

GEOL 310 Lab: How Effective is a Remediation System at a Regional Landfill?

Dr. Kevin Theissen, Dept. of Geology, University of St. Thomas
(kmtheissen@stthomas.edu)

Objectives of this exercise:

1. To better understand the significance of redox chemistry in the environment.
2. To make predictions on the behavior of certain redox-sensitive elements and the overall effectiveness of a remediation system based on field measurements.
3. Get practice making field measurements and properly collecting water and sediment samples for later laboratory analysis.

Background: Today we will visit the Isanti-Chisago Closed Landfill located to the east of Cambridge, MN. The landfill is 22 acres in size and contains approximately 421,000 cubic yards of waste (MPCA, 2005). The landfill operated from 1973-1992. When the landfill was closed in August of 1992 a six foot thick cover was in place. The landfill has 12 monitoring wells in place to examine water at the water table and greater depths. In 1996 a remediation system was completed to address concerns about problem levels of certain metals (As, Cu, Hg, Pb, Zn) and the volatile organic compound vinyl chloride. As of 2005 (the last time a comprehensive assessment of the site was conducted) the landfill was rated at a level that indicated it posed no threat to public health.

Instructions: *Our access to this site gives us a nice opportunity to examine how geochemical principles can be applied to protect the public from the often harmful levels of contaminants that are concentrated at landfill sites. We will start out with an overview discussion of the site and the chemical principles behind the remediation effort here. Then we will collect relevant data on the water chemistry and sediment characteristics at a few key spots within the landfill system. Everyone will get a chance to contribute to the data collection effort but please be patient as I dole out tasks and (where necessary) demonstrate what needs to be done! Before we leave the site, we will share some of data so that you can make a preliminary interpretation on the system's effectiveness.*

For this exercise you will be graded on:

- 1) The quality of your responses to the discussion questions (in this handout), and 2) your contribution to data collection at the site.

In later lab activities we will analyze water samples from the landfill remediation system for major elements and trace metals using the ICP-AES and use GIS to examine how the groundwater chemistry has changed through time at and around this site.

Field lab equipment:

Water sampling	Water monitoring	Sediment sampling
Acid-washed bottles	YSI multiprobe (pH, DO, ORP)	Waders
Nitrile gloves	Water bucket	Rubber boots
Concentrated sulfuric acid (H ₂ SO ₄) and litmus papers	Lamotte water test kits (for rapid Hg and Pb testing)	PONAR Grab sampler
Safety glasses	Colorimeter and manual	Plastic container
Sample bottle container	Field table	Sample bags and marker

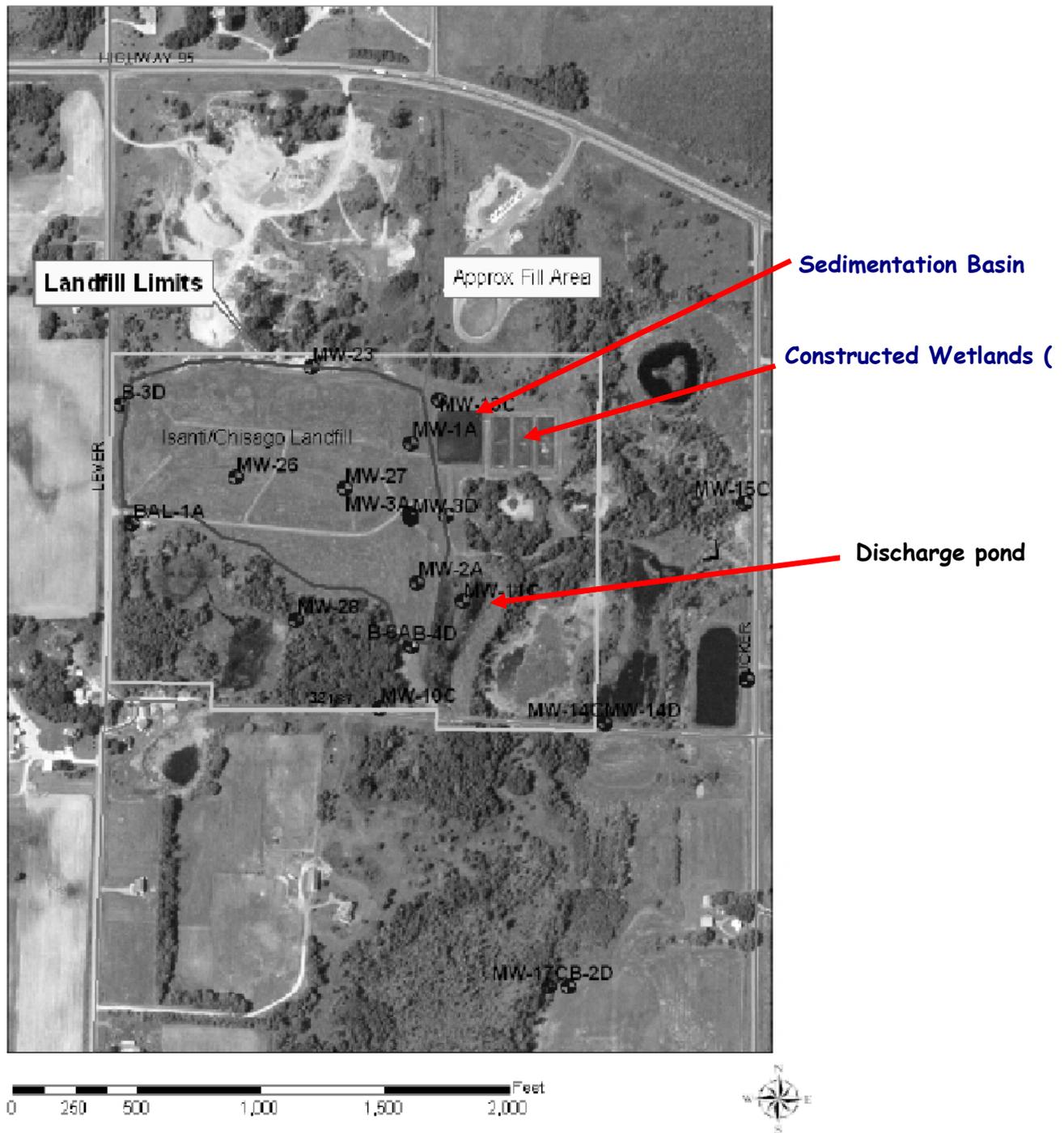


Figure 1. Aerial photo map of the Isanti/Chisago closed landfill system. Area enclosed by dark-colored inner solid line represents the actual closed landfill boundaries. Area enclosed by light-colored outer solid line represents the boundary of the complete landfill system including system ponds and wetland buffers. Monitoring Well locations are indicated by partially filled circles (Source: MPCA).

Discussion questions (due at our next class meeting). Your responses will be evaluated on their completeness, attention to detail, and clarity.

Based on our discussion in the field provide neatly written or typewritten responses to the following questions on this sheet:

1. What are heavy metals and why are they an environmental concern?
2. What are the common ionic forms of arsenic? Why are redox conditions crucial to the fate of As in the environment?
3. Based on our discussion, list and briefly discuss 3 factors that are important to the fate of As, Pb, and Zn in the environment.
4. Ideally, what would the flow of groundwater from the landfill through the cascade aeration remediation system cause to happen to any of these dissolved metals in the water?

