PIONEER TECHNICAL SERVICES

Reducing Design Uncertainty with Comparative Numerical Groundwater Modeling at a Former Smelter Site in Butte, Montana

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Presented by:

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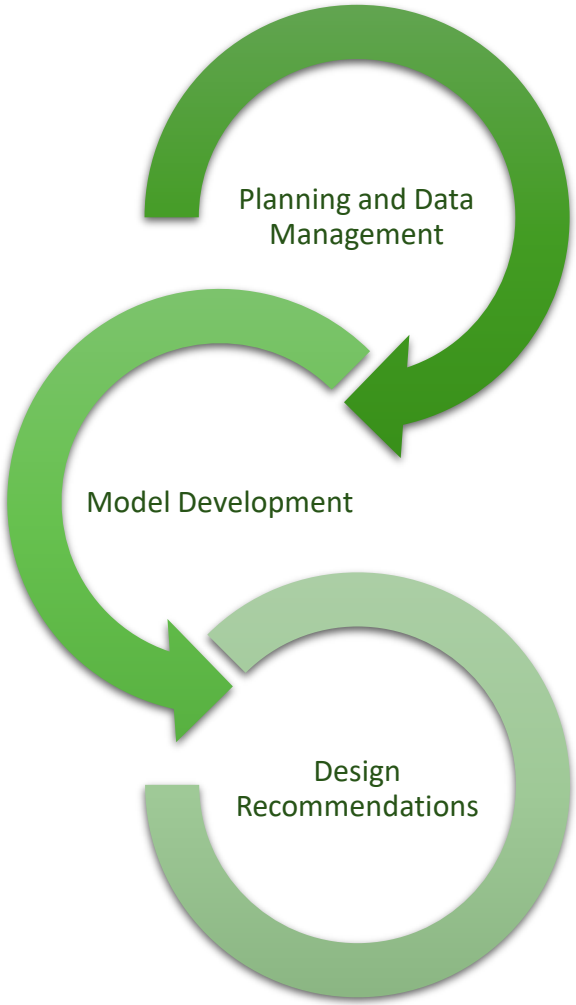
FORGING A BRIGHT & SUSTAINABLE FUTURE TOGETHER

Presentation Outline

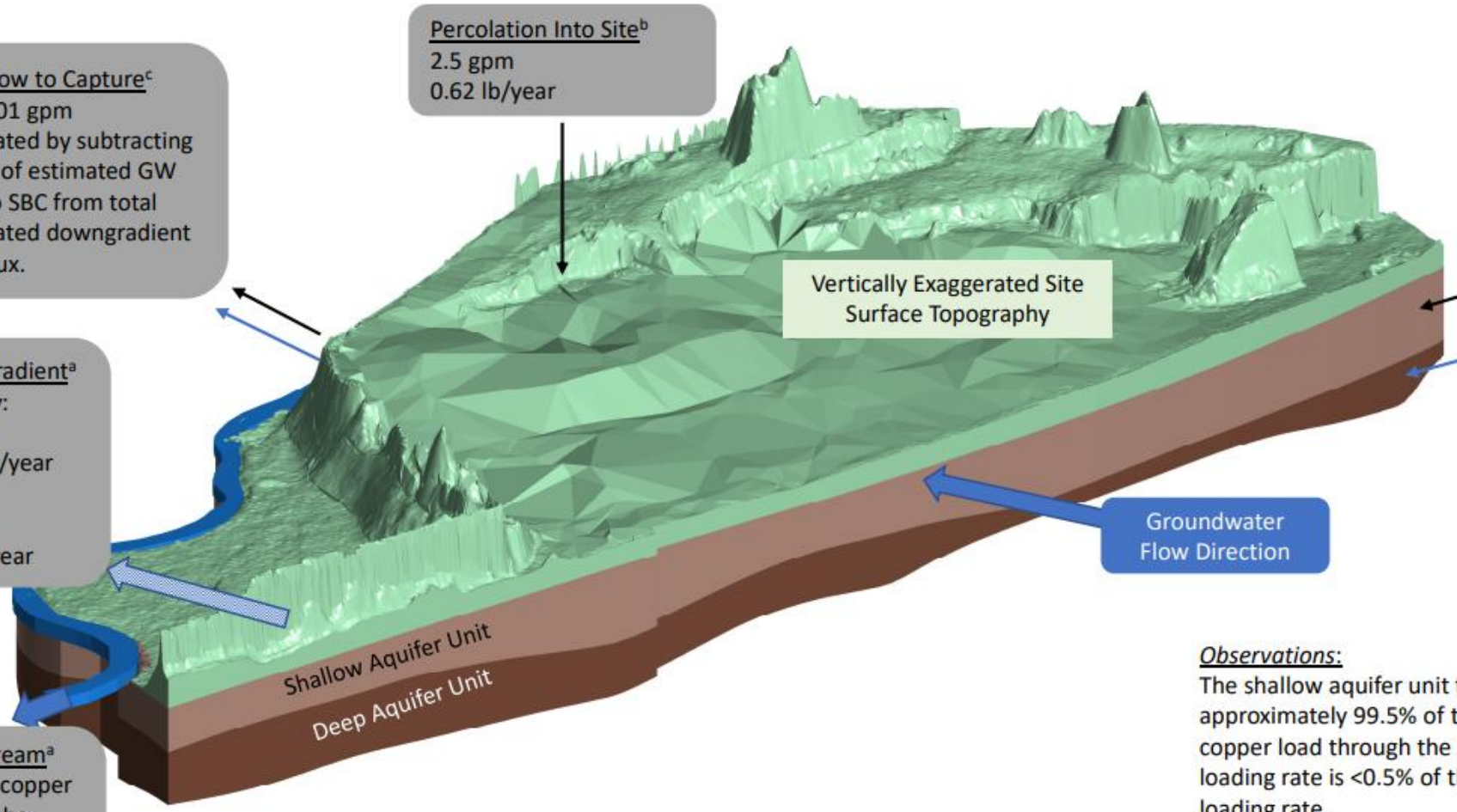
- Site Background
- Model Objectives
- Development and Calibration
- Comparative Design Scenarios
- Takeaways



Site Background

- Historical mining/industrial activities generated waste materials (tailings, slag, debris).
- Percolation of water through tailings, slag, and other historical mining waste materials leaches metals and carries them into the groundwater system.
- The primary contaminants of concern (COCs) are metals and metalloids from mine waste materials. Arsenic, cadmium, copper, lead, zinc, and mercury.

Conceptual Site Model

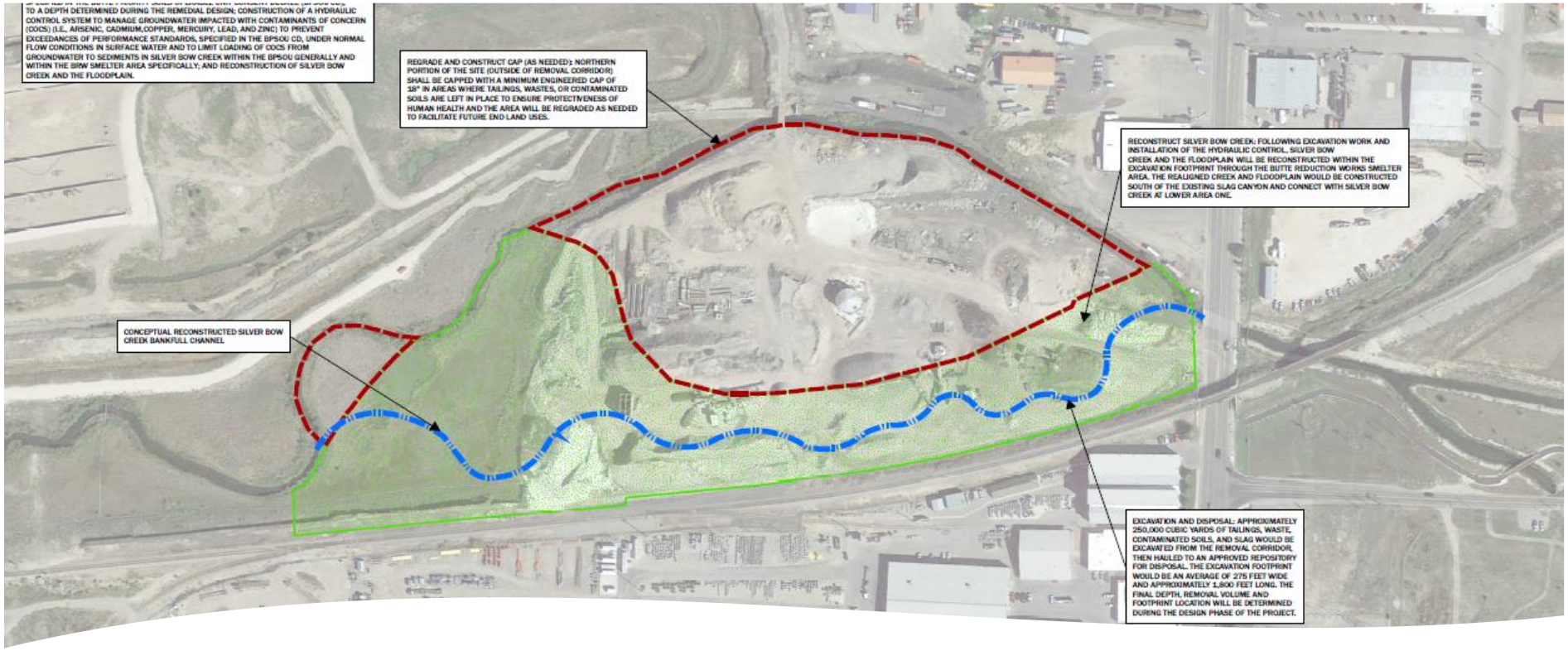


Observations:
The shallow aquifer unit transmits approximately 99.5% of the downgradient copper load through the Site; the percolation loading rate is <0.5% of the downgradient loading rate.

Purpose:
This figure compares the copper migration pathways at the Site.

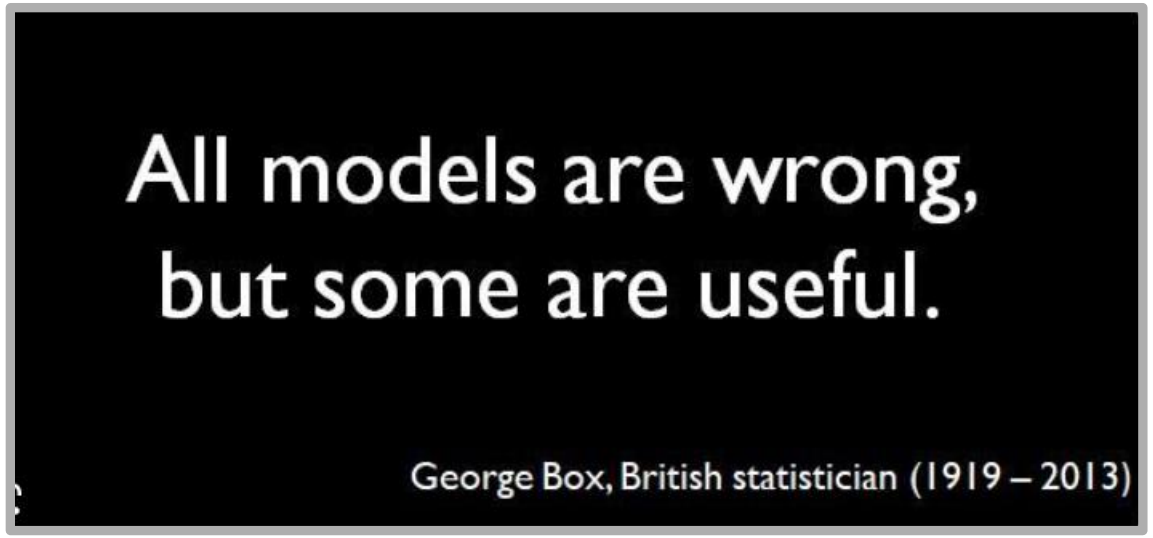
gpm – gallons per minute, lb/year – pounds per year, µg/L – micrograms per liter
[a] Data from *Table H-6: Summary of Flow and Copper Loading*
[b] Data from *Table H-10: Estimates of Percolation Load*
[c] Data from *SBC Loading Analysis Tech Memo*, Appendix G to BRW PDI ER

Selected Remedy



- **<u>Tailings, Waste, Impacted Soils, Slag Excavation, Removal, and Disposal</u>**
- Realign SBC Below the Confluence with Blacktail Creek and Construct 100-Year Floodplain
- **<u>Hydraulically Control and Treat COC-Impacted Groundwater within the Site</u>**
- Regrade and Construct Cap(s)
- Construction of End-Land-Use Features (trails, parking lot, plaza, etc.)

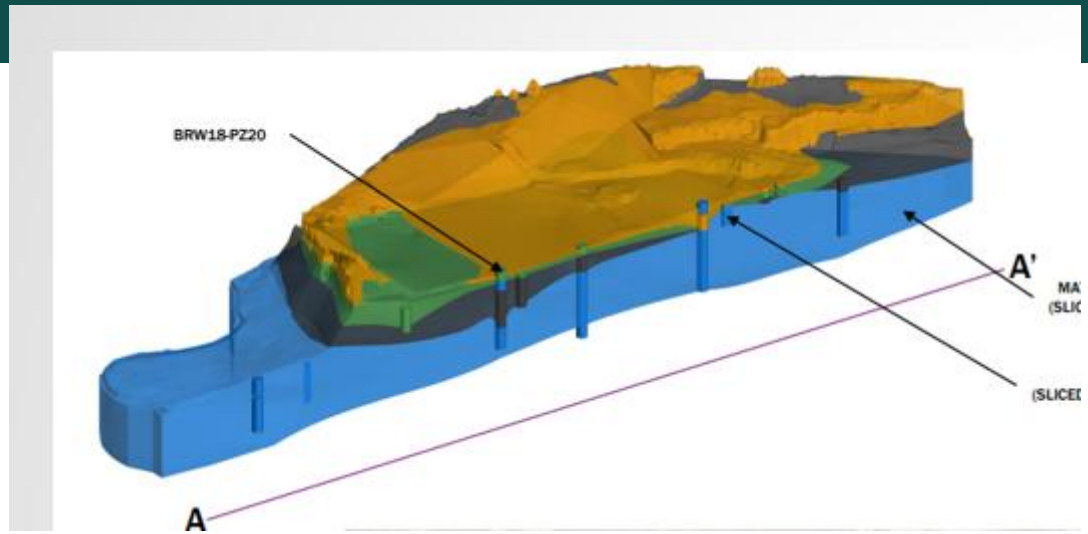
Model Objectives

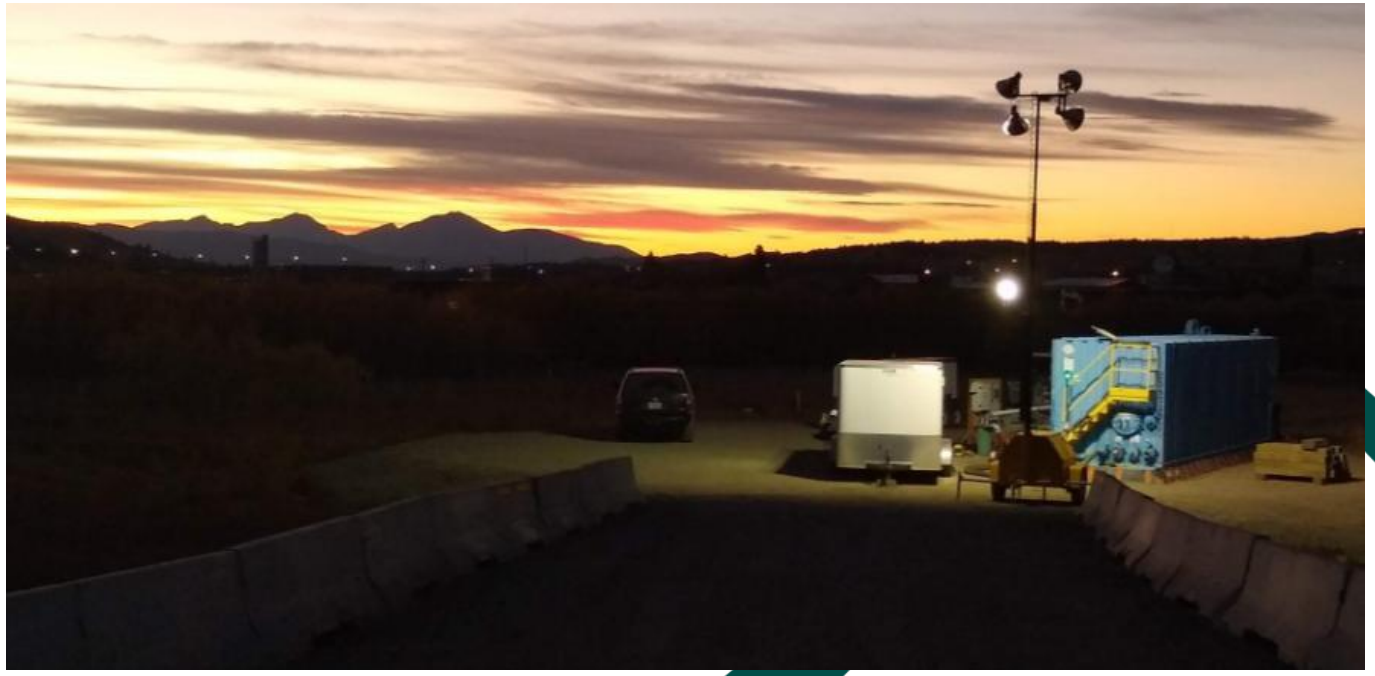


- Simulate construction dewatering and groundwater capture
- Compare design alternatives
- Visualize groundwater flow
- Chemical model not appropriate or necessary with the given extent of the dataset and remediation goals

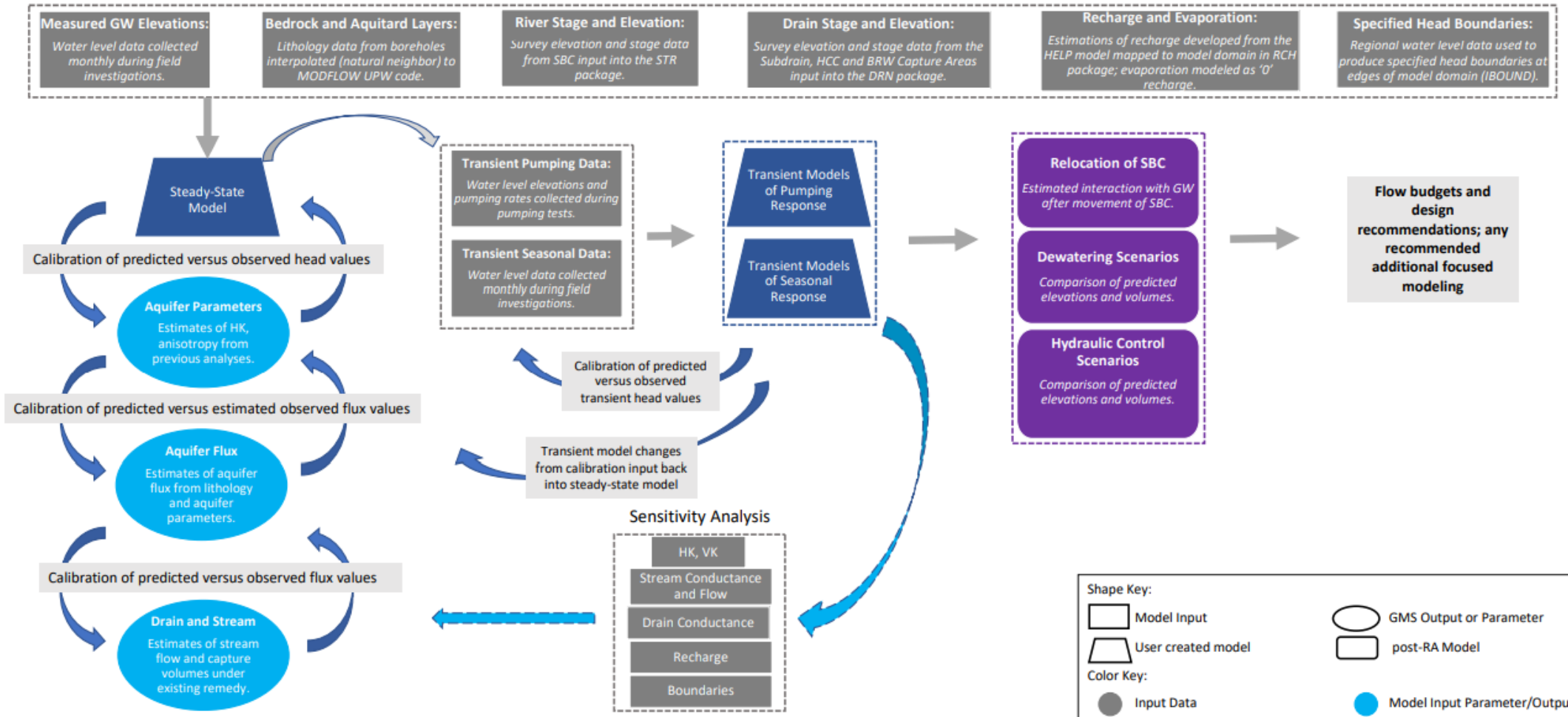
Available Dataset

- Existing monitoring wells
- Paired piezometers
- Pumping tests
- Site lithology model
- Regional geology
- Stream gages/transects
- Capture stages and flows
- Site groundwater contours
- Regional groundwater contours
- Other groundwater models (Tetra Tech, Formation)





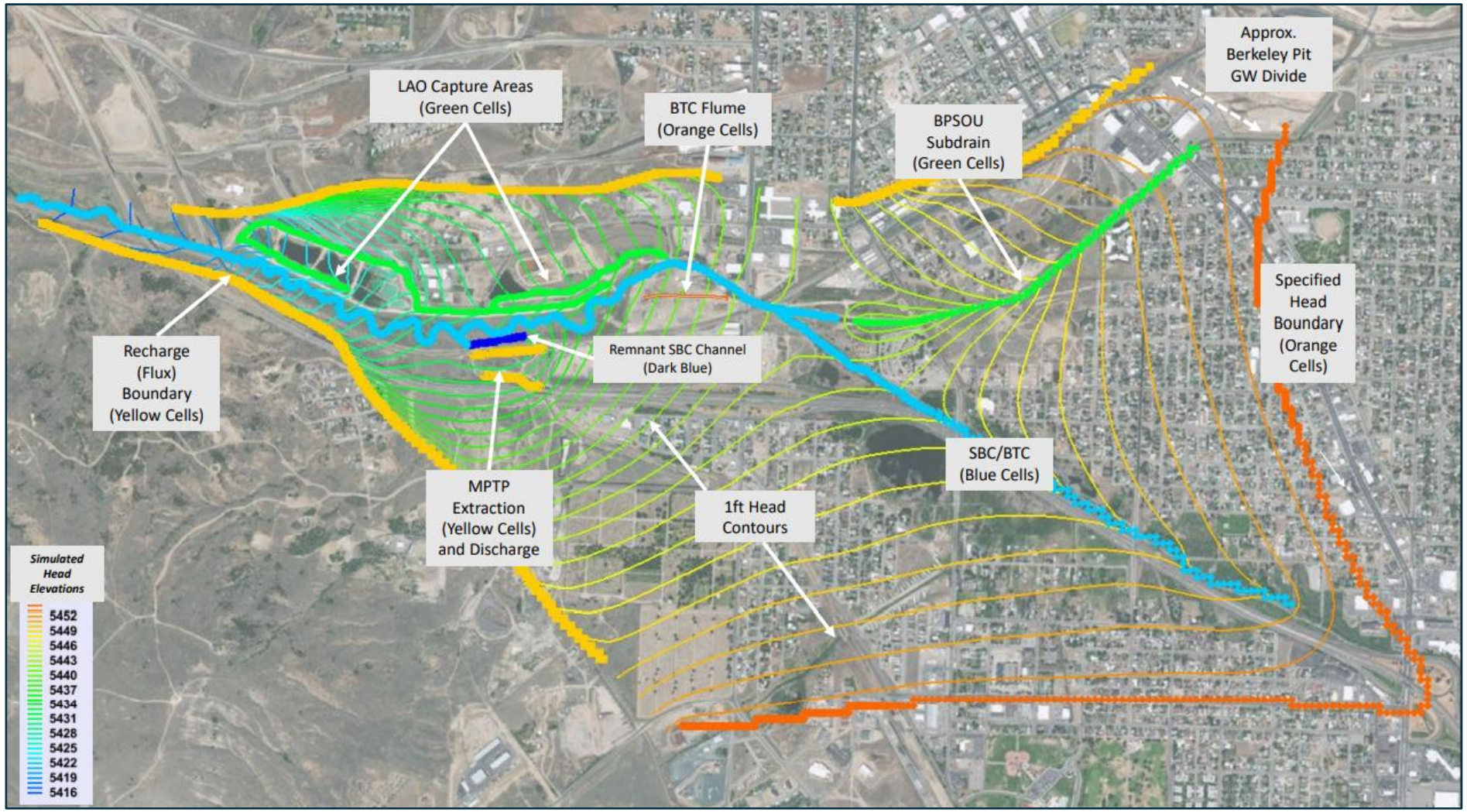
Model Selection



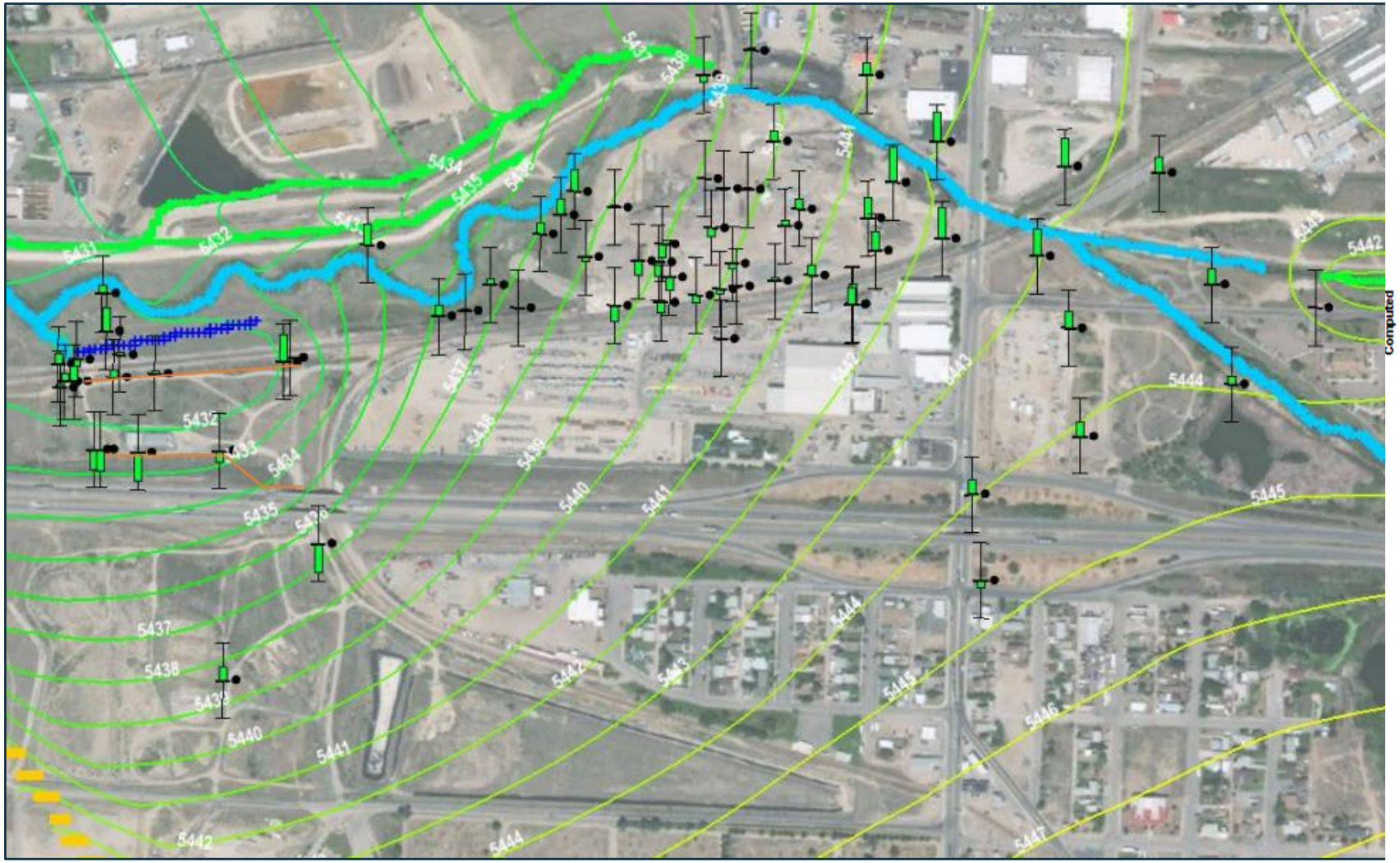
Note:

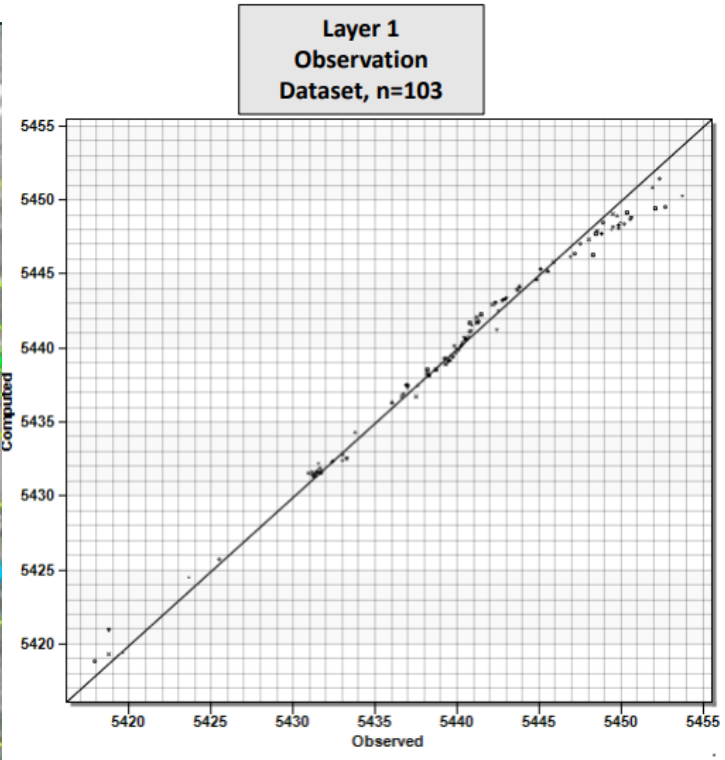
This figure was developed to help the reader understand the flow of the models and outputs created in GMS and how they interact. The shapes surrounding the object names have been categorized (see the shape key and color key to the right) to explain the purpose of each model and output. The arrows indicate how the model inputs, outputs, and calibration interact. The overall goal of the BRW GW Model is to inform the design of construction dewatering and hydraulic control at the Site. Specific details on how the models were created are in Appendix H to the BRW PDI Evaluation Report.

Model Domain



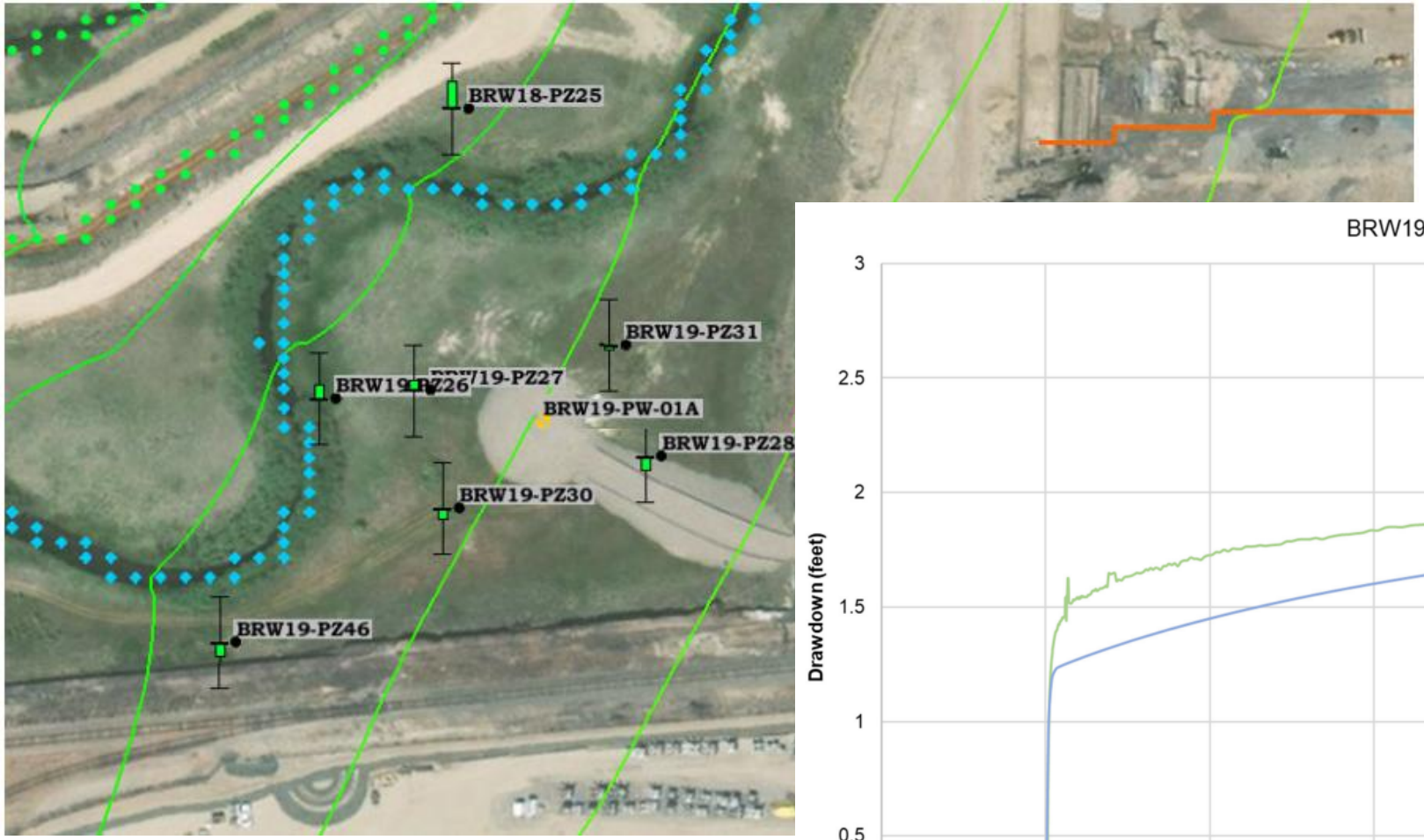
Calibration - Head

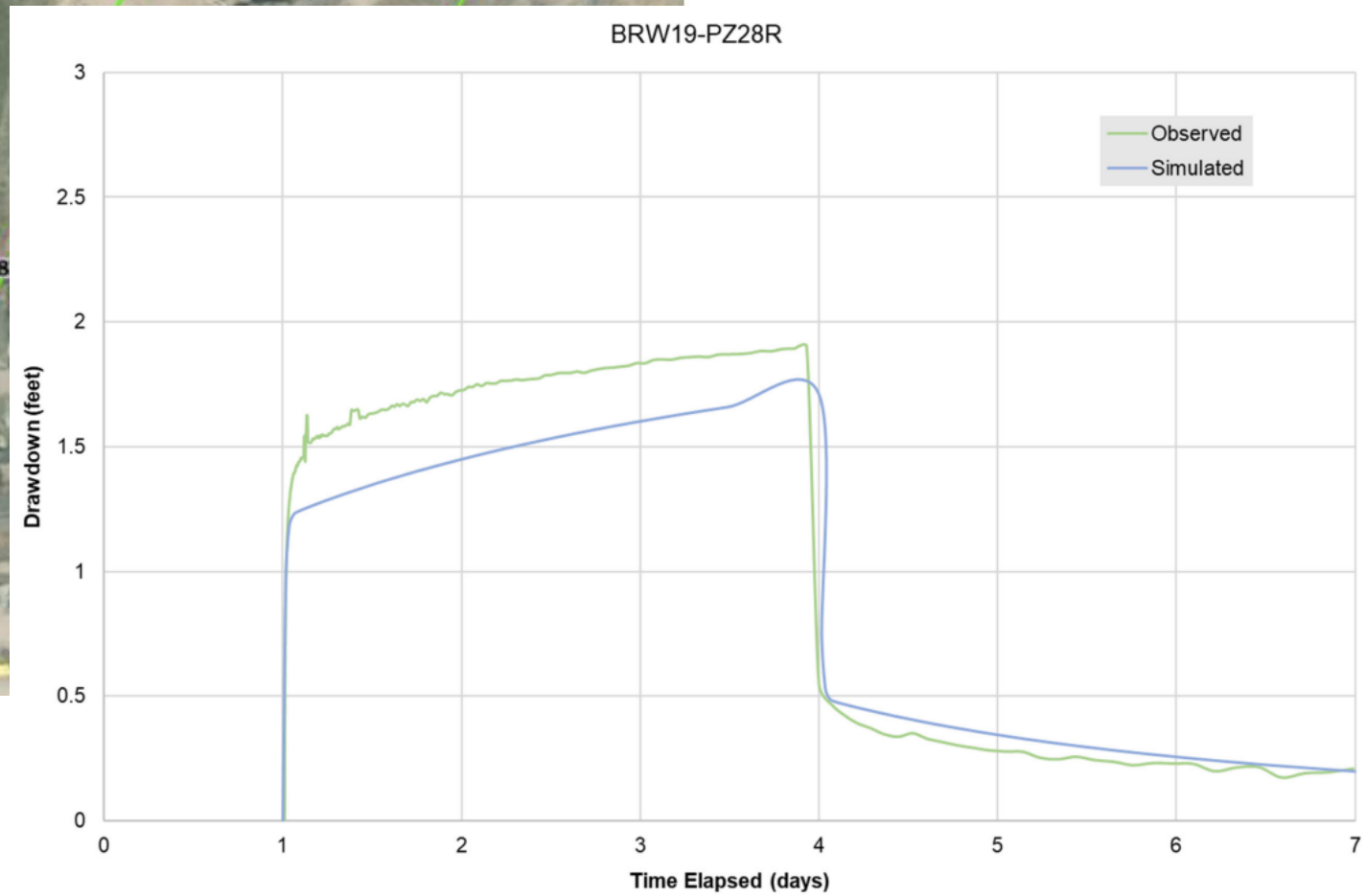




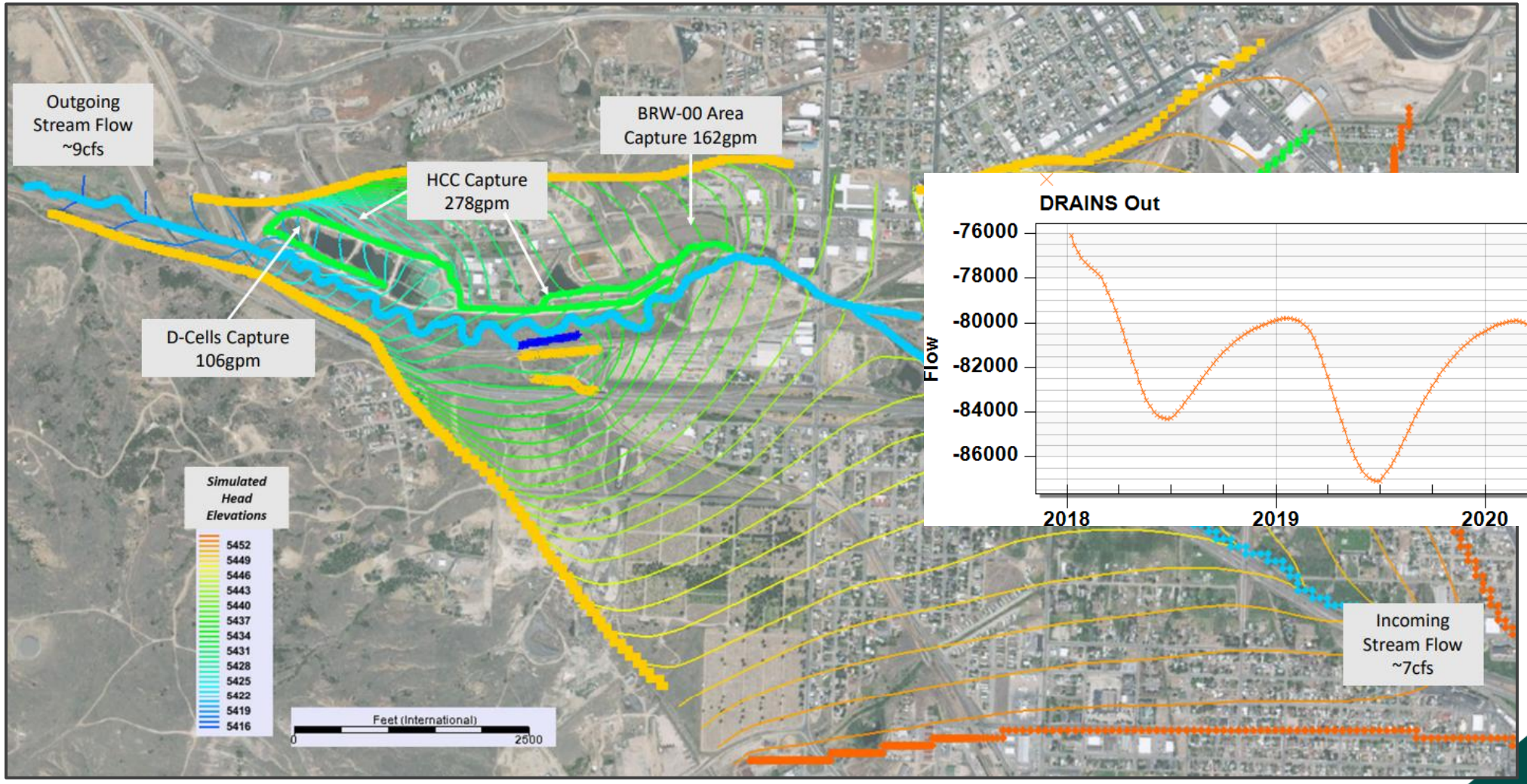
Residual Error Statistics -Layer 1	
Mean residual	0.19
Min. residual	-2.18
Max. residual	3.32
Absolute value mean residual	0.59
Root Mean Square (RMS)	0.85
Range of Observed Head	35.8
RMS/Range	2.4%
Absolute mean residual/Range	1.6%

Calibration - Head

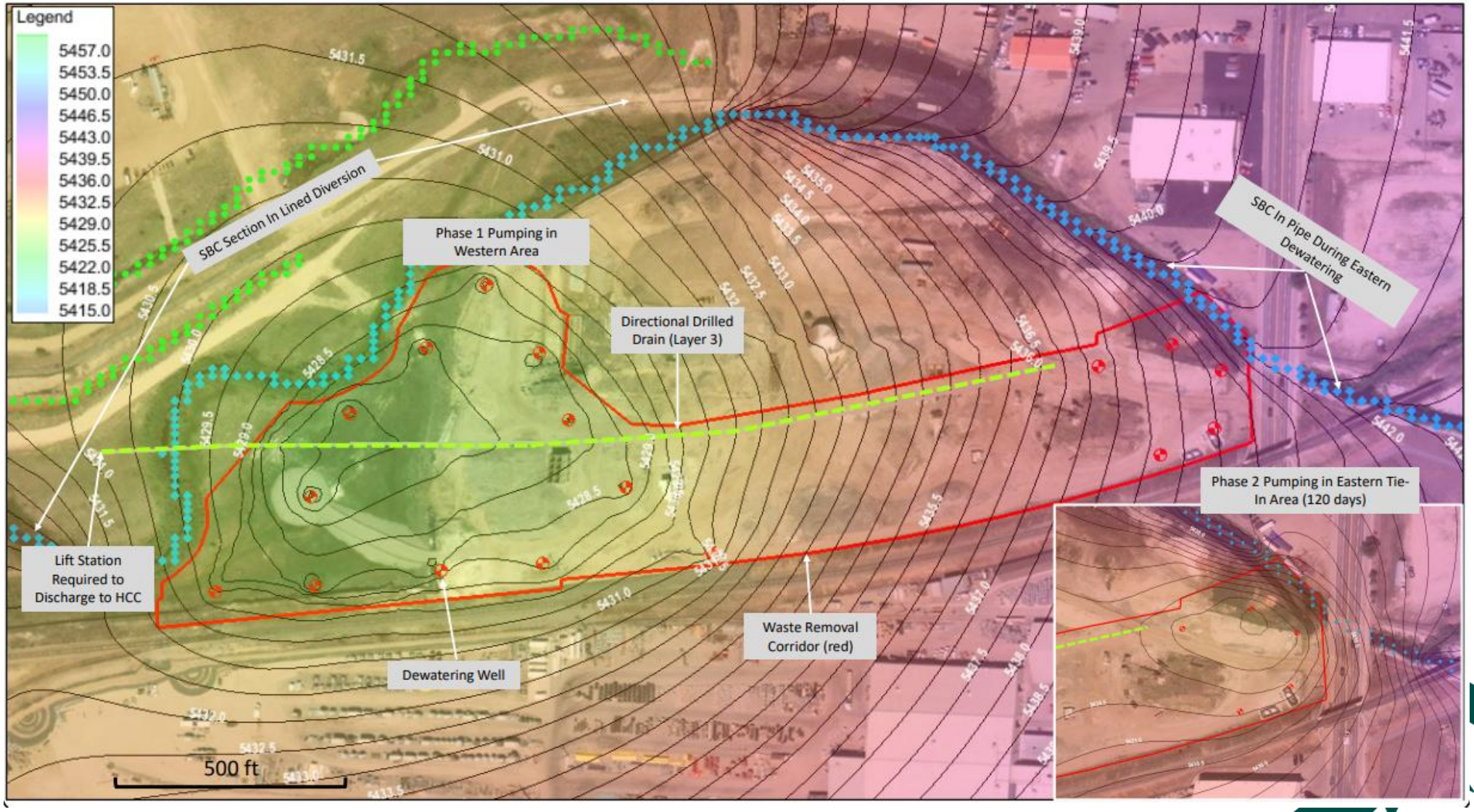




Calibration - Flux



Comparative Modeling Scenarios - Dewatering



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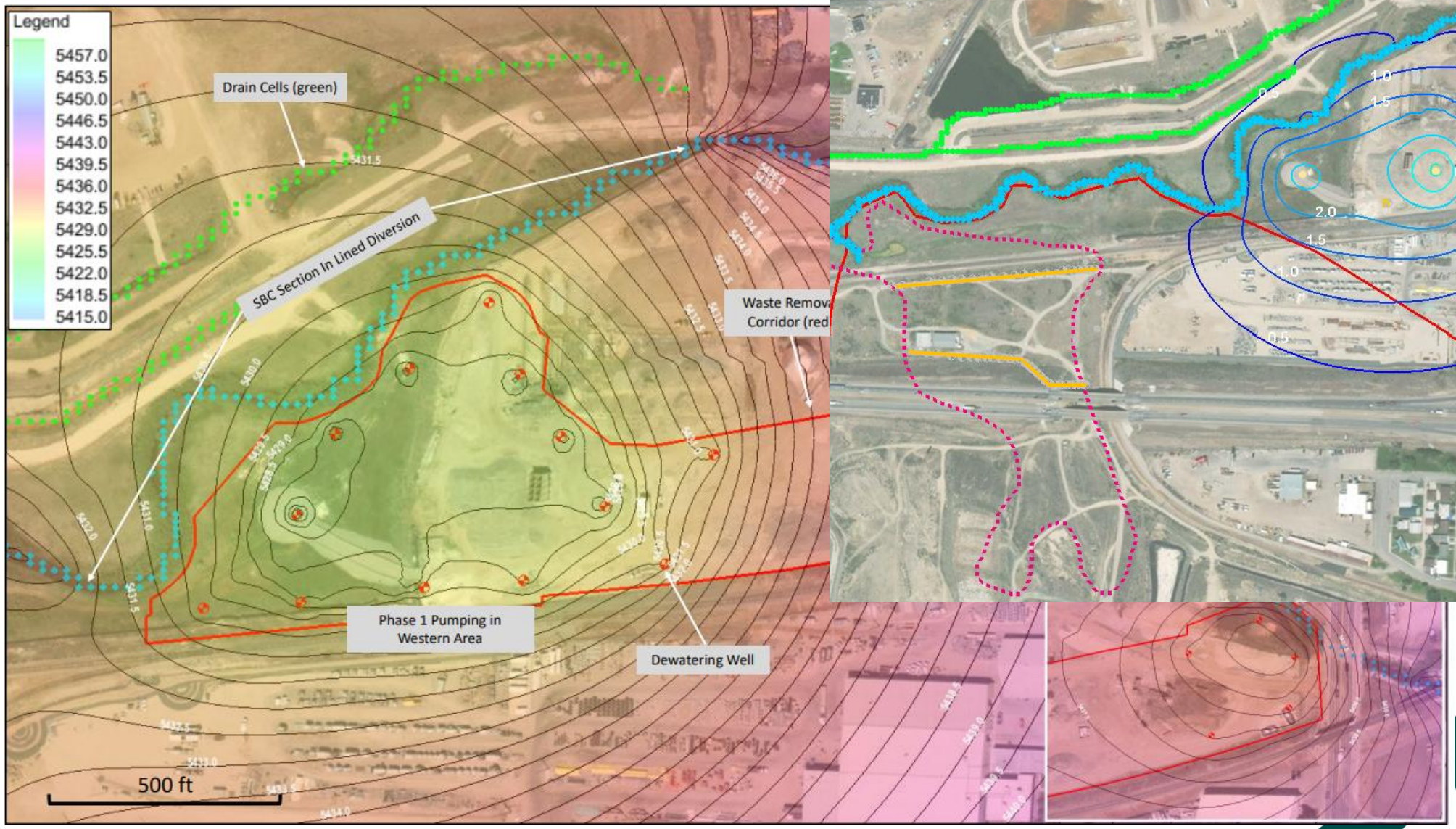

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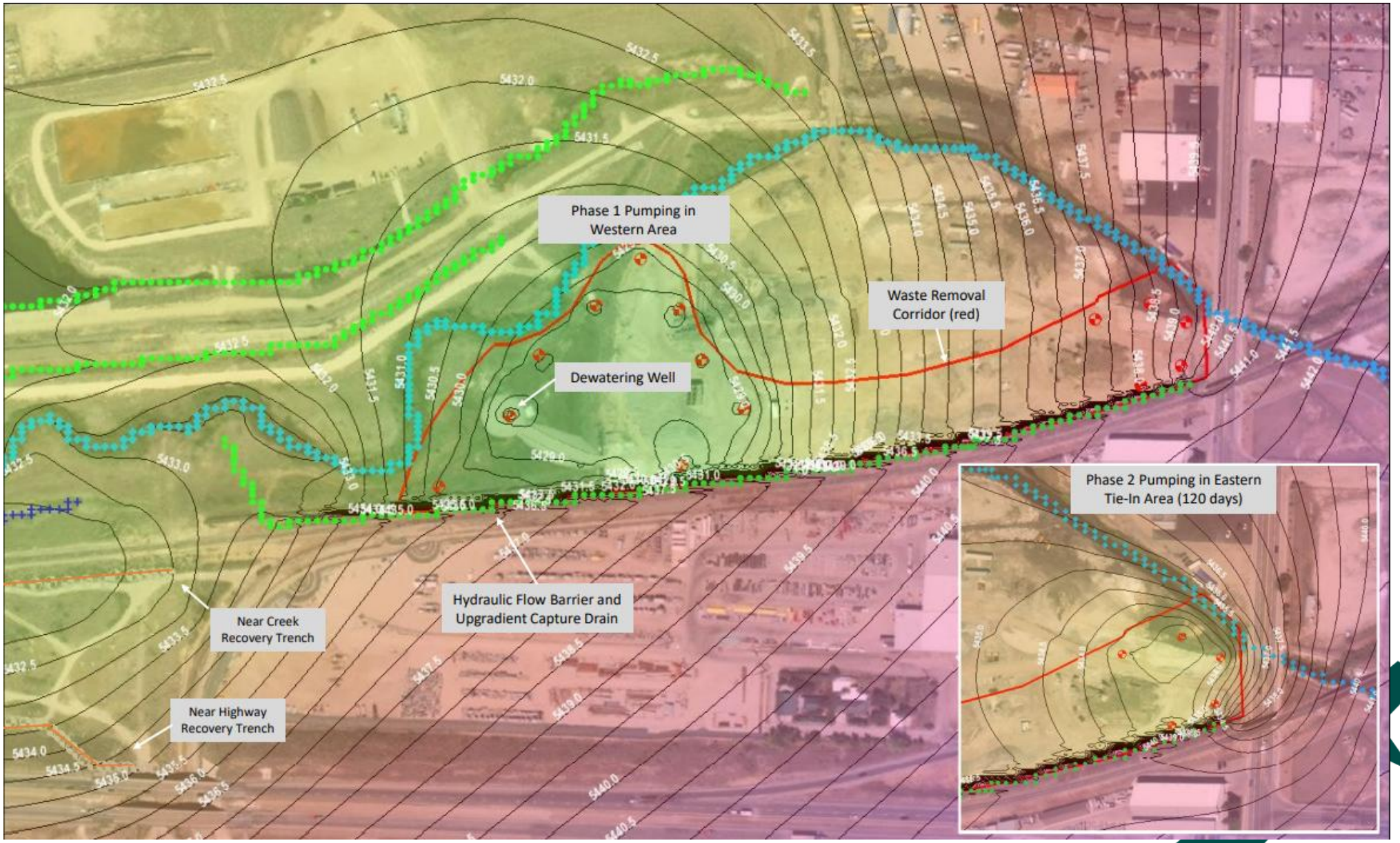
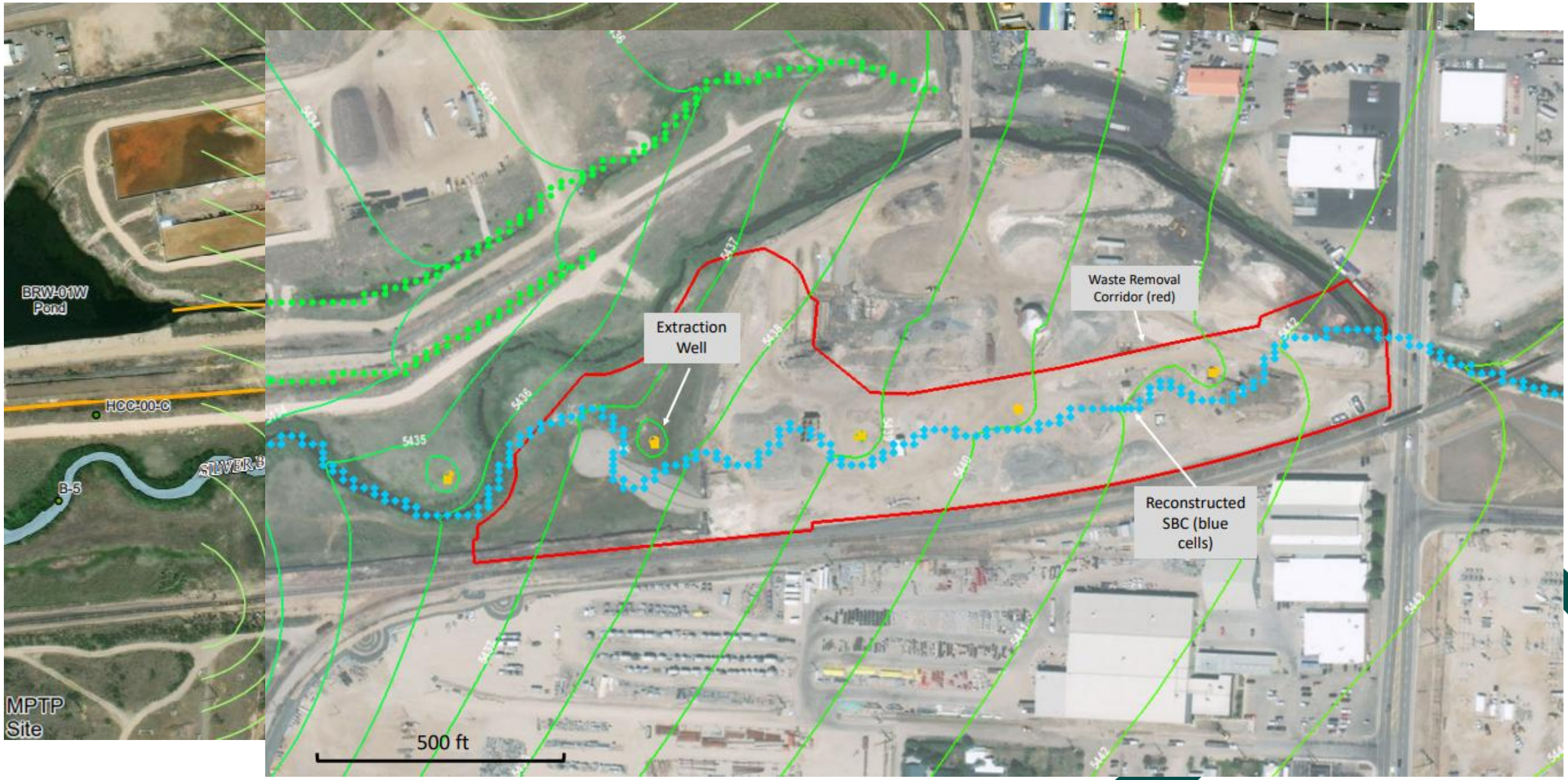


Comparative Modeling Scenarios – Hydraulic Control



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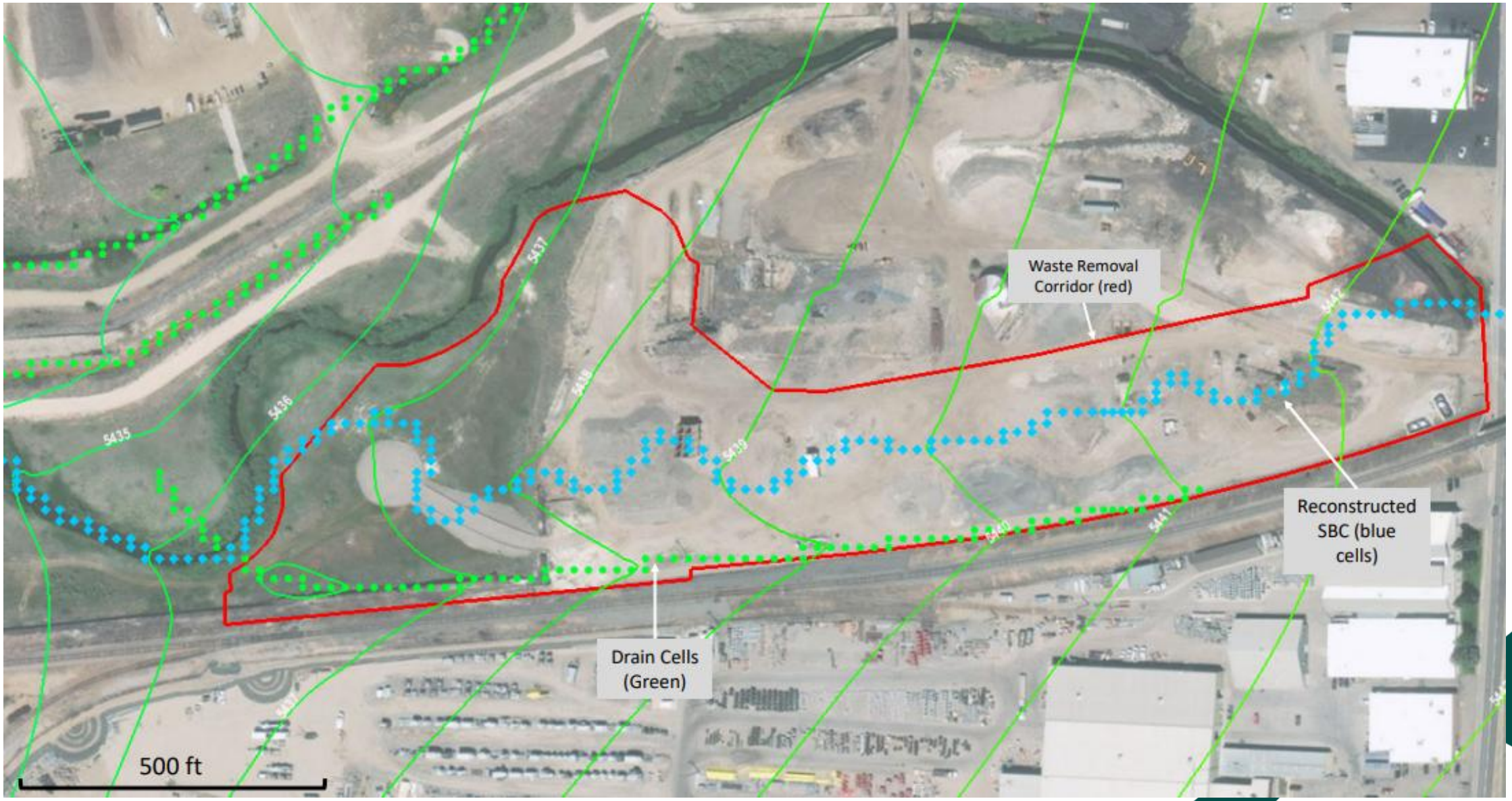

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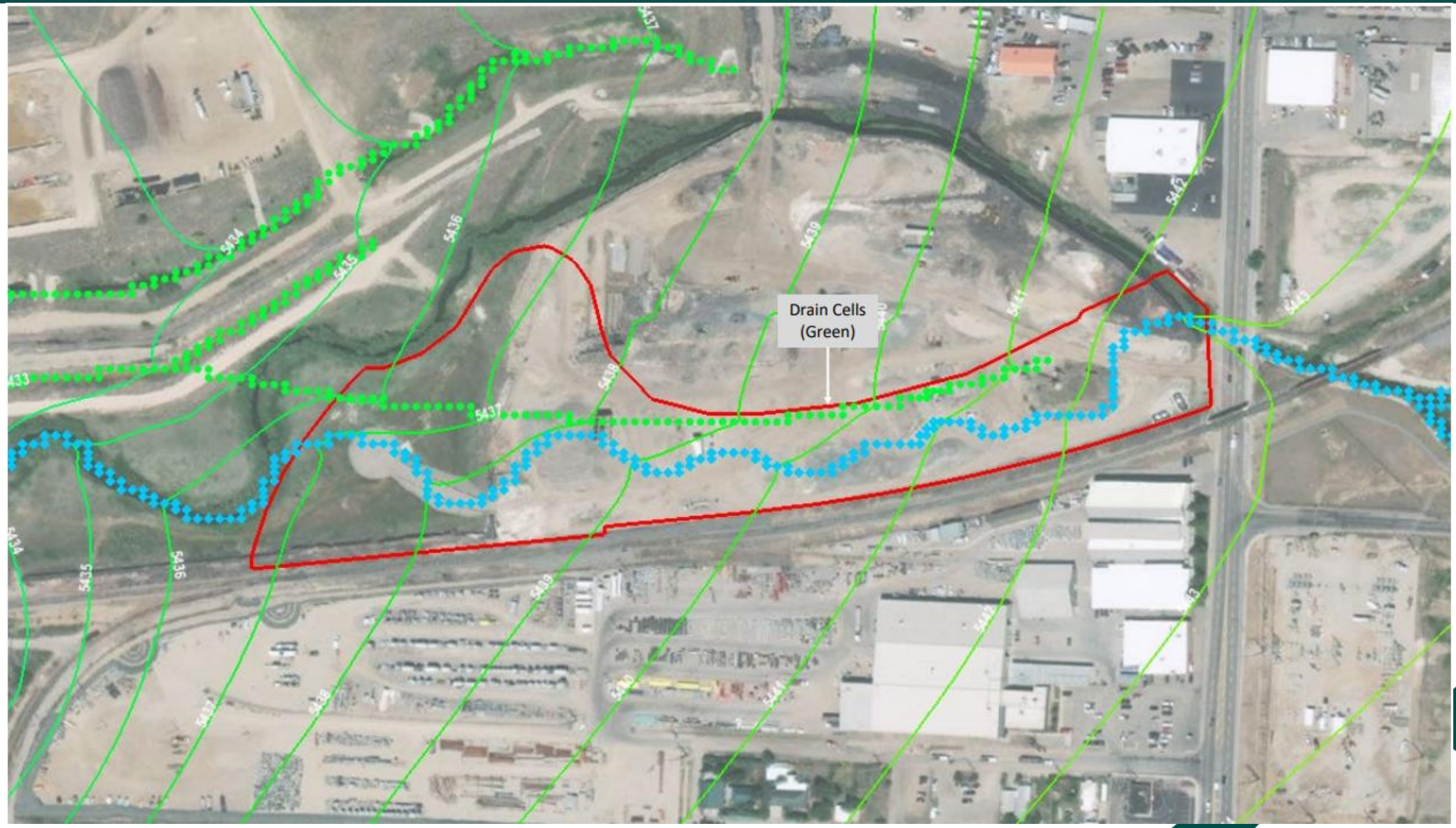

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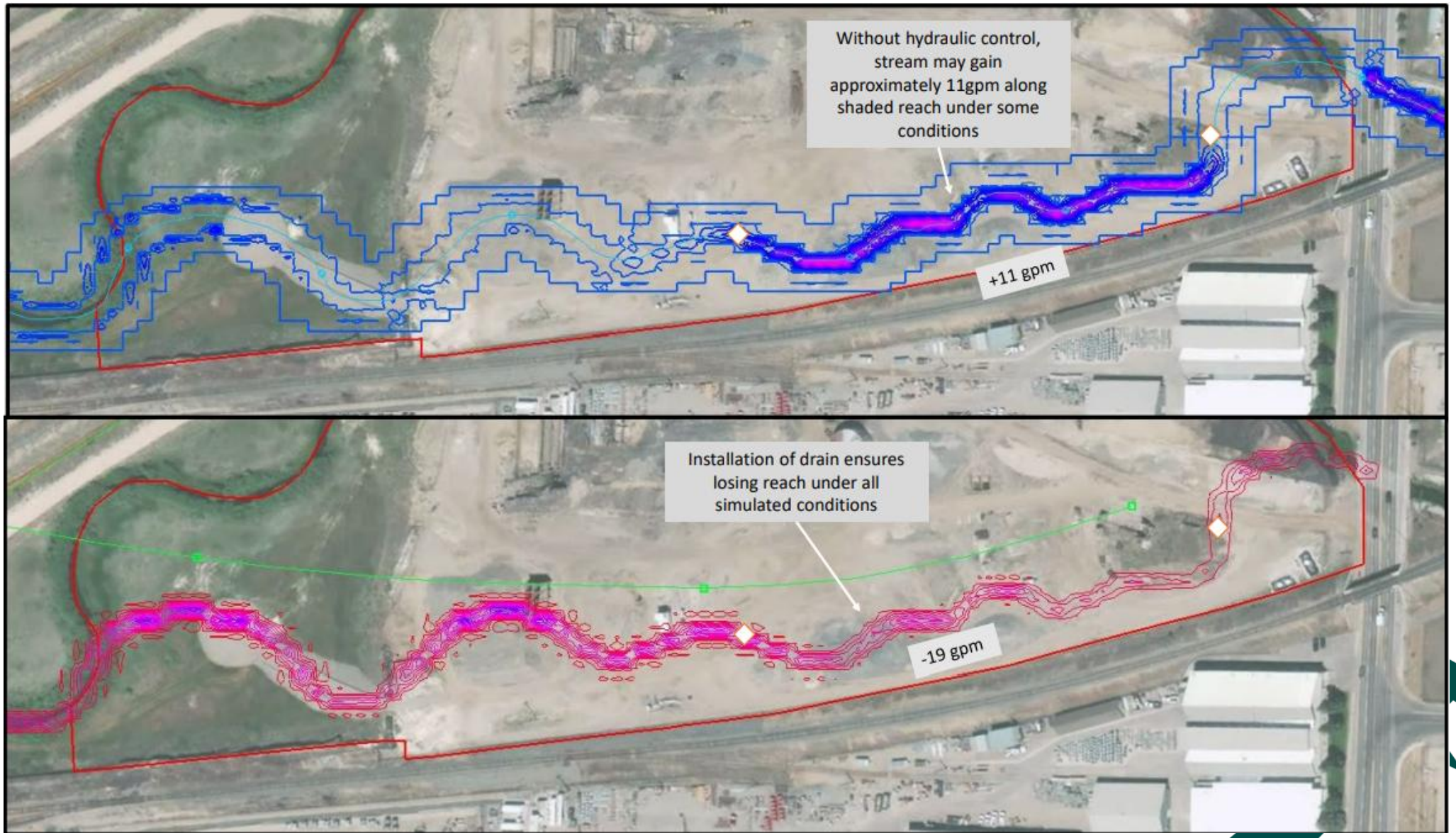

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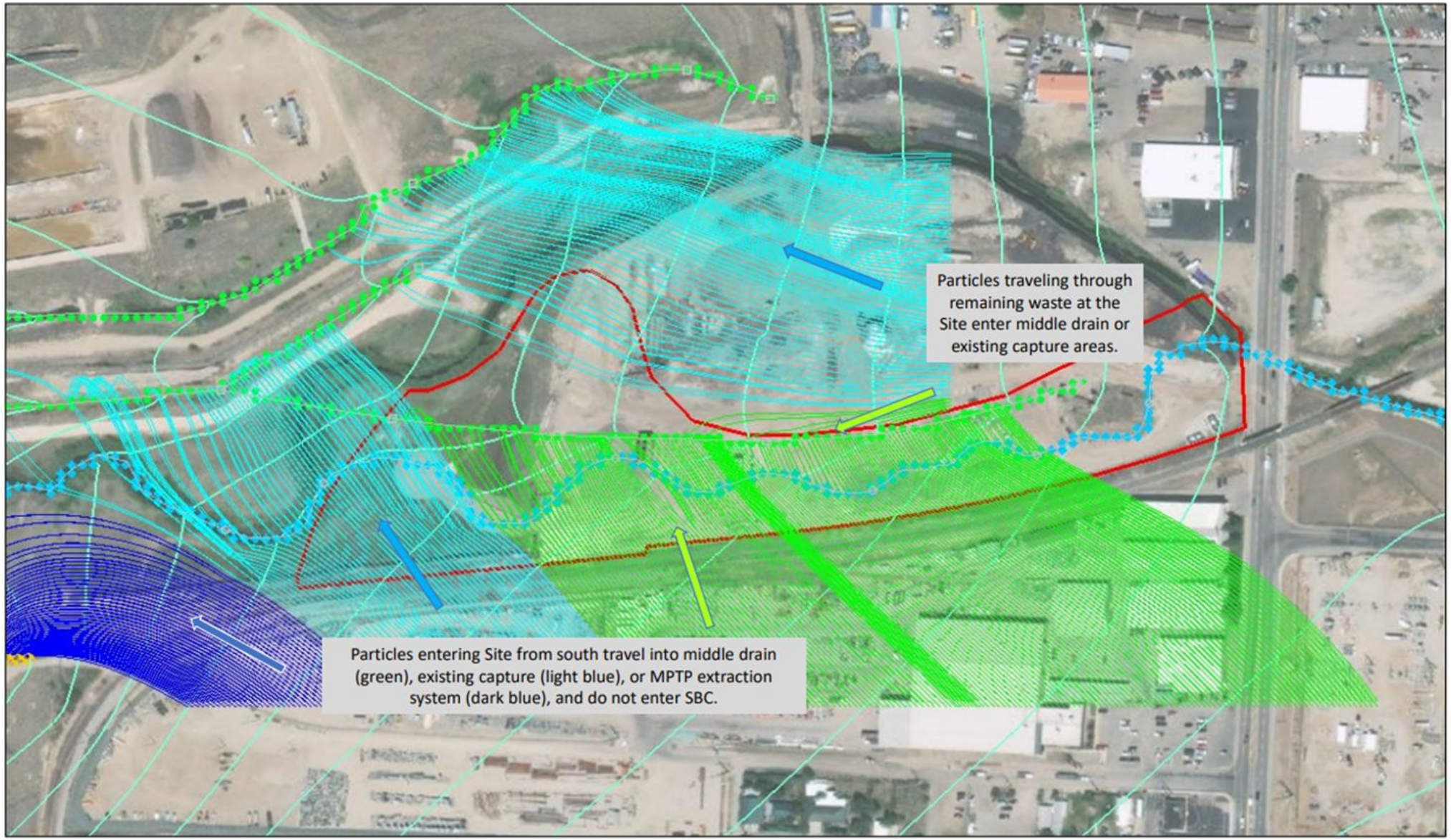

Takeaways

Waste Excavation

Construction Dewatering Design

Installation of Hydraulic Barrier

Silver Bow Creek Diversion

Hydraulic Control

Shallow Drain Installed North of Silver Bow Creek

Estimated Capture Volumes for Treatment

Keep the big picture in mind.

What is your error??

You might be able to model it, but should you?

Thank You!

- Karen Helfrich
- Maria Pomeroy
- Mike Borduin
- Damon Taylor