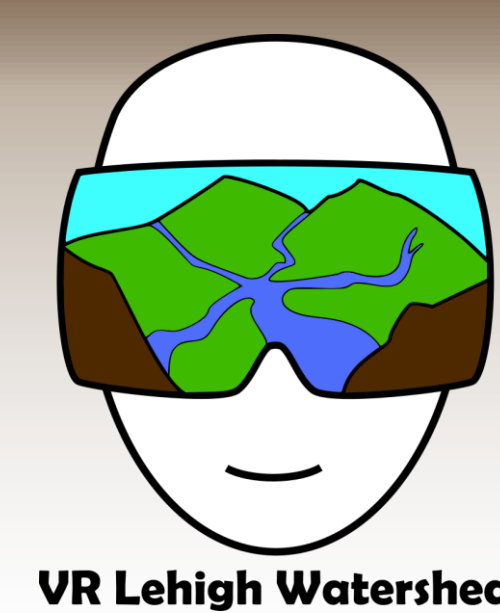


# Lehigh River Watershed VR: The Lehigh Gap Immersive Virtual Field Trip

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VR Lehigh Watershed

**Abstract.** To promote learner engagement about our watershed, we designed and developed an immersive virtual field trip (iVFT) prototype for HTC Vive to explore a rich area in geographical, environmental, and historical features: the Lehigh Gap in Pennsylvania, USA. The iVFT is designed to enable residents of the Lehigh River watershed to understand the environmental changes that have occurred in the past two centuries. Prototype feedback included that the iVFT experience promoted a feeling of immersion and engagement, an authentic experience due to the degree of realism, ease of use for navigating in the VR environment, a comfortable feeling, little to no dizziness, and losing track of time (i.e., flow).



The Lehigh Gap was a major historical transportation corridor in the American industrial revolution.

The **Lehigh Gap** was formed by the Lehigh River carving through Kittatinny Ridge (Blue Mountain) in Pennsylvania.

The iVFT enables one to learn about the construction and operations of **historical transportation systems** in the area.

The **canal boats** were pulled by mules on towpaths along the Lehigh River. Later on, boats were replaced by **railroads**. Tons of coal transported to the zinc smelters and the Lehigh Valley region beyond.



Kittatinny Ridge became a barren "moonscape" as a result of zinc smelting emissions from 1890-1970.



The **Lehigh Gap** is a keystone for learning:

**a) watersheds dynamics:**

- the Lehigh River transects many geologic provinces of the mountains.

**b) animal migration:**

- the Lehigh Gap is a major flyway for avian migration.

**c) environmental degradation AND ecological succession:**

- degradation caused by the intense activities of zinc smelting plants;
- recovery thanks to its designation as an EPA Superfund site.

**What is a Superfund site?**

- Contaminated sites with hazardous waste dumped, left out in the open, or improperly managed.
- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in 1980; informally called **Superfund**.

**Superfund goals:**

- Protect human health and the environment by cleaning up contaminated sites;
- responsible parties legally held liable for cleanup funds;
- Involve communities in the Superfund process;
- Return them to productive use.



Lehigh Gap Nature Center is the only Superfund **in the USA** to be restored to an environmental educational center.

Today, the Lehigh Gap **has been revitalized** through remediation efforts. Planted mixes of **warm season grasses** have trapped heavy metals in the soil **successfully**.

**Exploring** digitally reconstructed historic sites and assets allow the current generation of students to experience past events, and visit geographical landmarks either of difficult access or that no longer exist.



Immersive Virtual Reality Interactive Components: Outlines, Highlights, Labels, Buttons, Arrows, Help Texts, High Res Signs

Learners are able to:

**(A) examine and manipulate** a 3D model of Anthracite coal found at the site;

**(C) open a map** with a compass allows users to navigate through the trail pathways;

**(B) feel immersed** by moving along the trail in a sequence of 360° photospheres;

**(D) read** authentic trail **information signs** with local geographical and historical details.

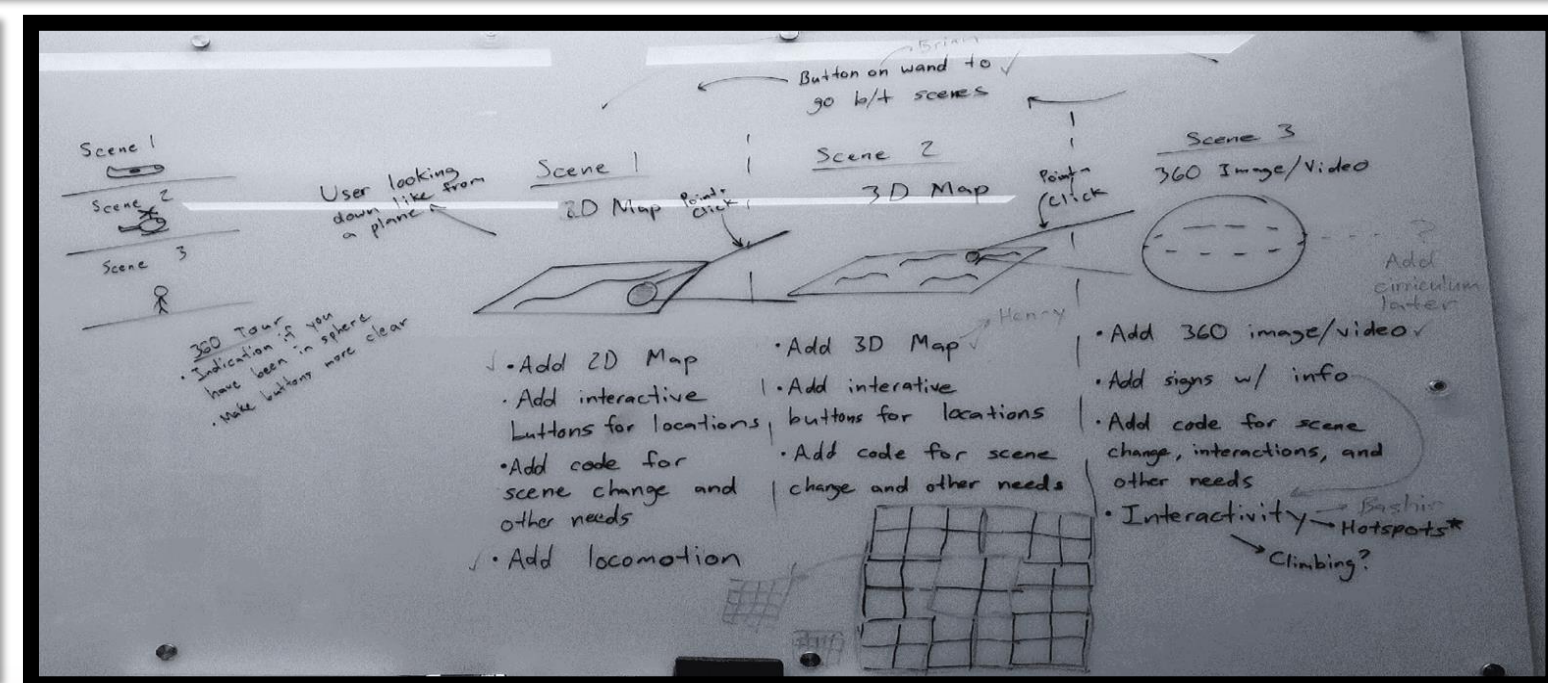
## The development (prototype)

**Developers:** 1 Instructional Technology Masters student, and 2 Engineering undergraduates.

**Software:** Unity3D (free), Blender (free), DroneDeploy (paid)

**Unity plugins:** World Composer (paid) + Bing Maps (free)

**Devices:** HTC Vive, Samsung 360, DJI Phantom 4 Drone



## Prototype test

The initial prototype was tested by:

- a secondary student;
- a high-school science teacher;
- undergraduate and graduate students;
- faculty at our university;
- Lehigh Gap Nature Center staff.

## Prototype feedback

- ✓ High degree of realism, making it feel like an authentic experience;
- ✓ Immersion feelings, simple navigation, more comfortable than expected, little to no dizziness;
- ✓ High engagement and flow state.

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ENVIRONMENTAL  
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