Pilot-Scale Design Proposal for Leachate Treatment at Tillamook Closed Landfill (TCL)

Capstone Team Members: Natalie Fowler, Chenxi Wu, Kamryn Smith

Advisor: Dr. Jeff Nason

Introduction

- Iron and ammonia concentrations in the leachate need to be reduced through passive treatments to meet permit limits to facilitate discharge into a vegetated swale.
- Constituent removal is important to ensure local water sources and aquatic systems remain unpolluted.
- Iron and ammonia reduction to below 0.95 mg/L and 3.0 mg/L, respectively.
- Key Constraints: area of 0.1 acres and seasonal flows ranging up to 100 GPM.

Methodology

- An alternatives analysis was conducted for iron and ammonia treatments to determine the project design.
- Decision matrices were used to rate and score alternatives based on team established criteria.

Table 1: Design Methodology

Design Element	Method
Aerator	Mass transfer and empirical formulas
Basin	Overflow rates
VFCW	Empirical formulas and loading rates

Results

Iron removal:

- Stepped cascade aerator:
  - Mechanism of removal is oxidation and precipitation
  - Design increases dissolved oxygen (DO) concentration to promote oxidation
  - Aeration efficiency: 82.4%
- Sedimentation basin:
  - Removal of ferric hydroxide precipitates
  - Solids removal efficiency: 92.1%

Ammonia removal:

- Vertical flow constructed wetlands (VFCW)
  - Mechanism of removal is nitrification
  - Intermittent feeding for 6 hours
  - Ammonia removal efficiency: 97.1%

Full-scale consideration:

- Scale up flow rate of 100 GPM
- Design details:
  - 2 stepped cascade aerators
  - 2 sedimentation basins
  - 4 series of 4 wetland cells in parallel
- Area:
  - Project is limited to 0.8 acres
  - Design area requirement: 0.64 acres

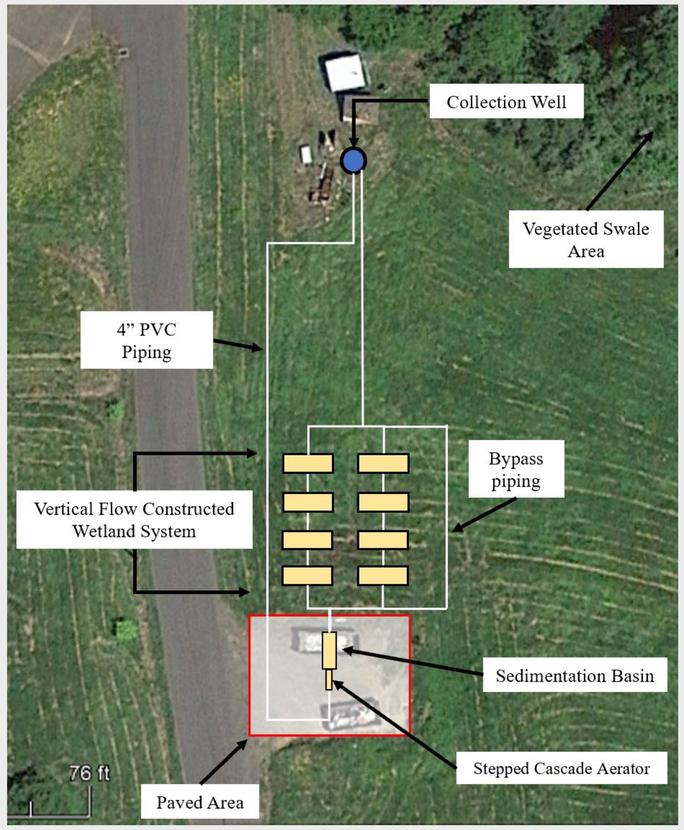

Figure 1: Pilot-scale on-site application

Pilot-scale consideration:

- Total required area is 0.0276 acres
- Effluent concentrations
  - Iron: 0.95 mg/L
  - Ammonia: 2.96 mg/L

Table 2: Design Specifications

Element	Length [ft]	Width [ft]	Height [ft]
Aerator	11.9	0.41	9.84
Basin	9.52	2.13	1.64
VFCW	25	5.9	2

Summary

The team developed a pilot-scale design that utilizes passive treatment methods for iron and ammonia removal. Both pilot and full scale designs are projected to fit within the allotted area. The team put an emphasis on developing a design that does not rely on chemical additives or continual energy use. The process consists of a stepped cascade aerator, sedimentation basin and VFCW system. This project in ongoing and is scheduled to conclude June 4th.

Future Works

- The engineering team will conduct a cost analysis and will consider the safety, regulatory and sustainability of the design.
- Head Losses through the wetland cells needs to be considered to ensure there are no system overflows.
- Pilot-scale assumptions need to be verified through pilot-scale testing.
- Data collection from pilot testing includes: iron, ammonia and DO concentrations, nitrification rate, and solids removal percentages.

Acknowledgements

- Special thanks to Dr. Jeff Nason for all the guidance on this project.
- Thanks to Rick Malin, TCL, and Parametrix for answering clarifying questions and providing preliminary data.

Oregon State University