

# Cinder Lake Landfill Contaminant Migration Modeling

Proposal Presentation: CENE 476

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# Introduction

- Purpose: City of Flagstaff is looking to improve the detection and modeling of leachate
- Client: Ken Fergason - Cinder Lake Landfill Project Manager



[1]

# Site Maps

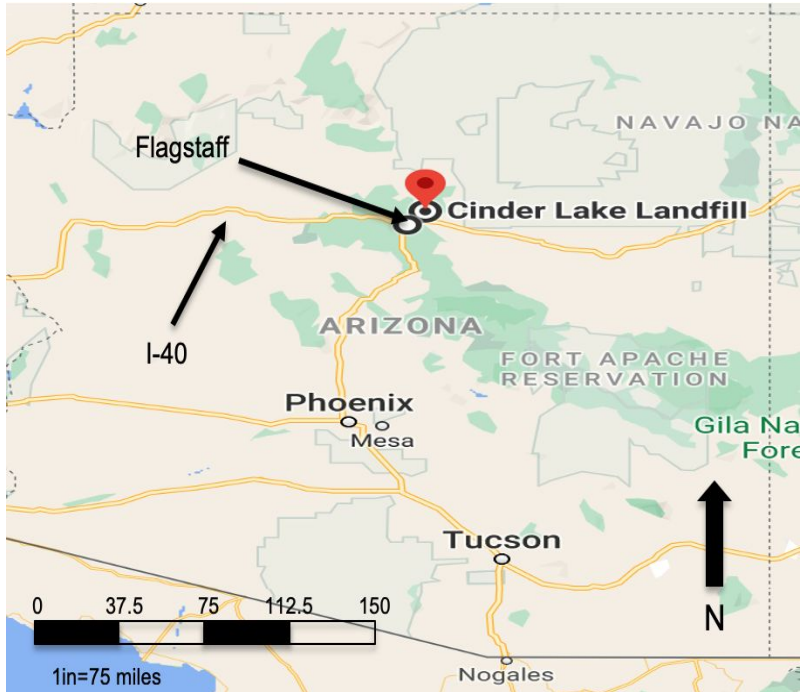


Figure 1 Landfill location in Relation to Arizona [2]



Figure 2 Landfill Location in Relation to the City of Flagstaff [3]

# Background

- 115 acres
- 70 miles radius of trash collection
- Unlined landfill with depth to GW = 1600 ft

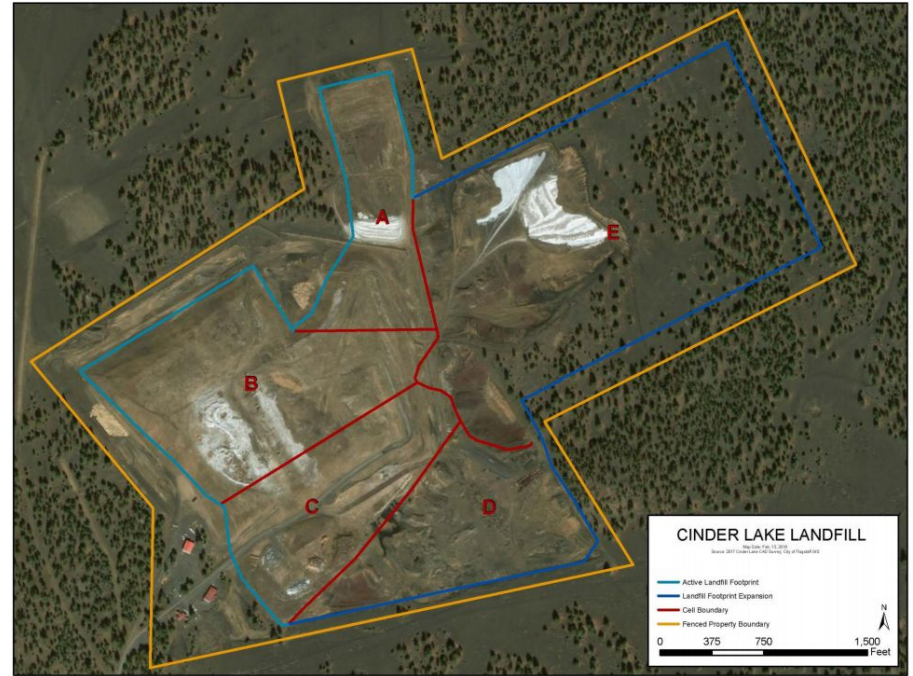


Figure 3: Cinder Lake Landfill [4]



# Scope of Services

- **Task 1: Site Investigation**
- **Task 2: Analyze Site Documents**
  - Task 2.1: Geotechnical Data Collection and Analysis
  - Task 2.2: Hydroprobe Data Collection and Analysis
  - Task 2.3: Landfill Layer Data Collection and Analysis



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Well	Sampling Episode	Moisture Content*** (% weight)			Descriptive Statistics				Prediction Limit
		Layer 1	Layer 2	Layer 3	Mean	Std Dev	Min	Max	( $\alpha=1\%$ )
V-1	16-Dec-97*	19.13	19.09	19.19	19.14	0.046	19.09	19.19	20.43
V-2	17-Dec-97*	19.52	19.34	20.20	19.69	0.455	19.34	20.20	20.9
V-3	17-Dec-97*	20.19	20.12	20.12	20.14	0.039	20.12	20.19	20.88
V-4	17-Dec-97*	18.32	18.36	17.85	18.17	0.284	17.85	18.36	18.69
V-5	17-Dec-97*	18.42	18.74	18.81	18.66	0.210	18.42	18.81	18.86

Table 1: Example Moisture Content Data [6]

# Task 3: Modeling

- Task 3.1: Create Updated HELP Model
  - Task 3.1.1: Create and Run HELP Model
  - Task 3.1.2: Compare HELP Model Results
- Task 3.2: Alternative Model Research
- Task 3.3: Model Comparison
  - Task 3.3.1: Efficiency Analysis
  - Task 3.3.2: Cost Comparison
- Task 3.4: Justification Report for Selected Model

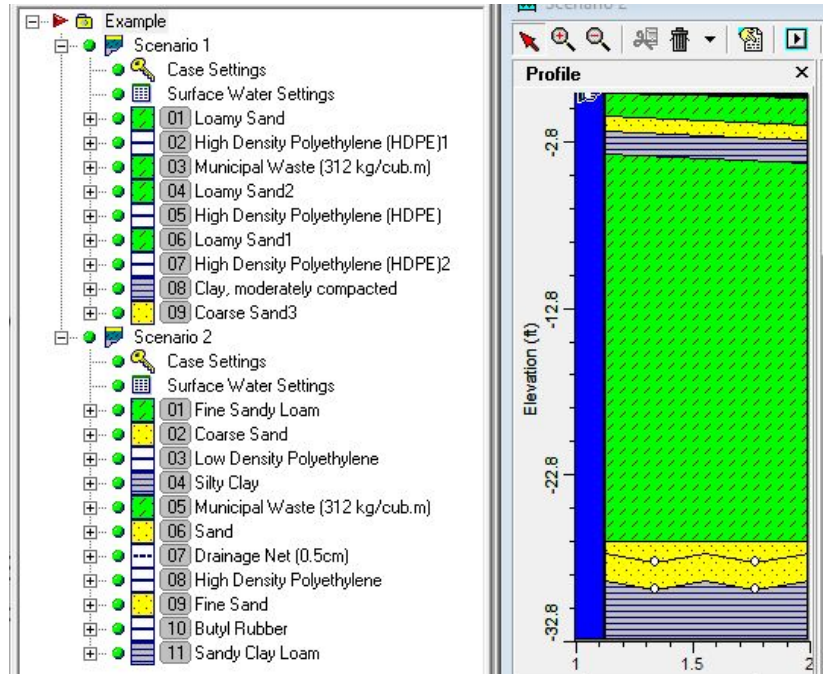


Figure 4: HELP Model

# Task 4: Research and Compare Geophysical Monitoring Methods

- Task 4.1: Develop List of Alternative Monitoring Technologies
- Task 4.2: Cost Analysis of Alternative Monitoring Technologies
- Task 4.3: Efficiency Analysis of Alternative Monitoring Technologies
- Task 4.4: Compare Alternative Methods to Hydroprobe



Figure 5: Time Domain Reflectometer [7]

# Task 5: Develop 3-D Plume Visualization

- Task 5.1: Interpolate 2-D Geophysical Data
- Task 5.2: Create-3D Plume Migration Map
- Task 5.3: Sensitivity Analysis for Potential Moisture Exceedance
- Task 5.4: Analyze Landfill Excavation Requirements for Various Plume Scenarios

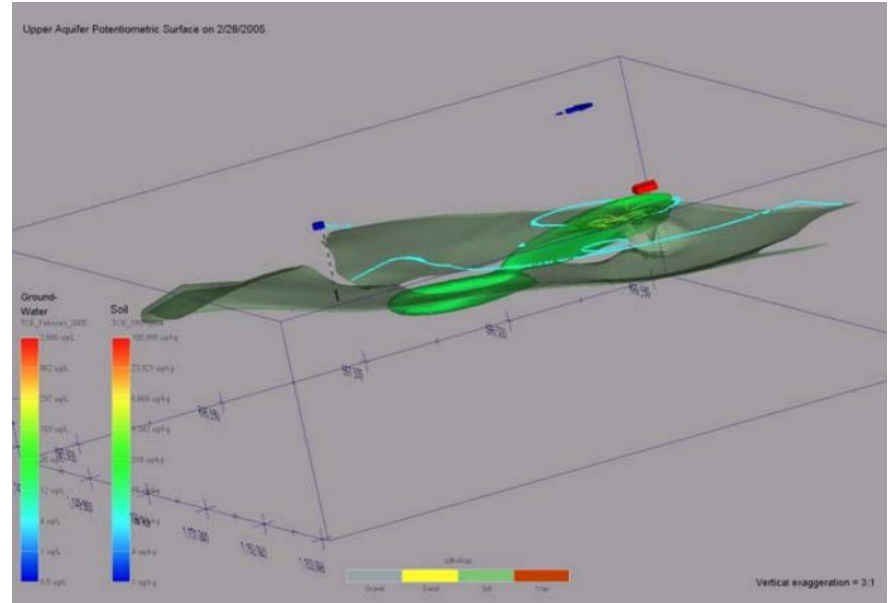


Figure 6: Example 3-D Plume Map [8]



# Task 6: Analysis of Project Impacts

- Task 6.1: Social Impacts
- Task 6.2: Economic Impacts
- Task 6.3: Environmental Impacts
- Task 6.4: Human Health Impacts



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# Task 7: Project Deliverables

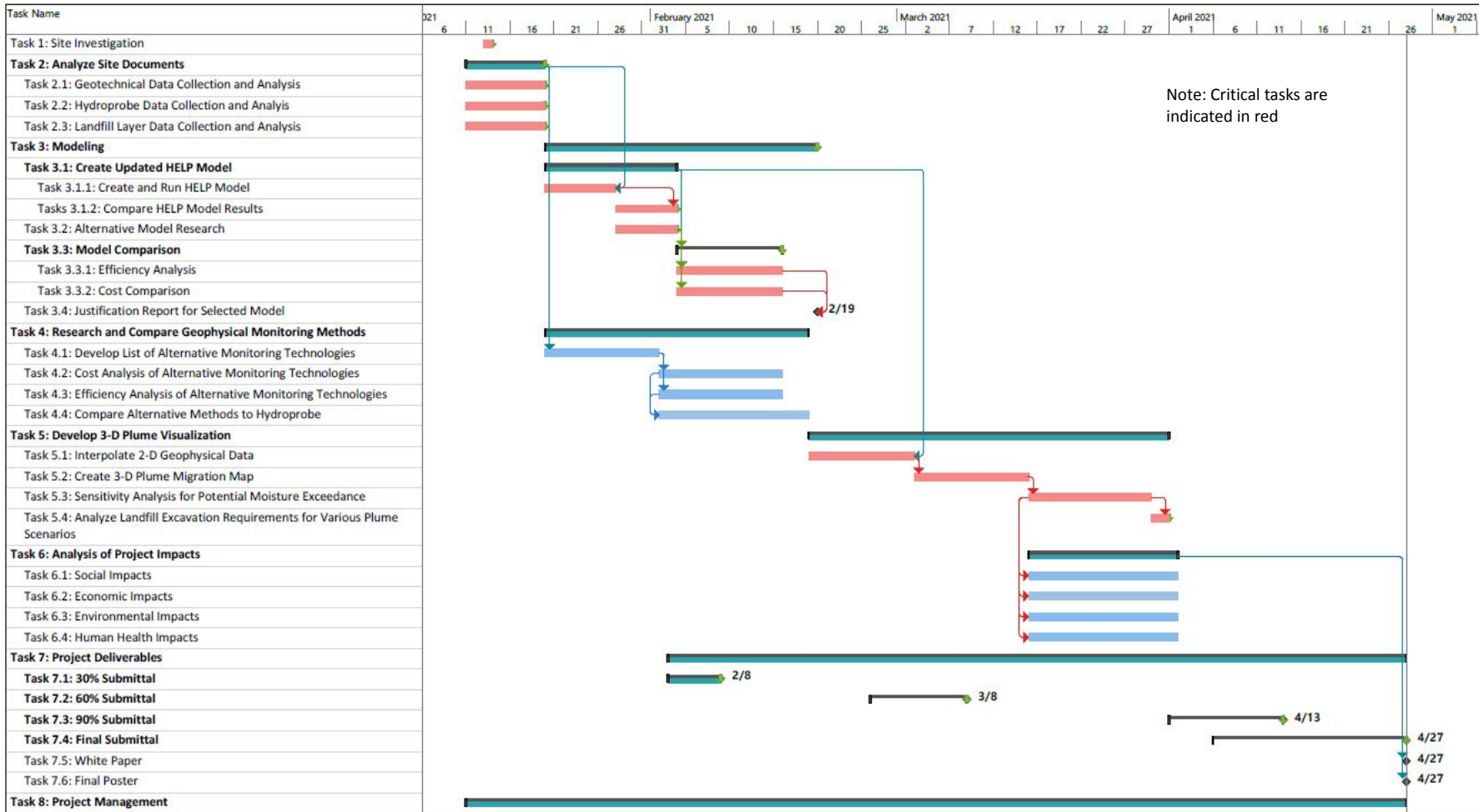
- Task 7.1: 30% Submittal
  - Task 7.1.1: 30% Report
  - Task 7.1.2: 30% Presentation
- Task 7.2: 60% Submittal
  - Task 7.2.1: 60% Report
  - Task 7.2.2: 60% Presentation
- Task 7.3: 90% Submittal
  - Task 7.3.1: 90% Report
  - Task 7.3.2: Practice Final Presentation
  - Task 7.3.3: 90% Website
- Task 7.4: Final Submittal
  - Task 7.4.1: Final Presentation
  - Task 7.4.2: Final Website
  - Task 7.4.3: Final Report
- Task 7.5: White Paper
- Task 7.6: Final Poster

# Task 8: Project Management

- Task 8.1: Meetings
  - Task 8.1.1: Grading Instructor Meetings
  - Task 8.1.2: Technical Advisor Meetings
  - Task 8.1.3: Client Meetings
  - Task 8.1.4: Team Meetings
- Task 8.2: Schedule Management
- Task 8.3: Resource Management



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# Staffing Plan

- Senior Engineer
- Environmental Engineer
- Intern
- Administrative Assistant
- 602 total hours

Table 2: Staffing Plan

Task	SENG Hours	ENG Hours	INT Hours	ADM Hours
Task 1: Site Investigation	4	4	8	4
Task 2: Analyze Site Documents		12	24	
Task 2.1: Geotechnical Data Collection and Analysis		4	8	
Task 2.2: Hydroprobe Data Collection and Analysis		4	8	
Task 2.3: Landfill Layer Data and Analysis		4	8	
Task 3: Modeling	8	58	36	4
Task 3.1: Create Updated HELP Model	2	12	4	
Task 3.1.1 : Create and Run Updated HELP Model	2	8		
Task 3.1.2: Compare HELP Model Results		4	4	
Task 3.2: Alternative Model Research		6	8	
Task 3.3: Model Comparison	6	32	16	
Task 3.3.1: Sensitivity Analysis	4	16	8	
Task 3.3.2: Cost Estimate Comparison	2	16	8	
Task 3.4: Justification Report for Selected Model		8	8	4
Task 4: Research and Compare Geophysical Methods	6	44	24	
Task 4.1: Develop List of Alternative Monitoring Technologies	2	8	8	
Task 4.2: Cost Analysis of Alternative Monitoring Technologies	2	16	4	
Task 4.3: Efficiency Analysis of Alternative Monitoring Technologies	2	16	4	
Task 4.4: Compare Alternative Methods to Hydroprobe		4	8	
Task 5: Develop 3-D Plume Visualization	8	80	16	
Task 5.1: Interpolate 2-D Geophysical Data	2	20	4	
Task 5.2: Create 3-D Plume Migration Map	2	24	4	
Task 5.3: Sensitivity Analysis for Potential Moisture Exceedance	2	24	4	
Task 5.4: Identify Portions of Landfill Requiring Excavation	2	12	4	
Task 6: Analysis of Project Impacts		24	16	16
Task 7: Project Deliverables	24	44	24	48
Task 8: Project Management	12	12	22	20
Sum Hours	62	278	170	92

# Cost

Table 3: Cost Summary Breakdown

1.0 Personnel	Classification	Hours	Rate, \$/hr	Cost
	SENG	62	194	\$ 12,058
	ENG	278	98	\$ 27,244
	INT	170	26	\$ 4,342
	ADM	92	39	\$ 3,618
	Total Personnel			\$ 47,262
2.0 Travel	2 meetings @ 26 mi/meeting		\$0.40/mi	\$ 21
3.0 Supplies	Modeling Software			\$ 5,000
4.0 Total				\$ 52,283

# References

- [1] The City of Flagstaff, "Cinder Lake Landfill," Civic Plus, [Online]. Available: <https://www.flagstaff.az.gov/941/Cinder-Lake-Landfill>. [Accessed 4 November 2020].
- [2] Google Maps, "Cinder Lake Landfill," Google, [Online]. Available: <https://www.google.com/maps/dir/35.1818863,-111.6541482/cinder+lake+landfill/@35.1458152,-112.2340898,9.25z/data=!4m9!4m8!1m1!4e1!1m5!1m1!1s0x872d8a5f04e1fa95:0x21c811654031dea3!2m2!1d-111.520972!2d35.304864>. [Accessed 7 September 2020].
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- [4] T. Hanson, M. Morales and B. Bluelake, "City of Flagstaff Public Works-Solid Waste Plan," Flagstaff, 2018.
- [5] I. Chapman, "A landfill in their backyard," CNN, 11 September 2020. [Online]. [Accessed 4 November 2020].
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- [7] Megger Limited, *TDR500/3 Handheld TDR*, Dover.
- [8] K. Takasaki and J. B. Burton, Using Environmental Visualization System Modeling to Develop Remediation Alternatives, Seattle.
- [9] J. Newton, "The Effects of Landfills on the Environment," 19 April 2018. [Online]. [Accessed 4 November 2020].
- [10] Dube Engineering, *Project Management Engineers*, Akron: WebTek.