Belt-The Creek That Coal Killed
Belt Water Treatment Plant

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MONTANA
Abandoned Mine Lands

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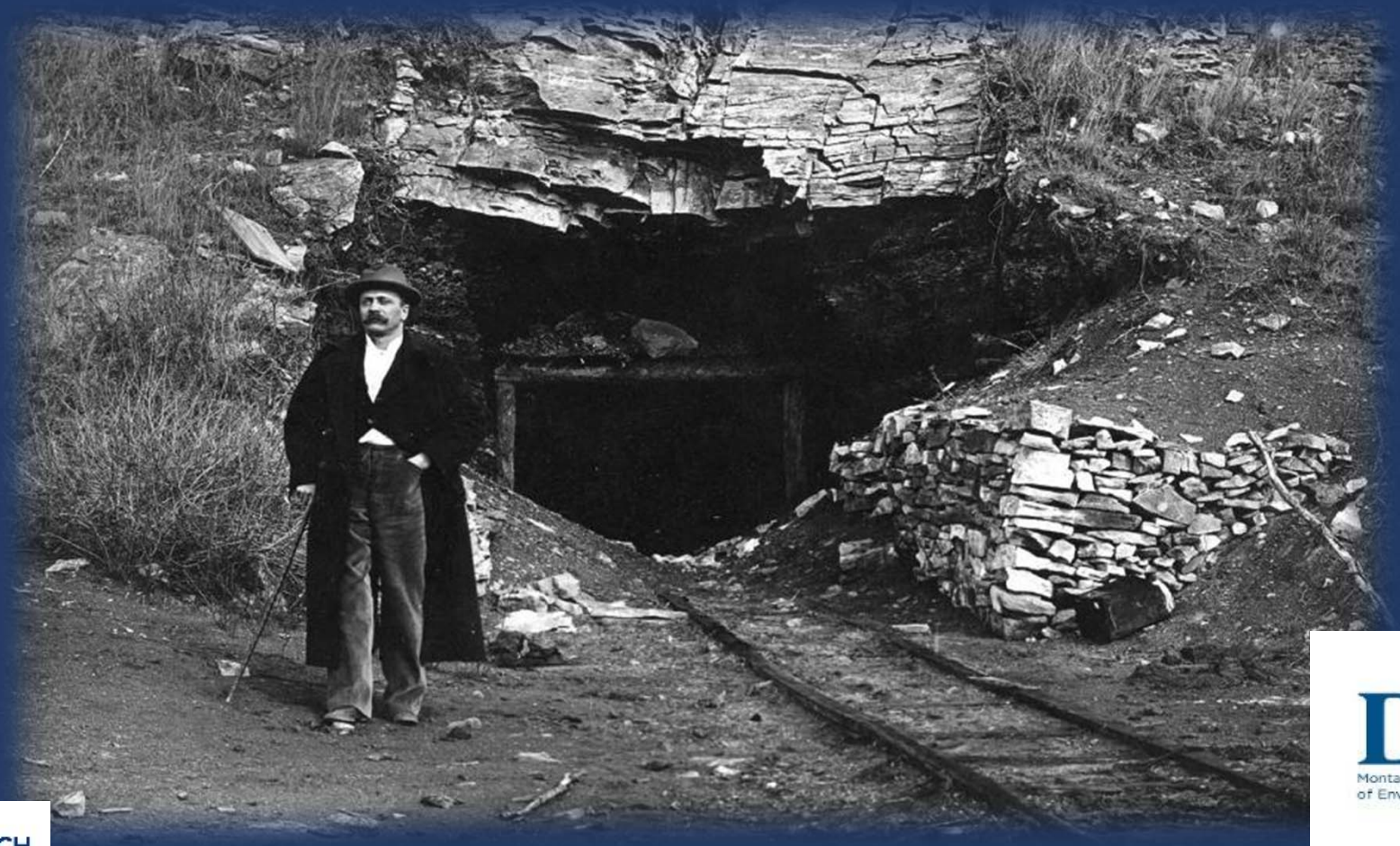
John K. Castner



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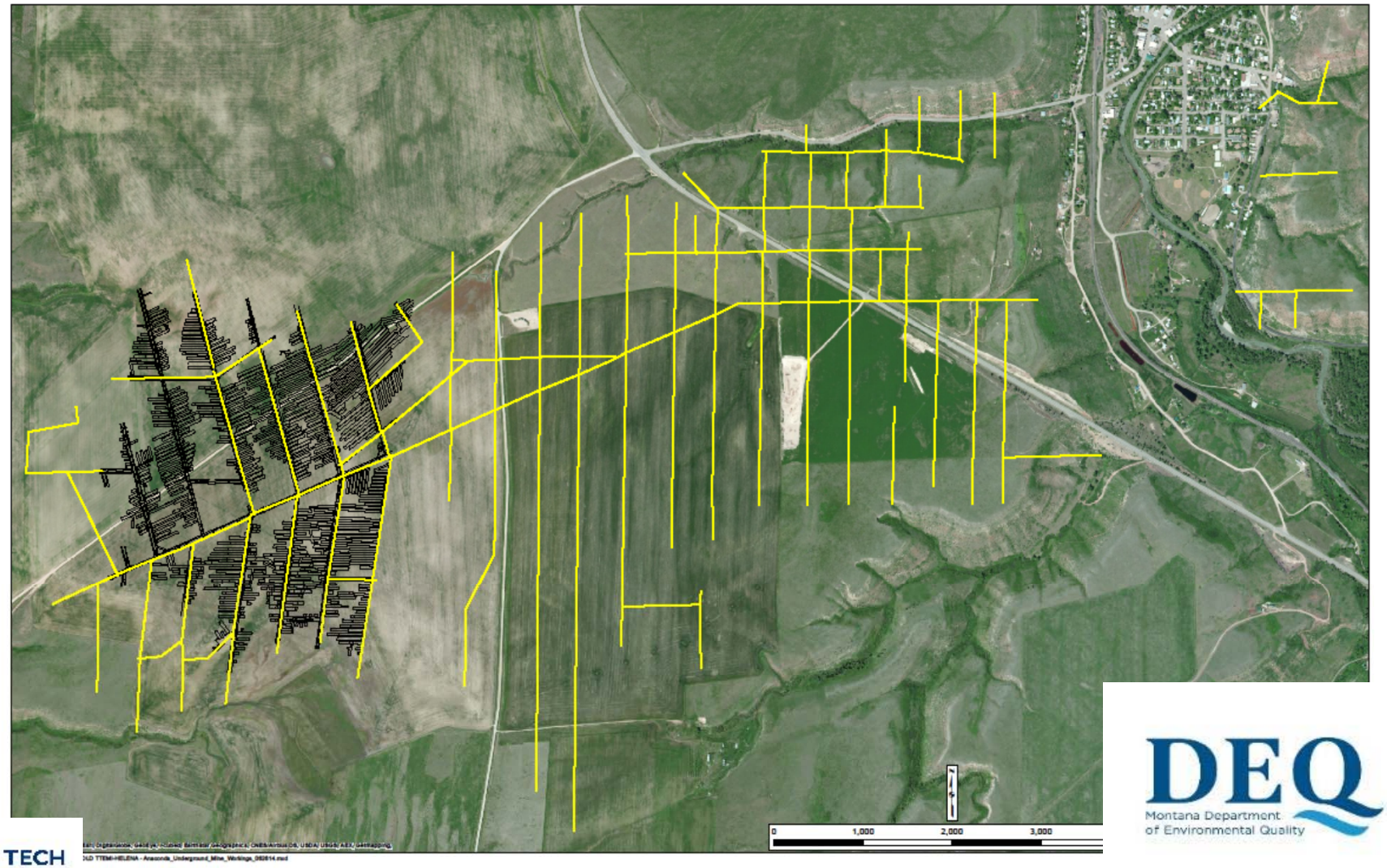

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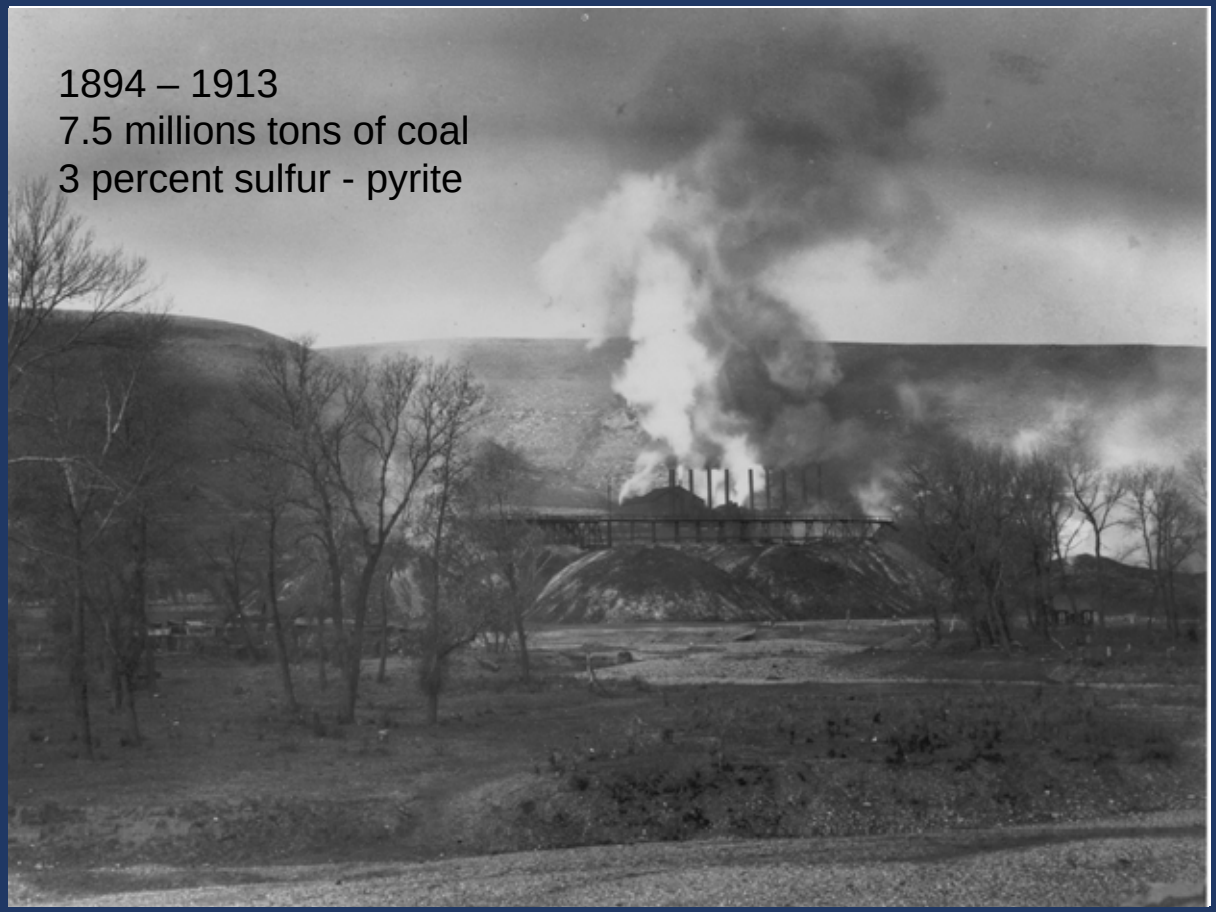
Historical Coal Mining and Coking



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Coke Oven Flats Prior to 1980s Reclamation

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Belt Overview

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Belt Creek Looking North

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Belt Creek Upstream of Mine Discharges

Water sampling indicates DEQ-7 water quality is met immediately upstream of the mine discharges

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French Coulee Drain

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Anaconda Mine, French Coulee, and Coke Oven Flats Drainage Flowing into Belt Creek

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Belt Swimming Hole

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Plan A

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Plan B

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Plan C

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Belt Water Treatment Plant Design

Colin McCoy, P.E.

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The Four Major Initial Design Considerations

1. Determine Treatment Type
2. Determine Plant Location
3. Determine Sludge Disposal
4. Design Basis

Treatment Type

- Contaminants of Concern (exceeded DEQ-7):
  - Aluminum (206 mg/L)
  - Arsenic
  - Beryllium
  - Cadmium
  - Copper
  - Iron (315 mg/L)
  - Thallium
  - Zinc
  - pH = 2.8
- Going through the NCP motions, the EECA evaluated:
  - Water-Powered CaO Addition (not effective)
  - Single Stage Hydrated Lime $
  - Two-Stage Hydrated Lime $$
  - Nanofiltration $$$$$$$$$

<u>Preferred Alternative: Single Stage Hydrated Lime</u>

Plant Location

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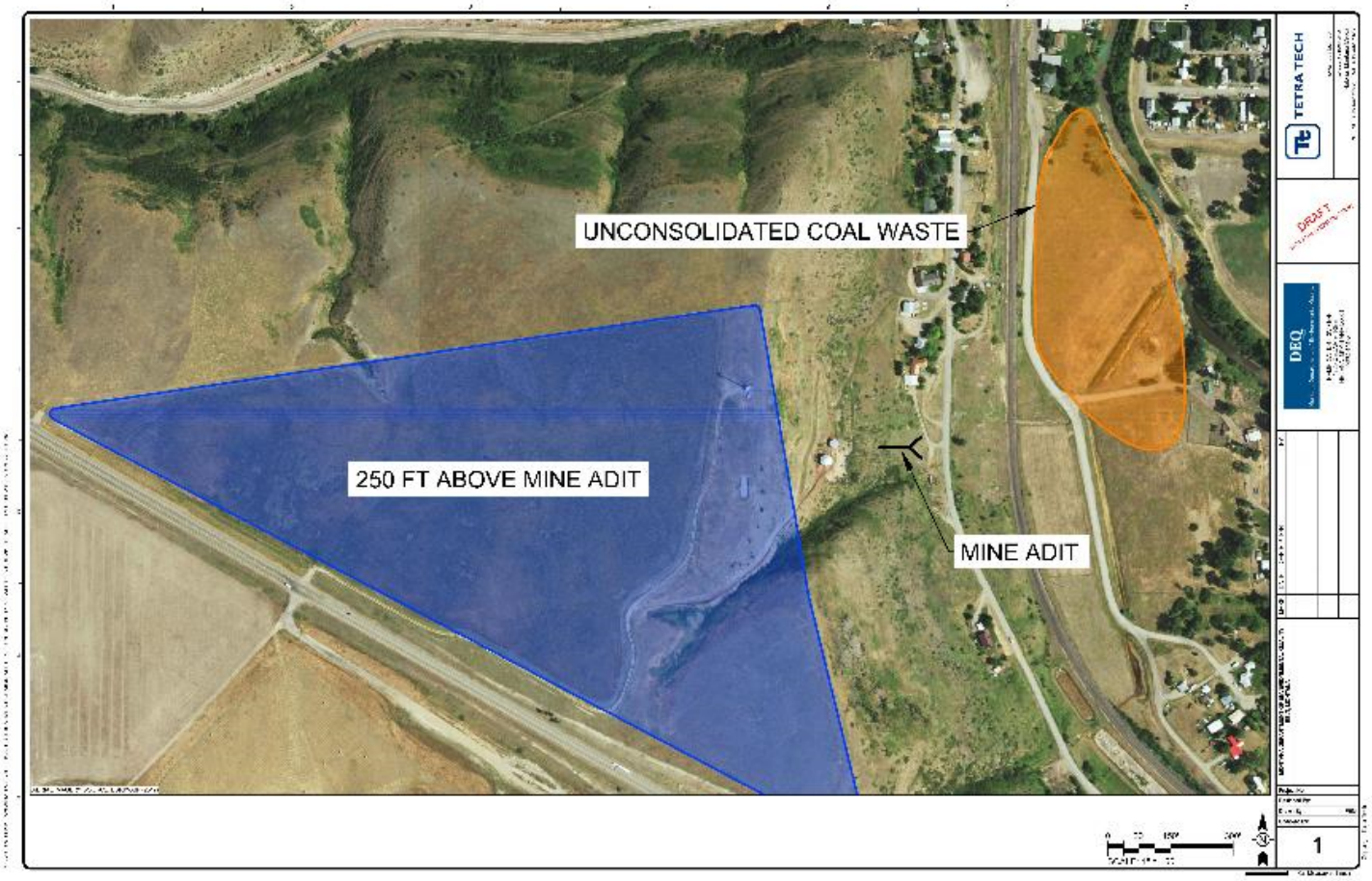
Two Options:

1. On unconsolidated coal waste below the adit
2. On DEQ property 250 feet above the adit

Obtained LiDAR data to cover large area

Plant Location Options



Sludge Disposal Options

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<u>Three Options Evaluated:</u>

1. Sludge Press and Landfill Disposal
2. Drying ponds
3. Injection into the Underground Mine Workings

<u>Preferred Alternative:</u> Injection into the Underground Mine Workings Mine Pool

Underground Evaluations

Step 1: Borings into mine workings (Really Stressful)
- Successful at 3-4/10 boring locations

Step 2: Downhole Camera (Really Cool)

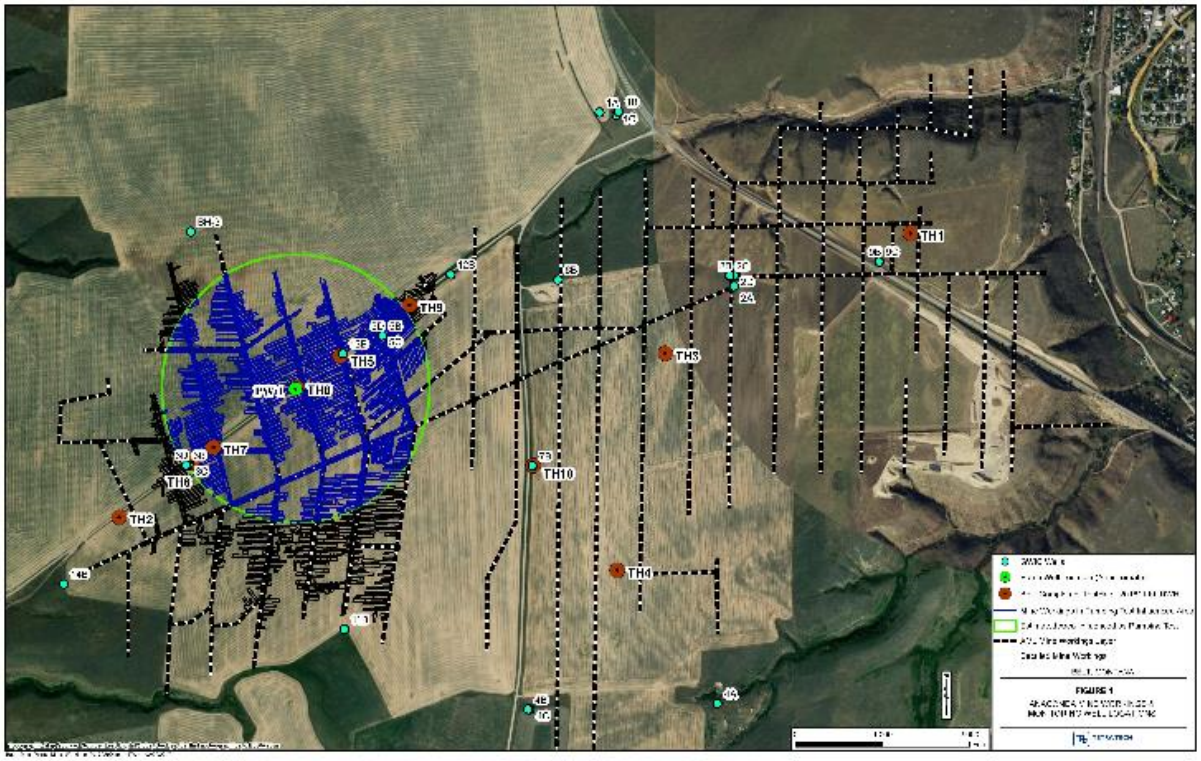
Step 3: Initial 1-week pump test

Weird Results at adit discharge – increased flow, then no effect

Step 4: 1 month 500gpm pump test (20+ million gallons)

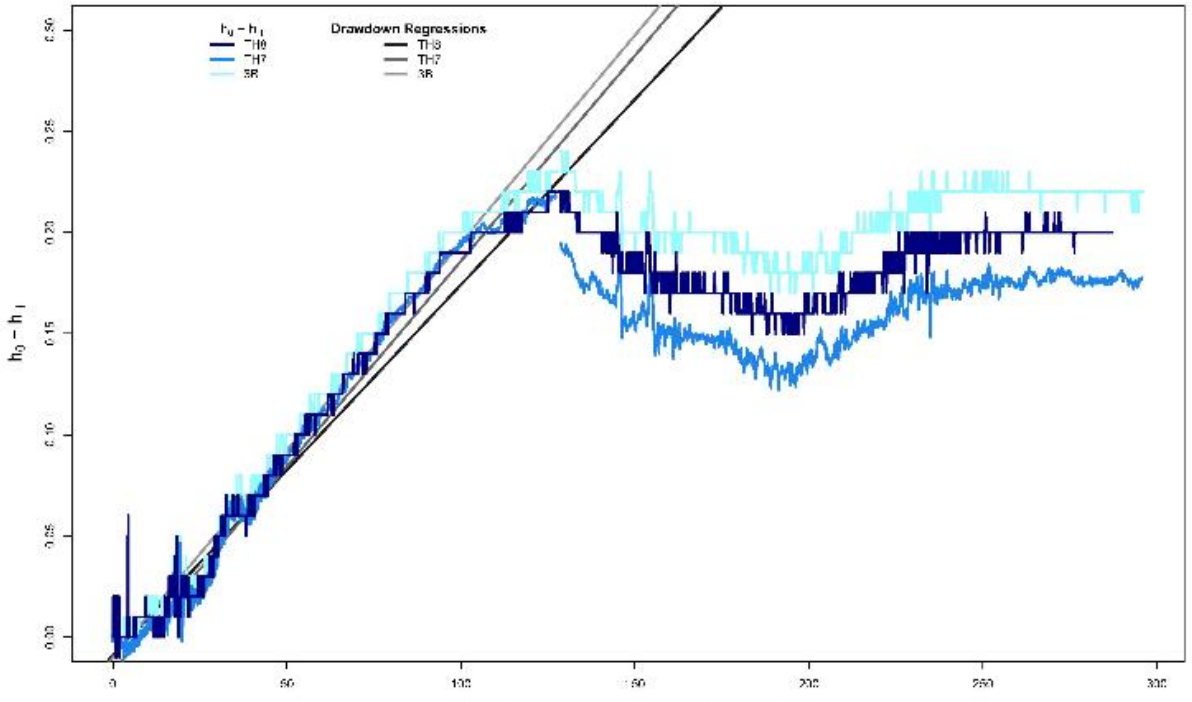
No effect on adit flow

Boring Locations and Mine Pool



Mine Workings

200 GPM 1 Week Pump Test



	TH8 Regression	TH7 Regression	3B Regression
h_0 = Head at start of pumping h_t = Head at each time step	Regression p-value: <2.2e-16 Adjusted R^2: 0.8526 Slope = 0.00185 ft/day	Regression p-value: <2.2e-16 Adjusted R^2: 0.9267 Slope = 0.00208 ft/day	Regression p-value: <2.2e-16 Adjusted R^2: 0.9578 Slope = 0.00205 ft/day

Figure 4
Belt 200 gpm Pump Test Drawdown vs Time

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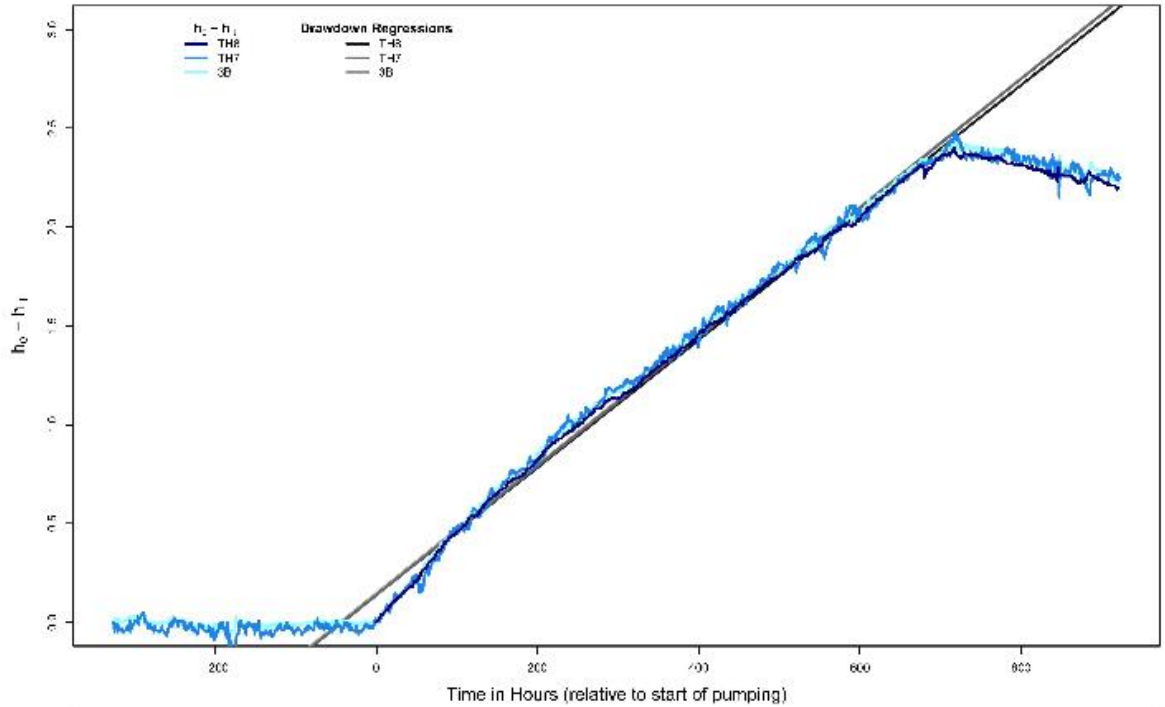
500 GPM 1 Month Pump Test



	TH8 Regression	TH7 Regression	3B Regression
h_0 = head at start of pumping h_t = head at each time step	Regression p-value < 2.2e-16 Adjusted R-squared 0.9958 Slope = 0.00822 ft/hr	Regression p-value < 2.2e-16 Adjusted R-squared 0.9928 Slope = 0.00826 ft/hr	Regression p-value < 2.2e-16 Adjusted R-squared 0.9948 Slope = 0.00825 ft/hr

Figure 3
Belt 500 gpm Pump Test Drawdown vs Time

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GJK - 2018 - 2-28

New Direction

Step 5: Drill near new plant location

(really stressful.....again!)

- Hit workings 2/4 borings (Whew.....)

New Plan: Try injection near the plant into dry workings.

Plan B: Longer pipeline to mine pool

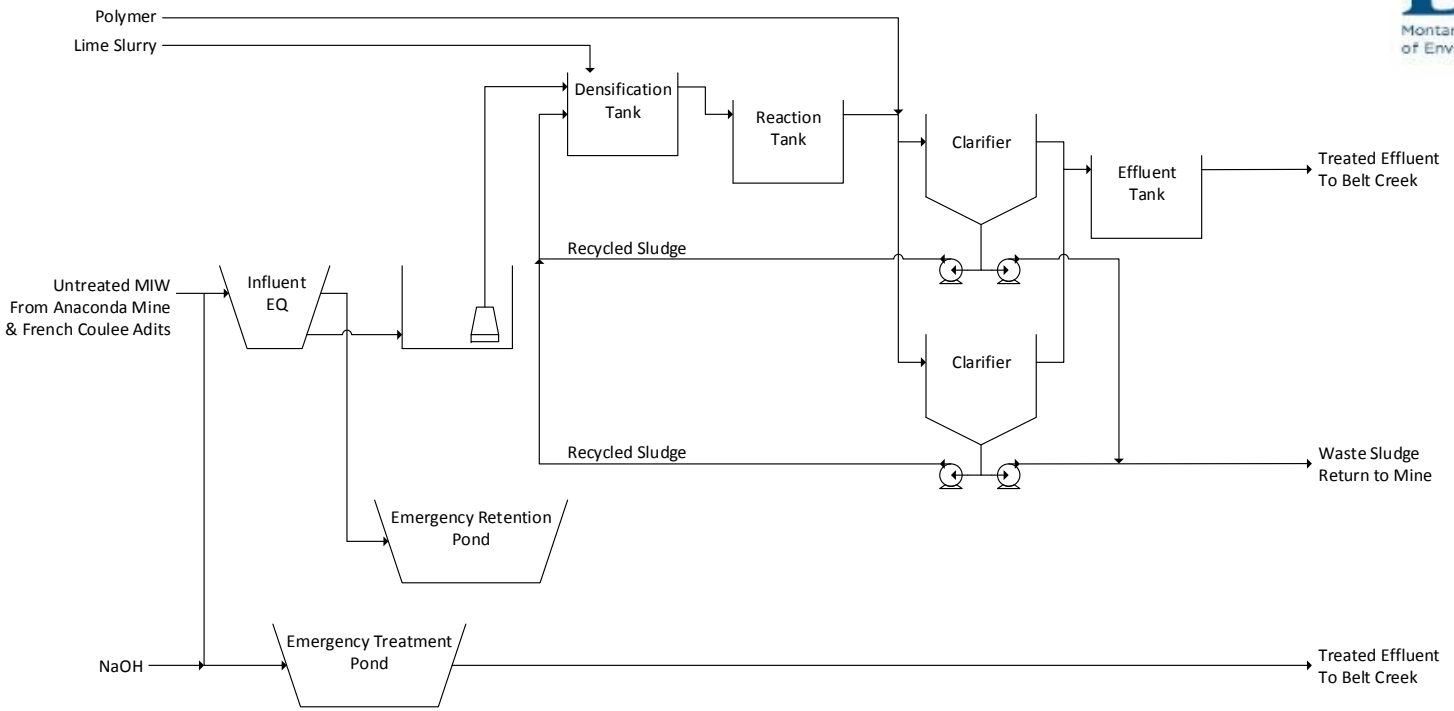
Plan C: Drying ponds?

Dry Underground Workings – New Injection Site

Design Basis

- Maximum Predicteded Flow: 225 gpm
- Single treatment train with dual outdoor clarifiers
- Design Basis for collection, process equipment and storage ponds: 225 gpm
- Design Basis for Clarifiers: 165 gpm (75th percentile)
- Sludge injection 500 feet from plant

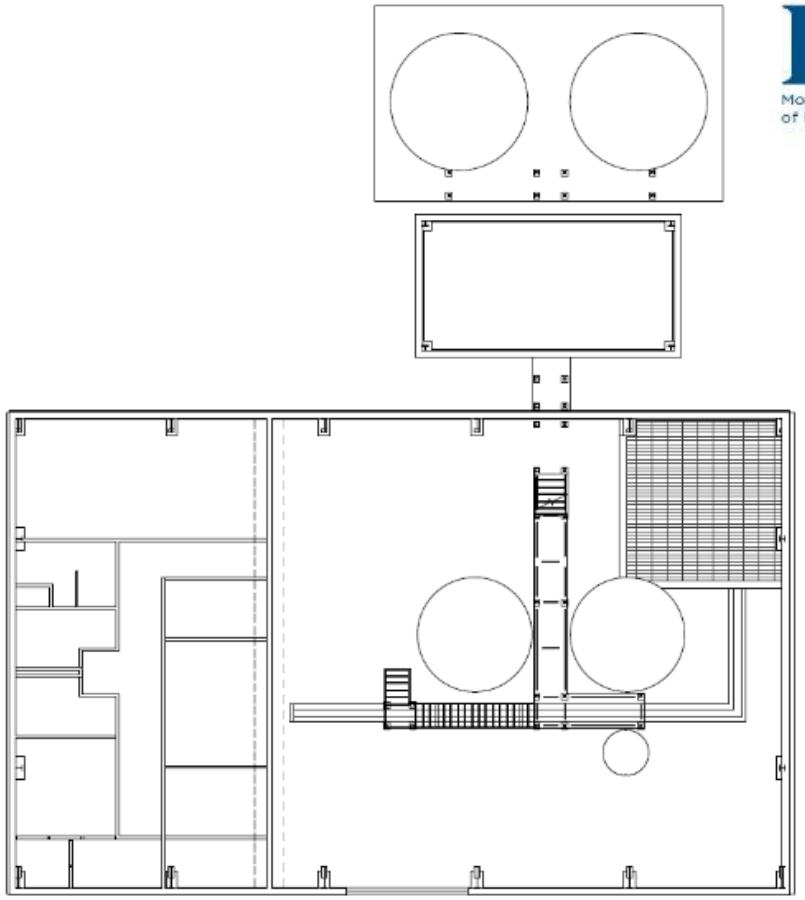
Process Design



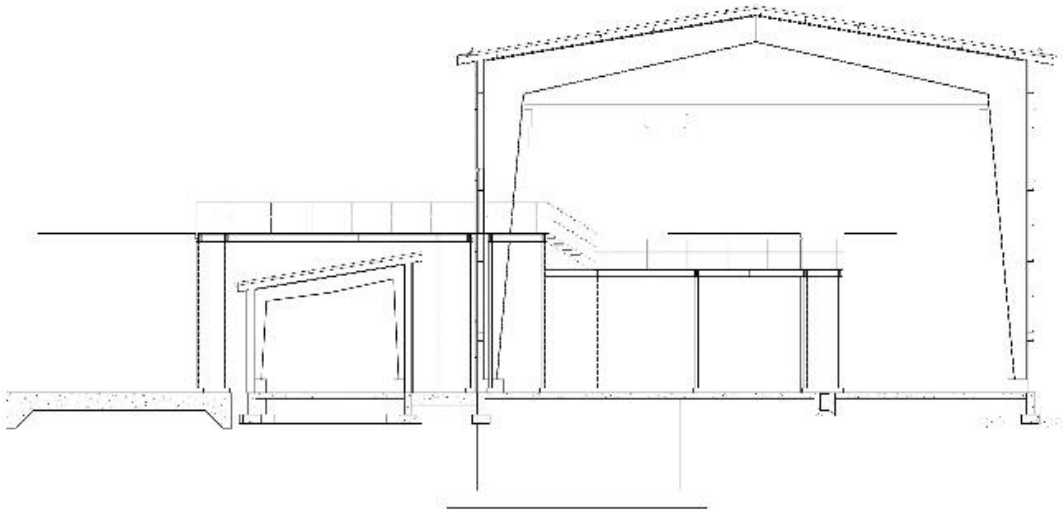
Plant Footprint

- Process Area Features
- Clarifiers outside reduce building footprint
- Elevated walkways to access tanks and clarifiers
- Staging and storage
- Potential future expansion
  - Zeolite treatment
  - Oxidation
- Crane rail system for equipment maintenance

- Administrative Area Features
- Shower
- 2 restrooms
- Meeting Room
- Break Room
- Control Room



Plant Cross Section



Contingencies

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Currently Considering:

- Caustic dosing and settling pond below adit
- Pond with 2-week retention time near the plant
- Dual Clarifiers

Plant Layout

Questions?

Fun Fact

Tom Henderson, besides being an excellent human and great hydrogeologist, was the base guitarist for a 1990's grunge band from Denver, Colorado that opened for Green Day.