht/Soybeans	218.2	Dbl Crop WinWht/Soybeans	66.7	-151.5
Grapes	27.6	Grapes	32.5	4.9
Grass/Pasture	98461.2	Grass/Pasture	98085.2	-376
Oats	345.2	Oats	358.5	13.3
Other Hay/Non Alfalfa	5801.2	Other Hay/Non Alfalfa	6238.6	437.4
Pumpkins	20	Pumpkins	3.3	-16.7
Rye	11.8	Rye	18.9	7.1
Sod/Grass Seed	16.2	Sod/Grass Seed	16	-0.2
Sorghum	10.7	Sorghum	5.8	-4.9
Soybeans	23655.7	Soybeans	23048.1	-607.6
Speltz	16.9	Speltz	19.1	2.2
Sunflowers	6.4	Sunflowers	54.7	48.3
Switchgrass	6.7	Switchgrass	3.8	-2.9
Winter Wheat	3310.3	Winter Wheat	4662.9	1352.6

Analysis

Figure 1. Topographical Map of Study Area

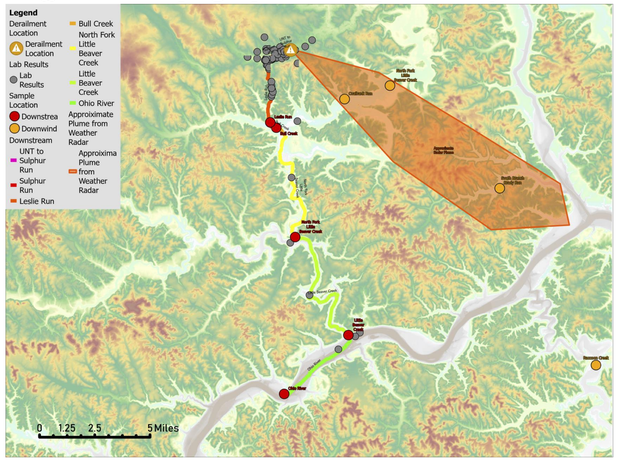


Figure 2. Streams Overlayed on Hill Shade

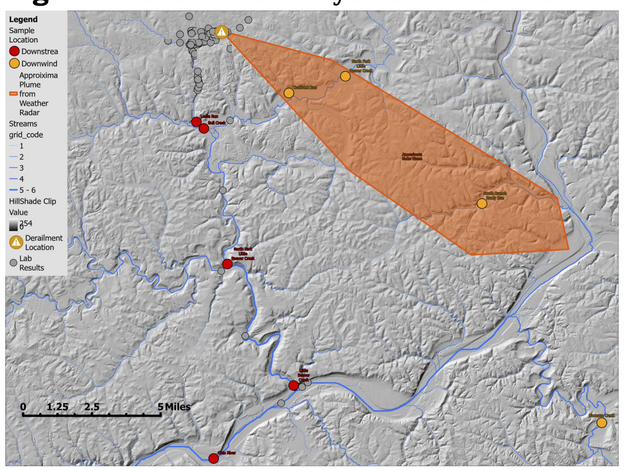


Figure 3. Cropland 2023

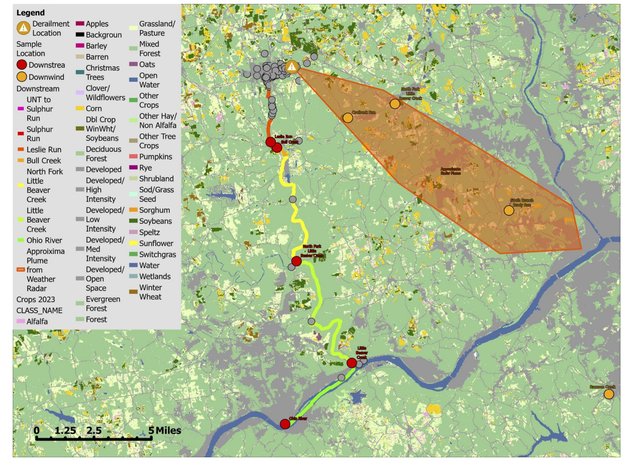
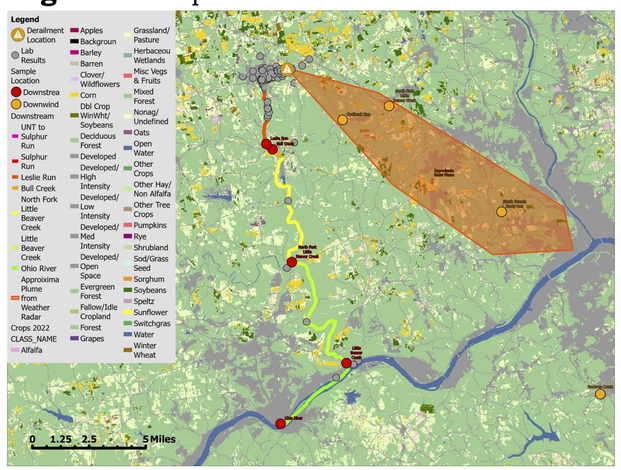


Figure 4. Cropland 2022



Conclusion

The comparison of cropland usage between the year preceding the derailment and the year following does not display significant changes, minor variations could likely be attributed to crop rotations. Despite this, ongoing monitoring of land use and potential crop impacts remains crucial, particularly moving into 2024. The EPA's sampling locations provide valuable insights into the downstream and downwind dispersion of chemicals, highlighting the importance of understanding their spread and potential environmental impacts. For further information, the EPA posts ongoing updates, data, images, and videos regarding air, soil, and water sampling., as well as cleanup efforts. To easily access this website, scan the QR code.

References

Data: Derailment Location, Sampling Locations, and Lab Results from Region 5 Fields EPA, Cropland data from USDA CropScape NASS CDL Program, Topographical DEM- USGS TNM Download v2.0
Sources: EPA, USGS, USDA
Projection: Albers Conic Equal Area
Created using ArcGISPro 3.1.2