



TETRA TECH

# Beal Mountain Mine

## Leach Pad Problems, Investigation & Closure Plan

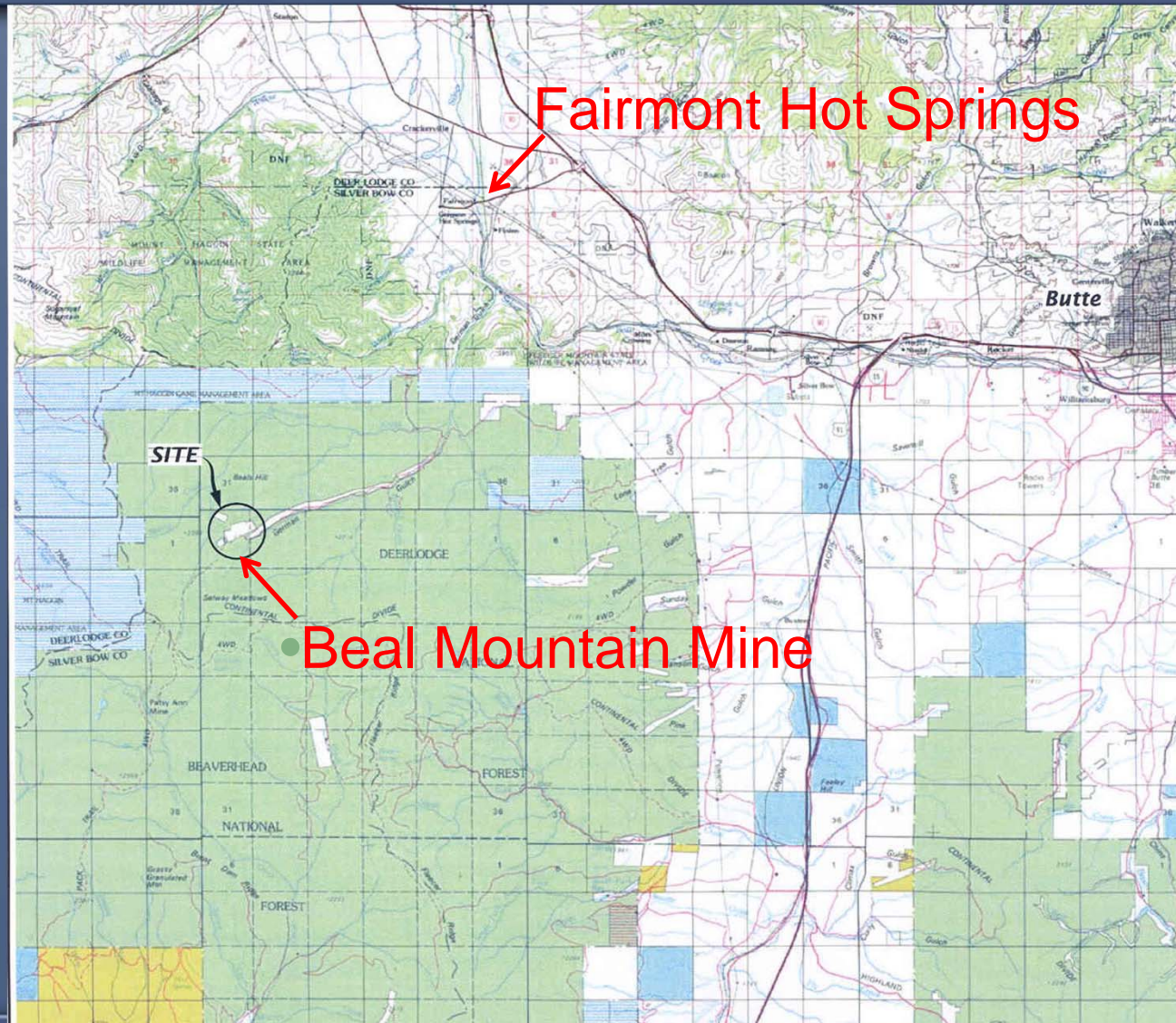


**Mine Design, Operations  
& Closure Conference**

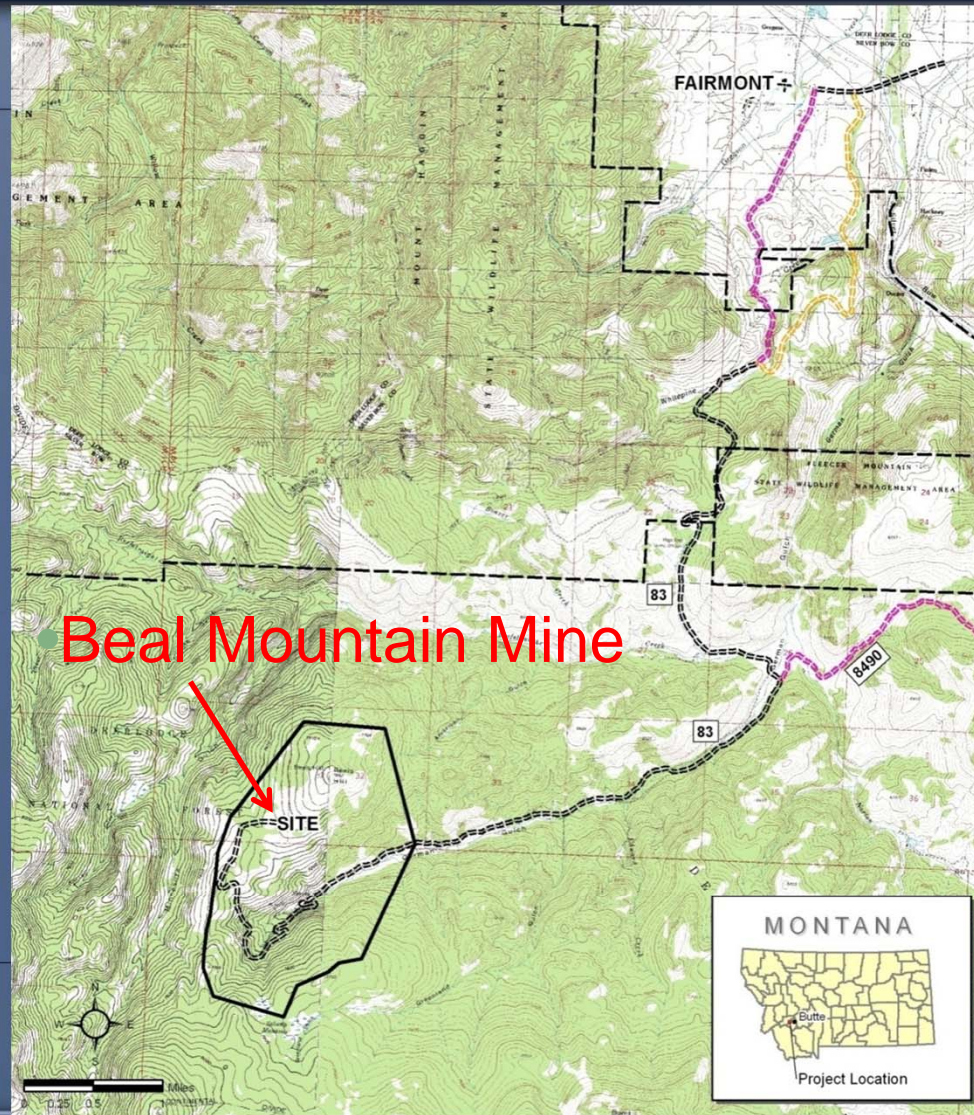
**May 1-5, 2011**

Allan Kirk  
Mike Hatten  
Jim Maus  
Mary Beth Marks, USFS

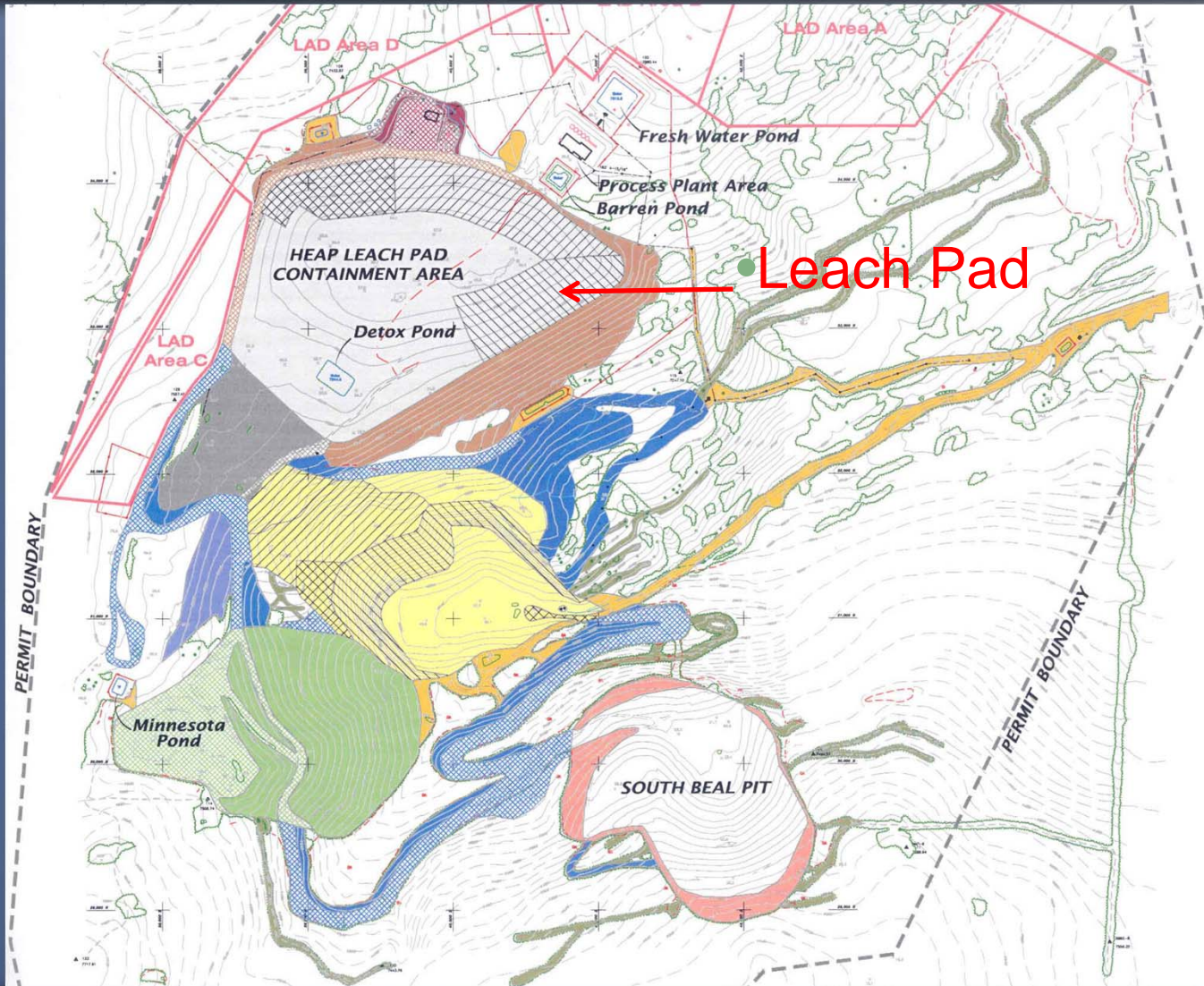
# General Location Map



# Site Vicinity Map – Permit Area Boundary



# Beal Mountain Mine - Facility Map



## Beal Heap Leach Pad – looking west

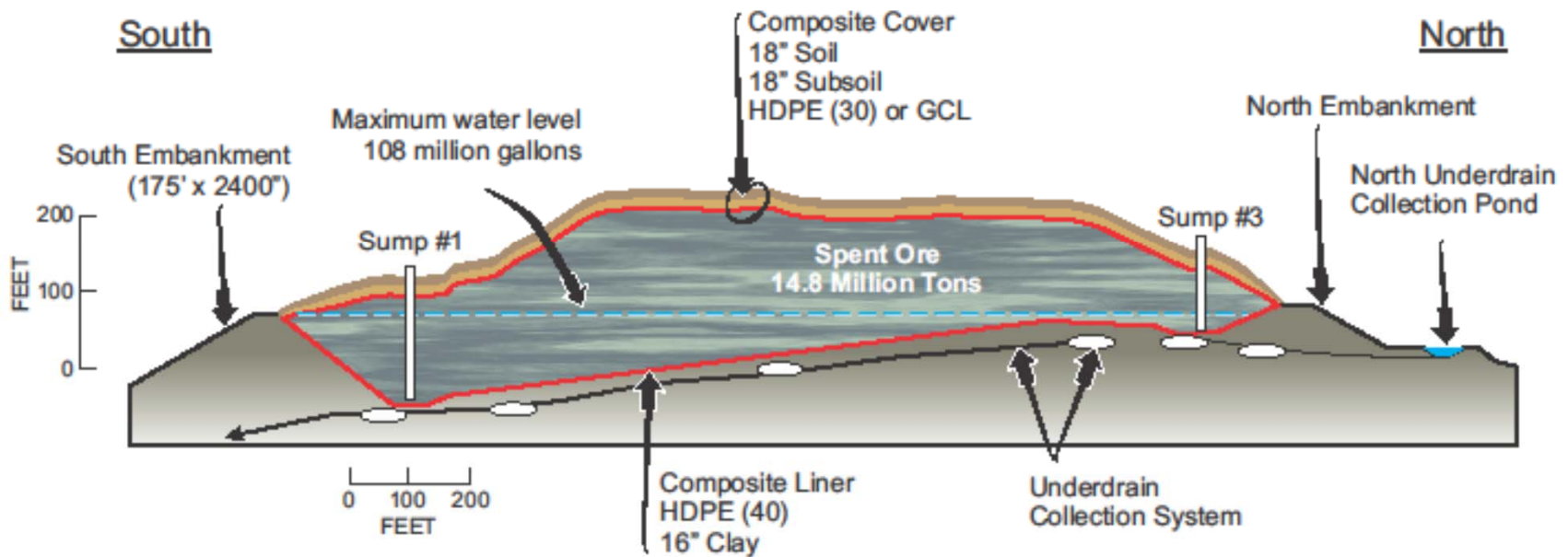


77 acres  
108 million gallon capacity  
15-17 inches ppt per year

10/02/2006



# Leach Pad Conceptual Construction



# Leach Pad Problems

**Excessive Water Accumulation  
and Water Balance  
Very Poor Water Quality**



## Solution Accumulation by Month

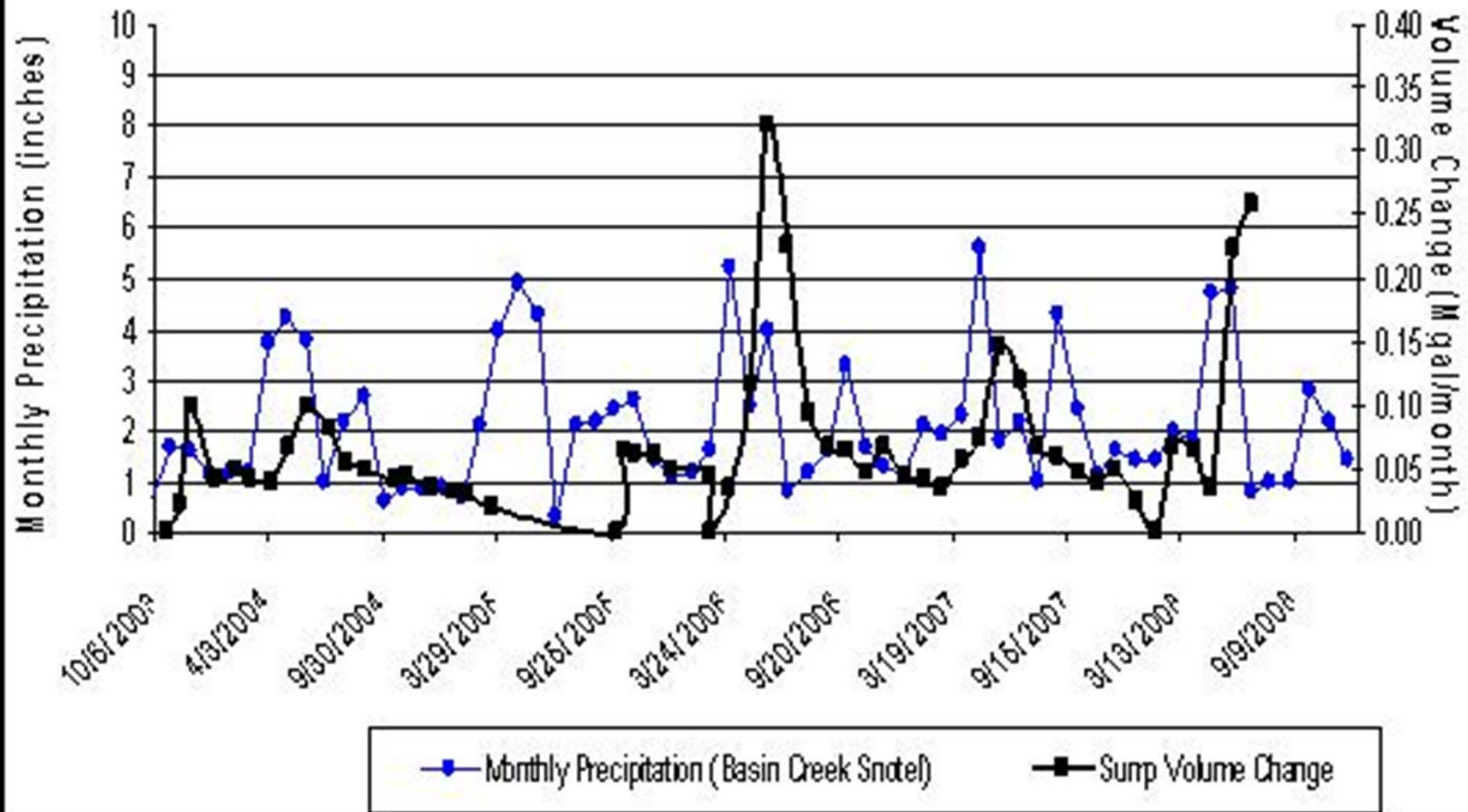
**TABLE 3-10**  
**RATE OF SOLUTION ACCUMULATION ON THE LEACH PAD BY**  
**MONTH**

<b>Months of the Year</b>	<b>Millions of Gallons per Month</b>
April	2.0 to 2.5
May and June	6.0 to 8.0
July and August	2.5 to 3.0
September through March	1.4
<b>Total</b>	<b>28.8 to 34.3</b>





# Leach Pad – Monthly Precipitation vs. Volume Change



Follows annual Precipitation and GW hydrograph



# Drifted Snow North Side of Leach Pad



# Leach Pad Water Balance Issues

- Water is of very poor quality and needs to be treated before discharge
- Water must be treated to maintain reasonable water levels on the pad (no overflow, minimize risk of failure)



RO Treatment System

# Heap Leach Pad Potential Excess Water Sources

- Possibilities -
  - Leaking through geotextile cover on pad
  - Water entering over the top of the bottom liner



# Leach Pad Investigation

Dye Tracer Studies

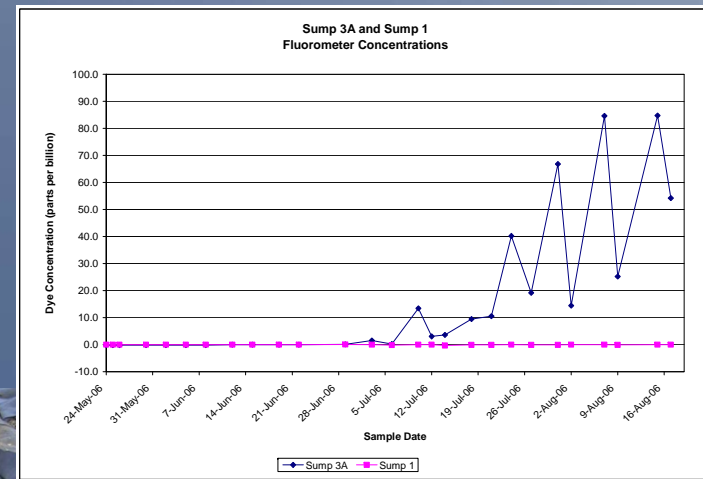
Cover Test Pits

Perimeter Trenches

GW Monitor Wells



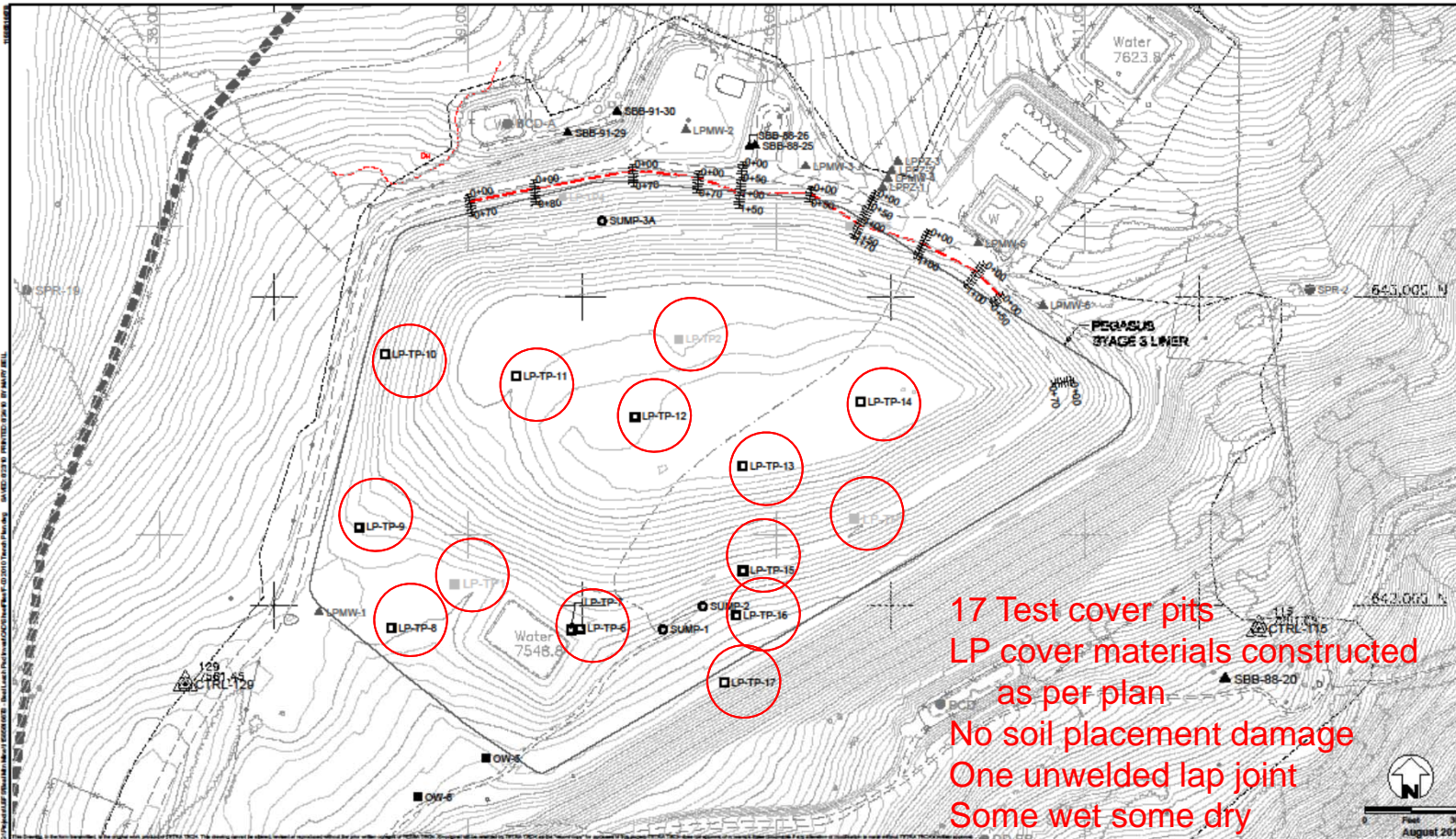
# SW Interceptor Ditch - Dye Tracer Investigation



PVC Joints lapped  
the wrong way



# LP Cover Test Pits



17 Test cover pits  
 LP cover materials constructed as per plan  
 No soil placement damage  
 One unwelded lap joint  
 Some wet some dry



▲ Monitoring Well  
 ● Leach Pad Sump  
 ○ Abandoned Leach Pad Sump  
 ▲ 108  
 7437.07  
 Local Concrete Control Point and Elevation (Feet)

▲ LPMW-2 2009 Leach Pad Investigation Monitoring Well  
 ▲ LPPZ-2 2009 Leach Pad Investigation Plezometer Well  
 □ LP-TP-10 2010 Leach Pad Investigation Test Pit  
 ■ LP-TP-1 2009 Leach Pad Investigation Test Pit

● 2010-LP-TP-1  
 - - - - - Edge of Existing Cover  
 ———— Projection of Pegasus Gauge 3 Bottom Liner  
 2009 - 2010 Leach Pad Trenches  
 0+00  
 0+50

Beal Mountain Mine  
 2010 Leach Pad Phase II Investigation  
 Plan View  
 Silver Bow County, Montana  
 FIGURE 3  
 August 2010



## Cover Test Pits (wet and dry)



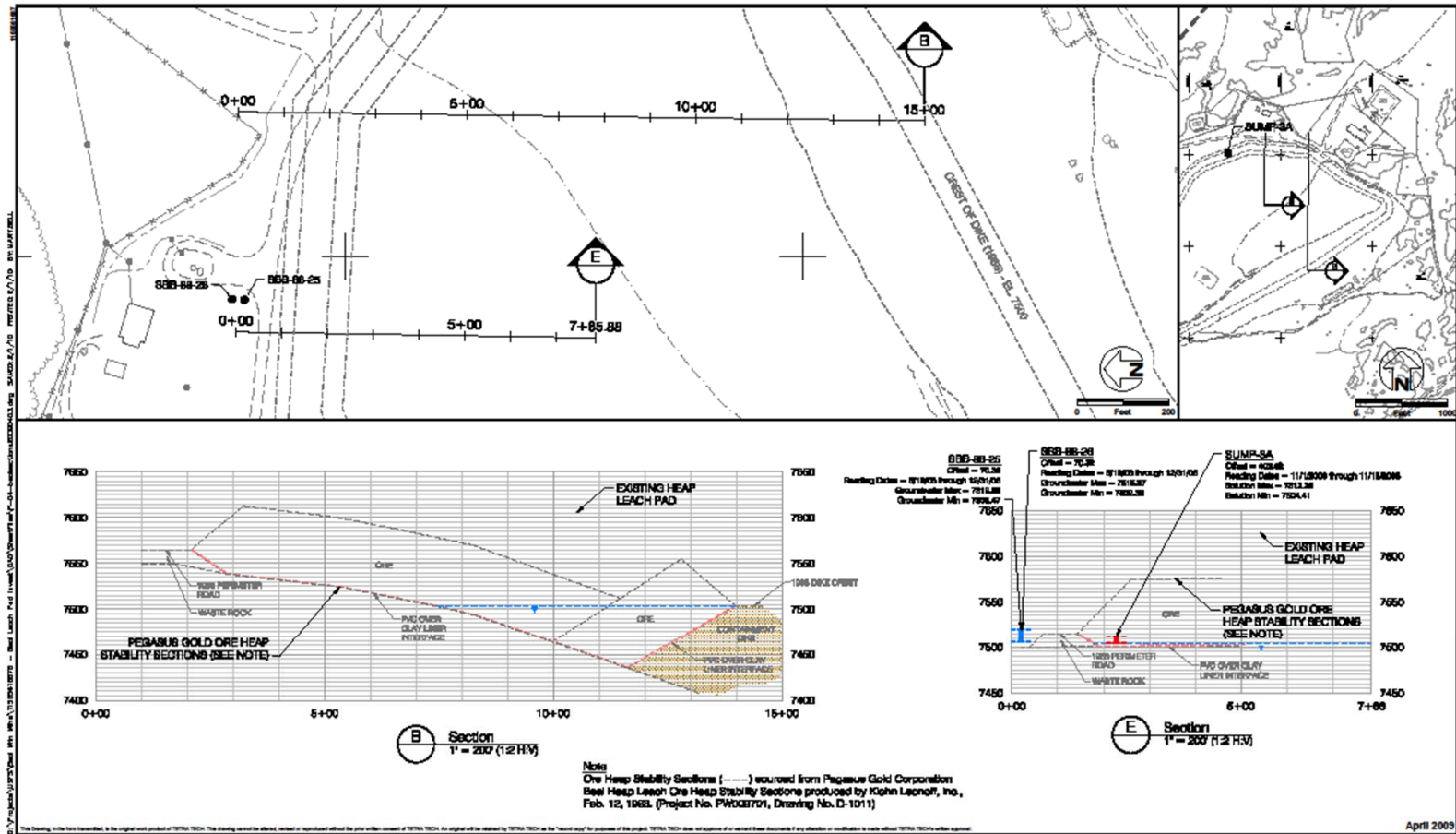
TP-5 dry

TP-2 wet





# Water Level Relations – Cross Sections



April 2009

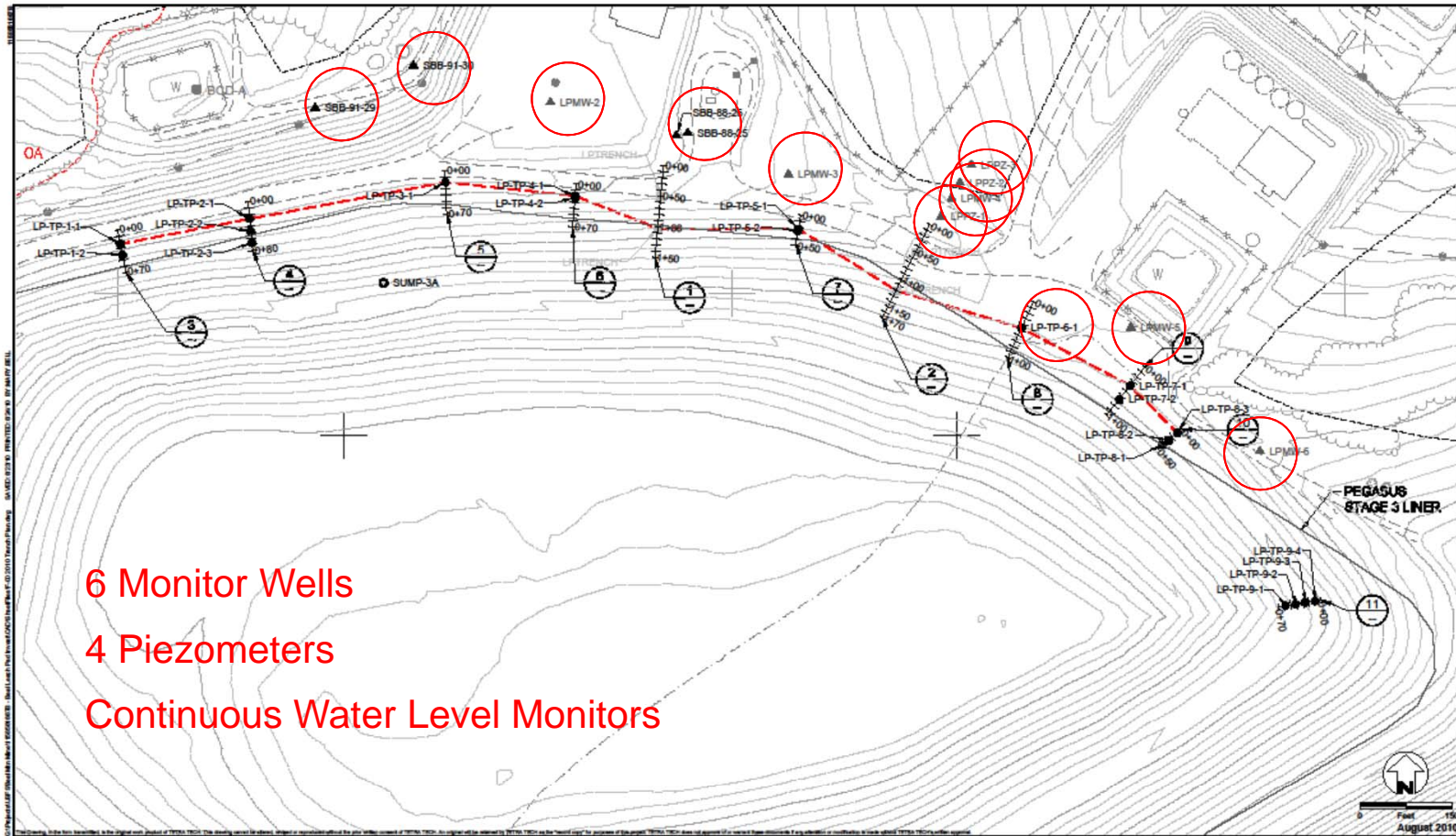


## Water Flow On and Off the Pad

Beal Mountain Mine  
Leach Pad Liner Investigation  
Silver Bow County, Montana  
FIGURE 7



# LP Groundwater Monitoring Wells and Piezometers



6 Monitor Wells  
 4 Piezometers  
 Continuous Water Level Monitors



- ▲ Monitoring Well
- Leach Pad Sump
- Abandoned Leach Pad Sump
- ▲ 108  
7437.07  
Local Coordinate Control Point  
and Elevation Field
- ▲ LPMW-2  
▲ LPPZ-2  
2008 Leach Pad Investigation Monitoring Well  
2008 Leach Pad Investigation Piezometer Well  
2008 - 2010 Leach  
Pad Trenches
- 2010-LP-TP-1  
2010 Leach Pad Trench Stake Locations
- - - Edge of Existing Cover
- Projection of Pegasus Stage 3 Bottom Liner

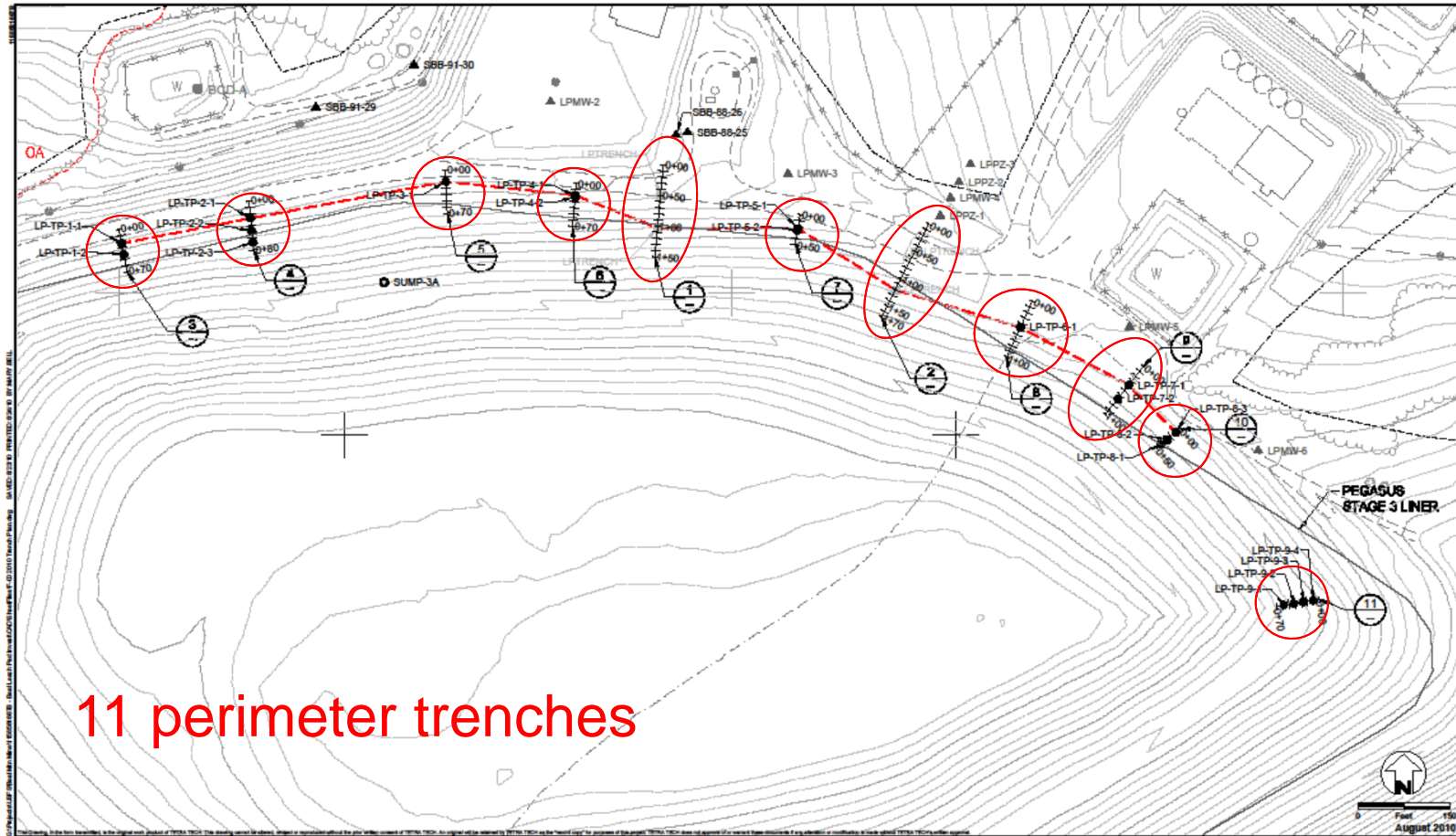
Beal Mountain Mine  
 2010 Leach Pad Phase II Investigation  
 Trench Plan View  
 Silver Bow County, Montana  
 FIGURE 4



# Leach Pad Perimeter Trenches



# LP Perimeter Trenches – North Side



11 perimeter trenches



- ▲ Monitoring Well
- Leach Pad Bump
- Abandoned Leach Pad Sump
- ▲ 106  
7437.07  
Local Coordinate Control Point  
and Elevation (Feet)

- ▲ LPMW-2 2008 Leach Pad Investigation Monitoring Well
- ▲ LPPZ-2 2008 Leach Pad Investigation Plasmometer Well
- 0+00  
+0+50  
1  
2008 - 2010 Leach  
Pad Trenches

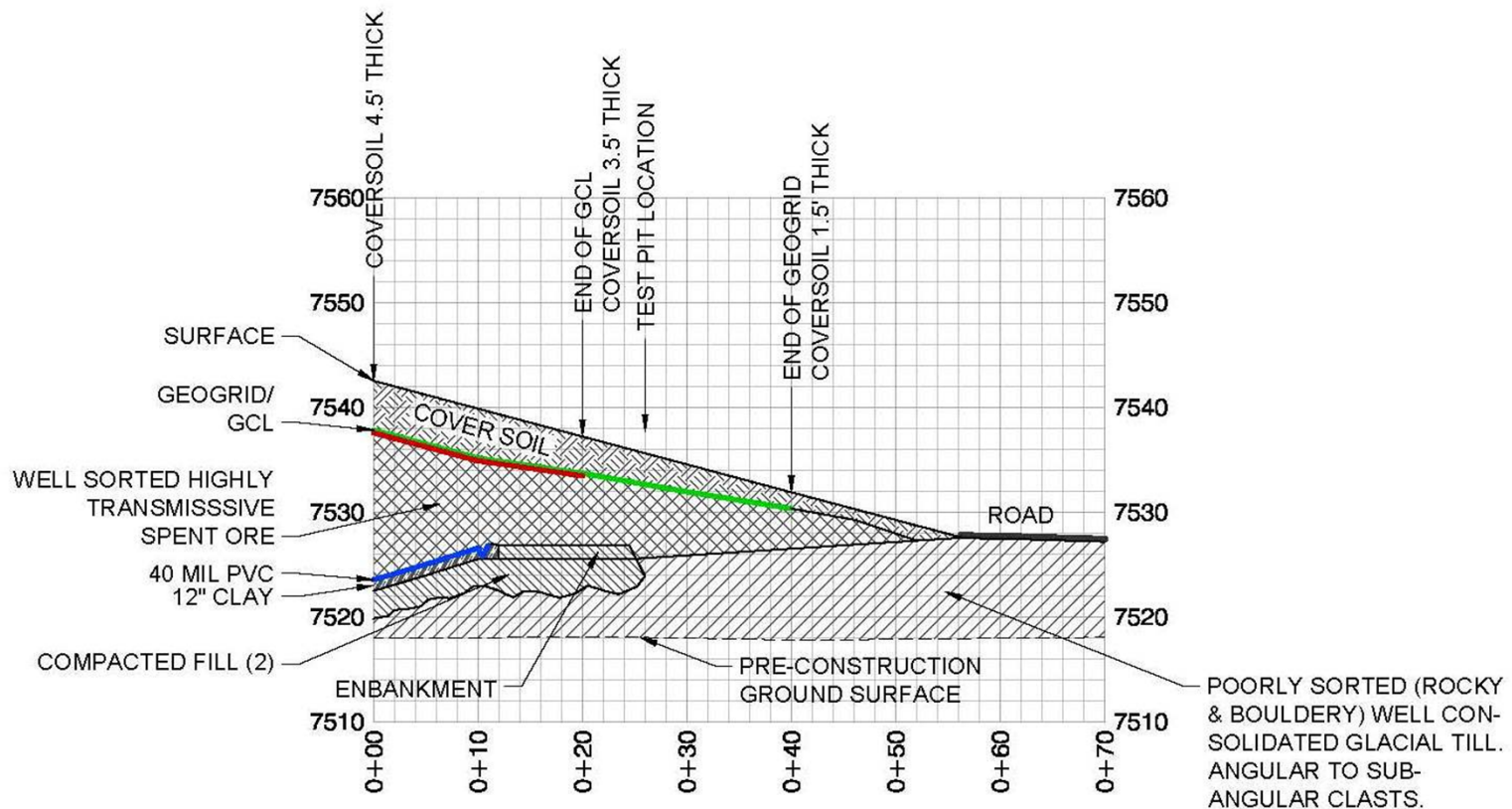
- 2010-LP-TP-1 2010 Leach Pad Trench Stake Locations
- - - Edge of Existing Cover
- Projection of Pegasus Stage 3 Bottom Liner


Beal Mountain Mine  
2010 Leach Pad Phase II Investigation  
Trench Plan View  
Silver Bow County, Montana  
FIGURE 4

## Beal Leach Pad Perimeter Trench #2



# Leach Pad Perimeter Trench #1 – Cross-Section Results



 Leach Pad Trench 1  
1" = 40'

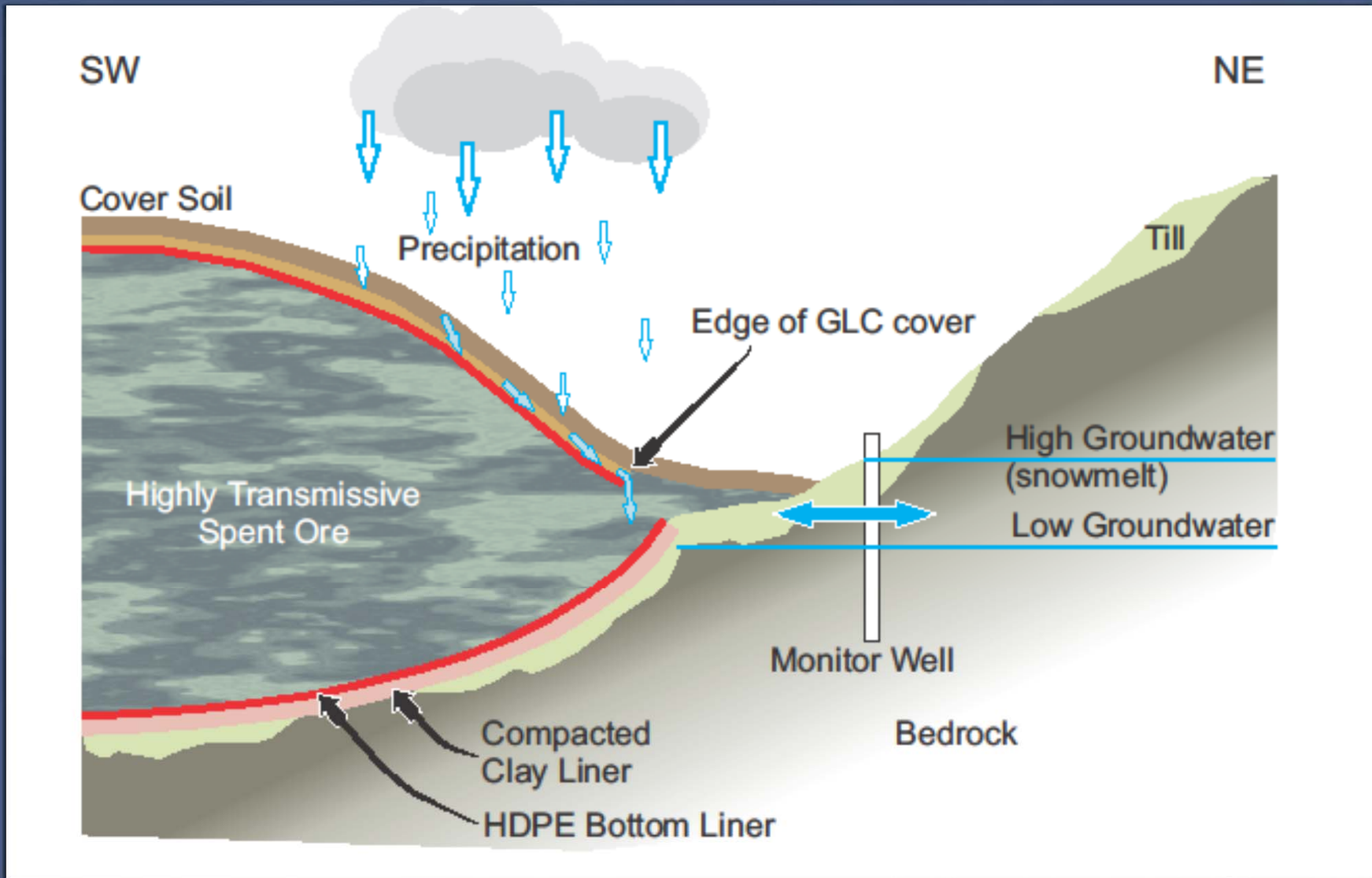
Spent ore graded off the pad  
Cover Extents -GCL termination



## Spent Ore is Highly Transmissive



# Existing Condition Schematic





# PROPOSED SOLUTION



## Beal Mountain Mine Design-Build

- US Department of Agriculture – Forest Service (USDA-FS) has contracted a comprehensive design-build team comprised of :

Construction Team (Prime Contractor)



Construction Team (Liner Installation Subcontractor)



Design Team (Technical Coordination/Engineering Design)

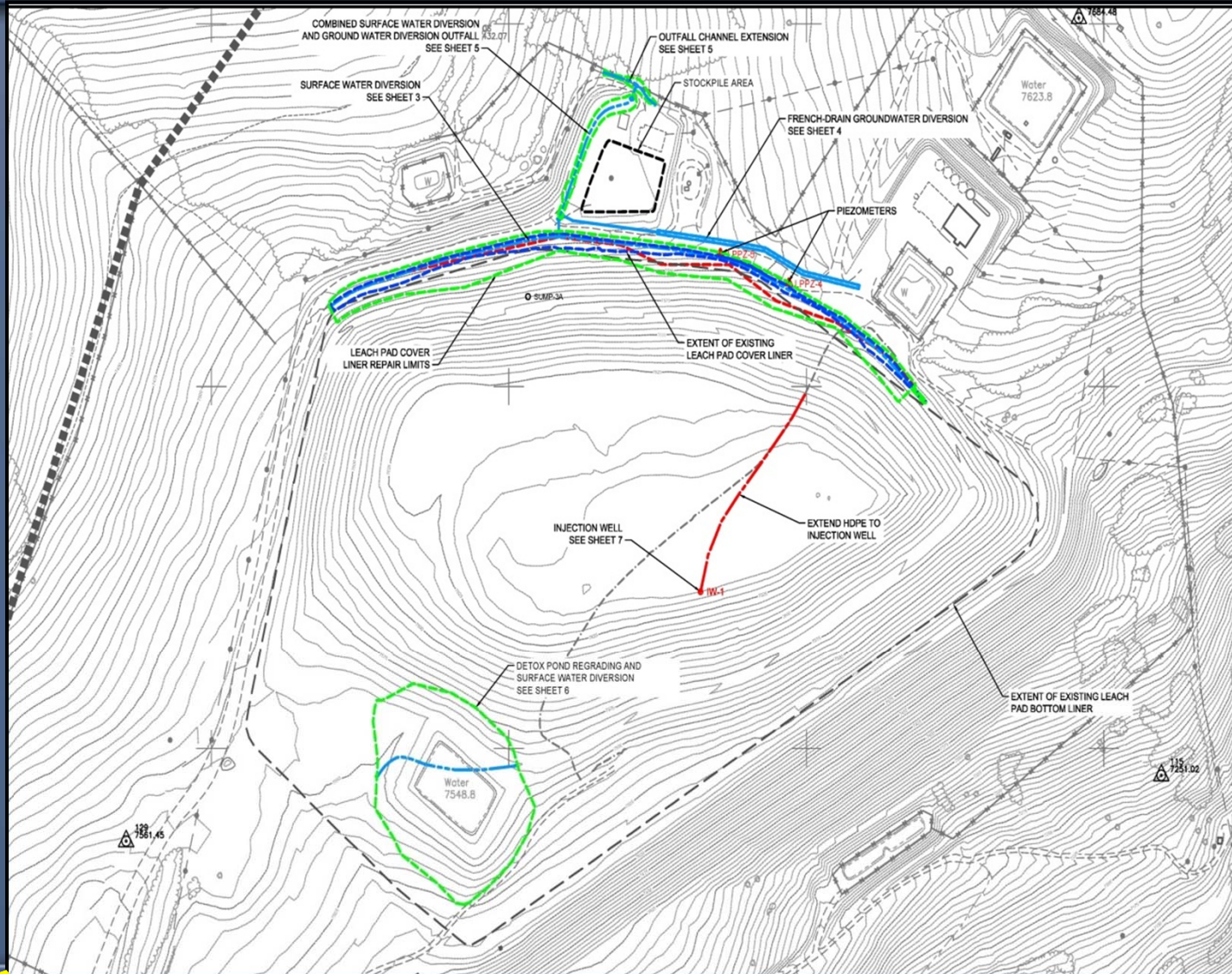


## Design Components

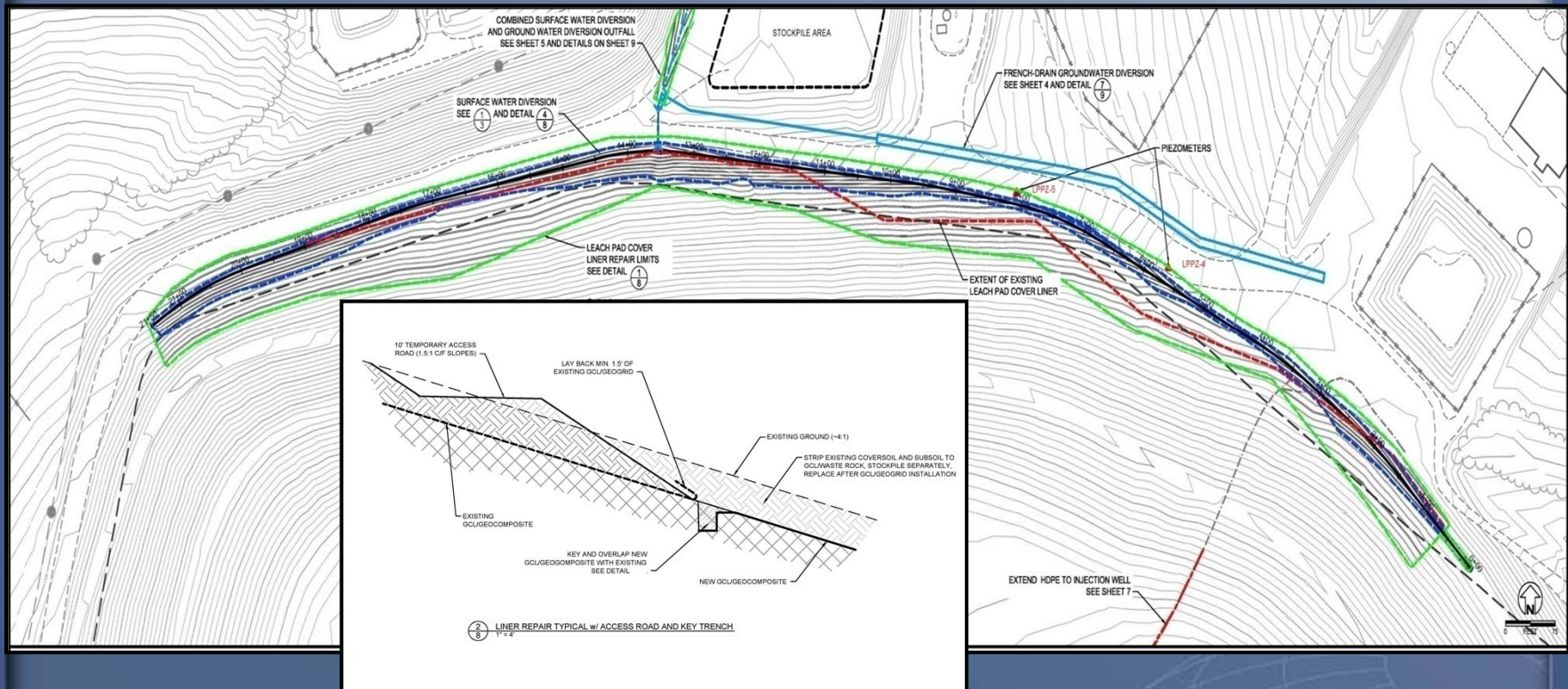
- Extended composite soil and GCL/Geodrain leach pad cover;
- Construction of a surface water diversion channel to direct water collected from the cover away from the leach pad;
- French drain to the north of the leach pad intercepting shallow groundwater and preventing it from entering the leach pad;
- Removal of the Detoxification Pond, regrading and construction of a composite soil/PVC leach pad cover system; and
- Construct a new injection well for treatment system reject water.



# Beal Mountain Mine – Site Plan View



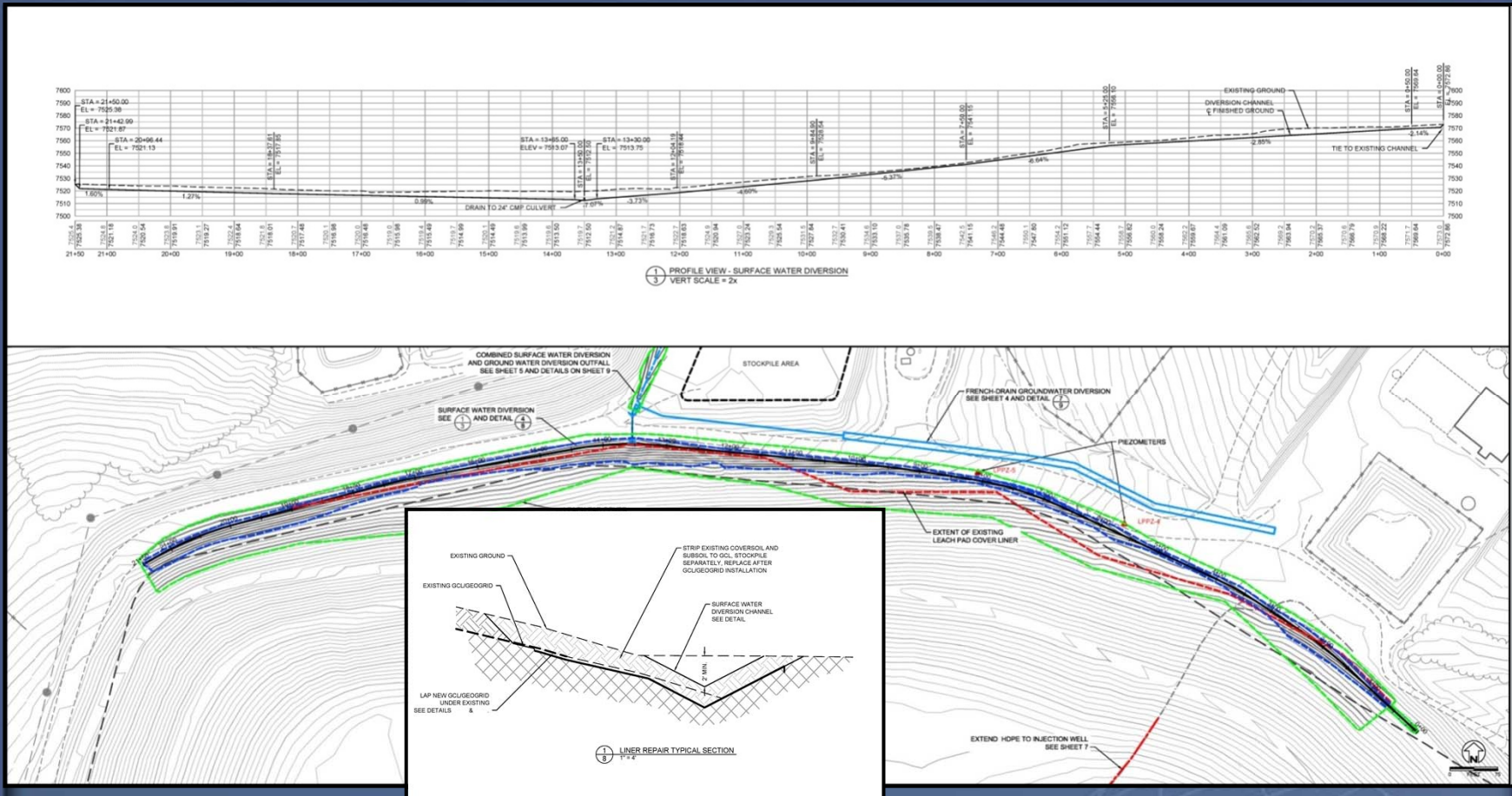
# Cover Liner Repair



- Liner Excavation along the northern edge of the Leach Pad
- Construction of the extended composite soil and GCL/Geodrain leach pad cover



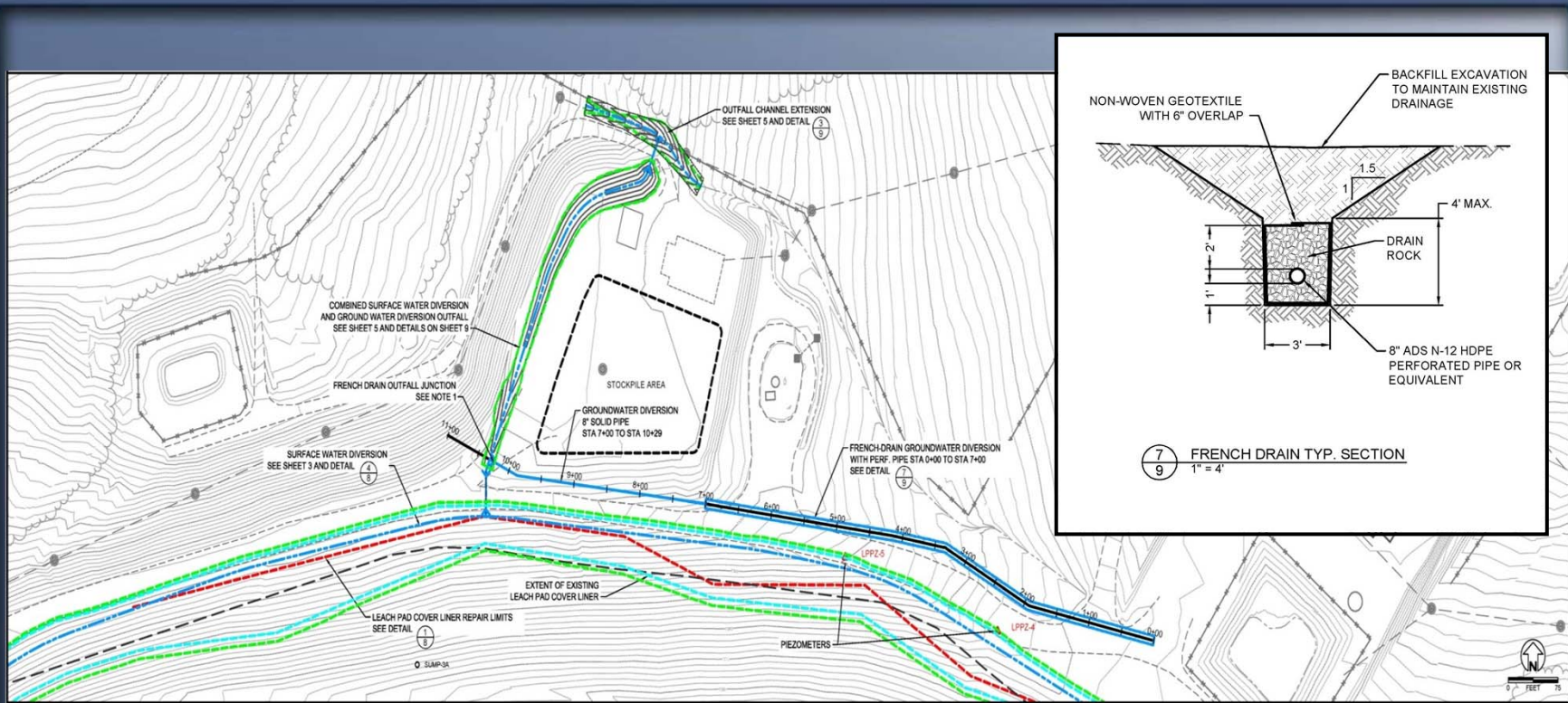
# Surface Water Diversion and Outflow Channel Objective



- Provide adequate outlet for surface waters to be discharged away from the leach pad and prevent surface water infiltration into the leach pad.



# French Drain Construction Objective



- Intercept groundwater at an elevation below the top of the leach pad base-liner, divert groundwater away from the leach pad perimeter, and thus prevent groundwater infiltration into the leach pad during high groundwater events such as spring run off and high rainfall events.

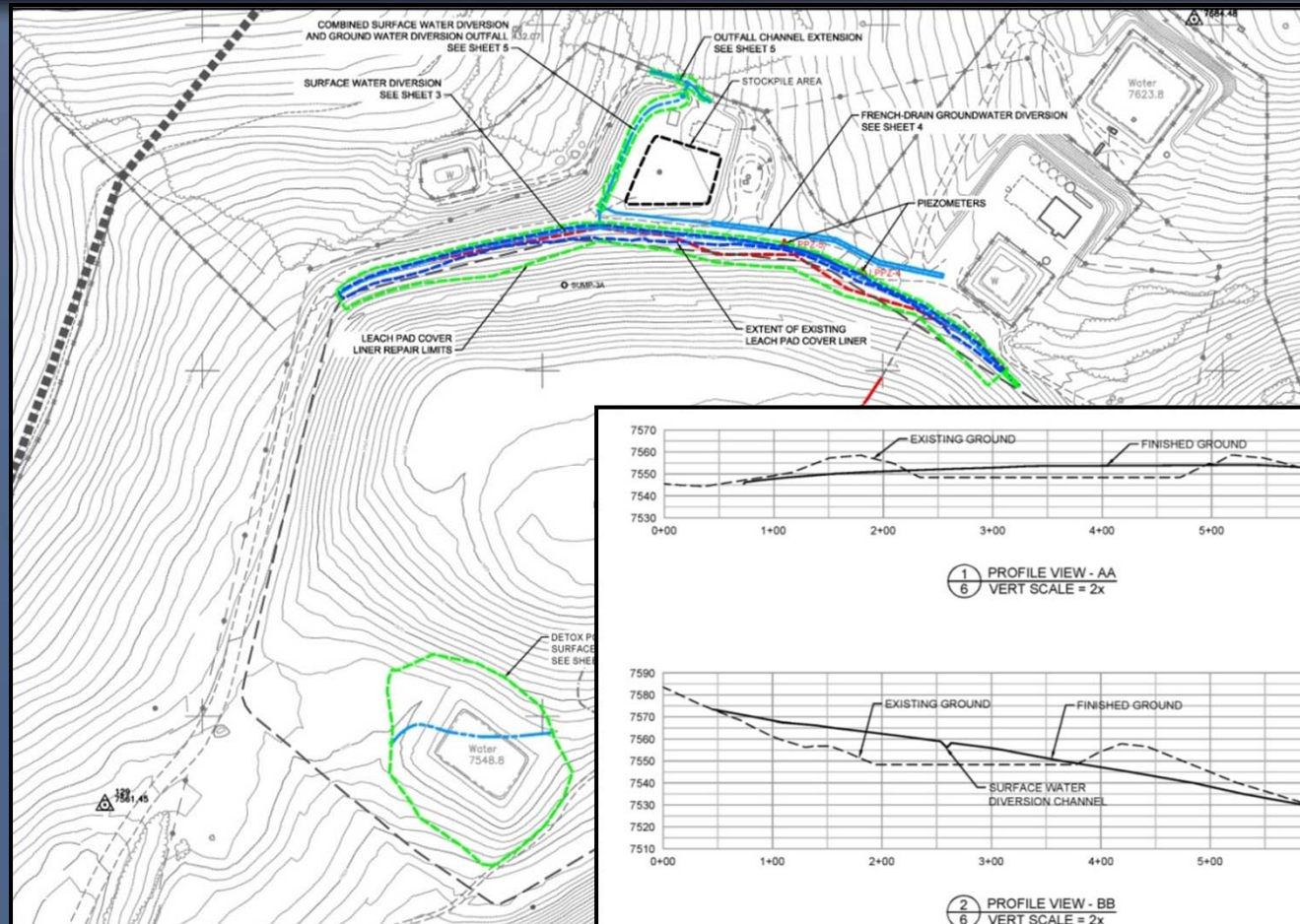


# Detoxification Pond





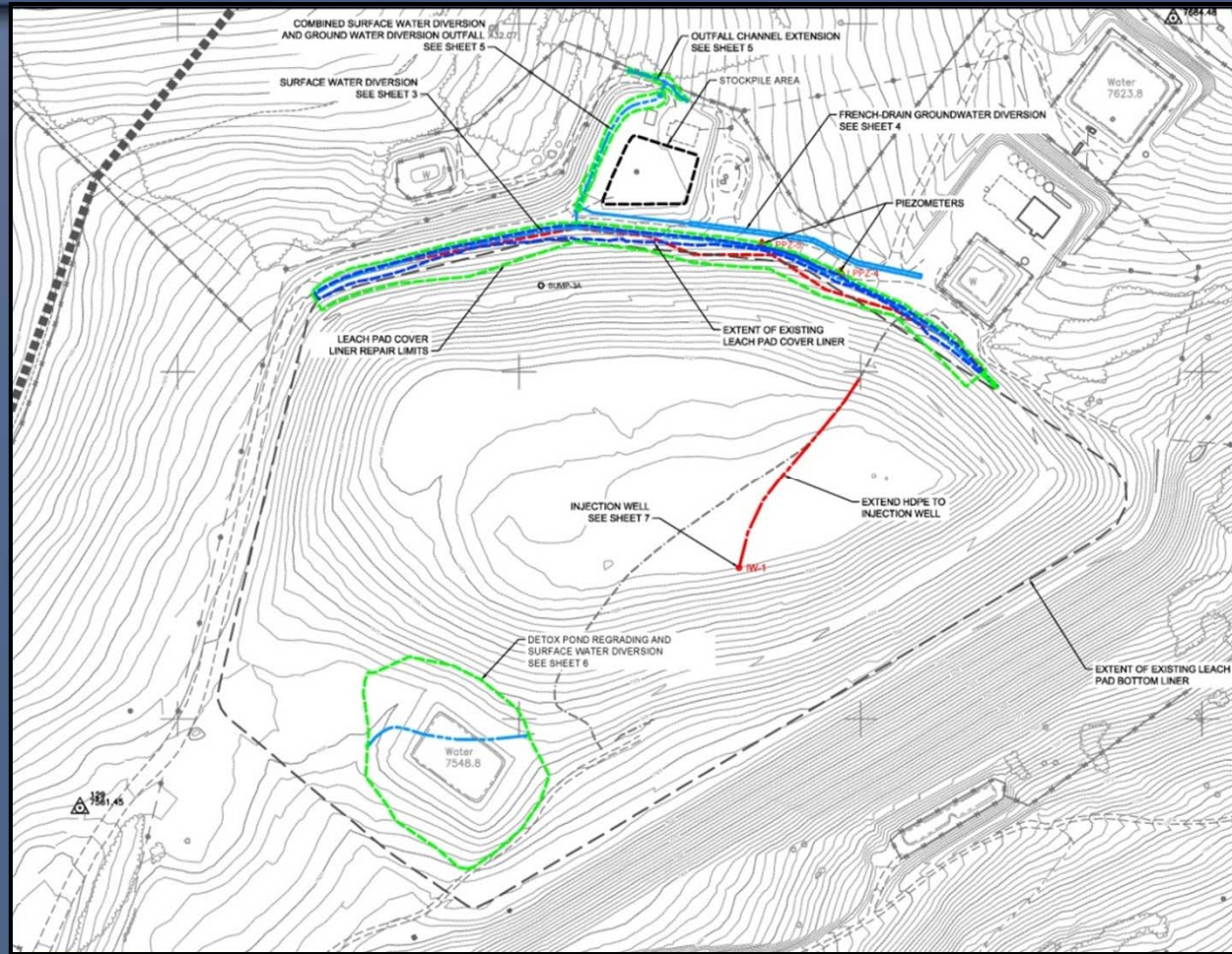
# Detoxification Pond Reclamation Objective



Further eliminate another source of precipitation and surface water from infiltrating into the leach pad.



# Injection Well Objective

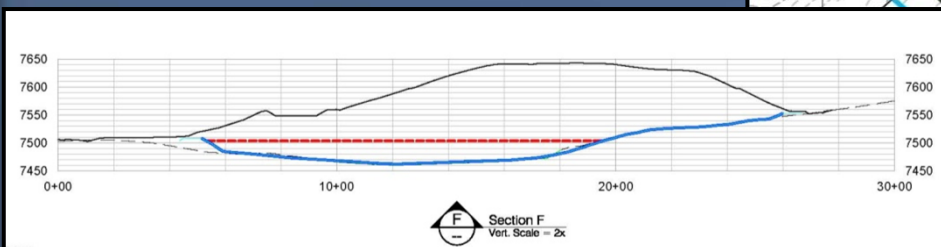
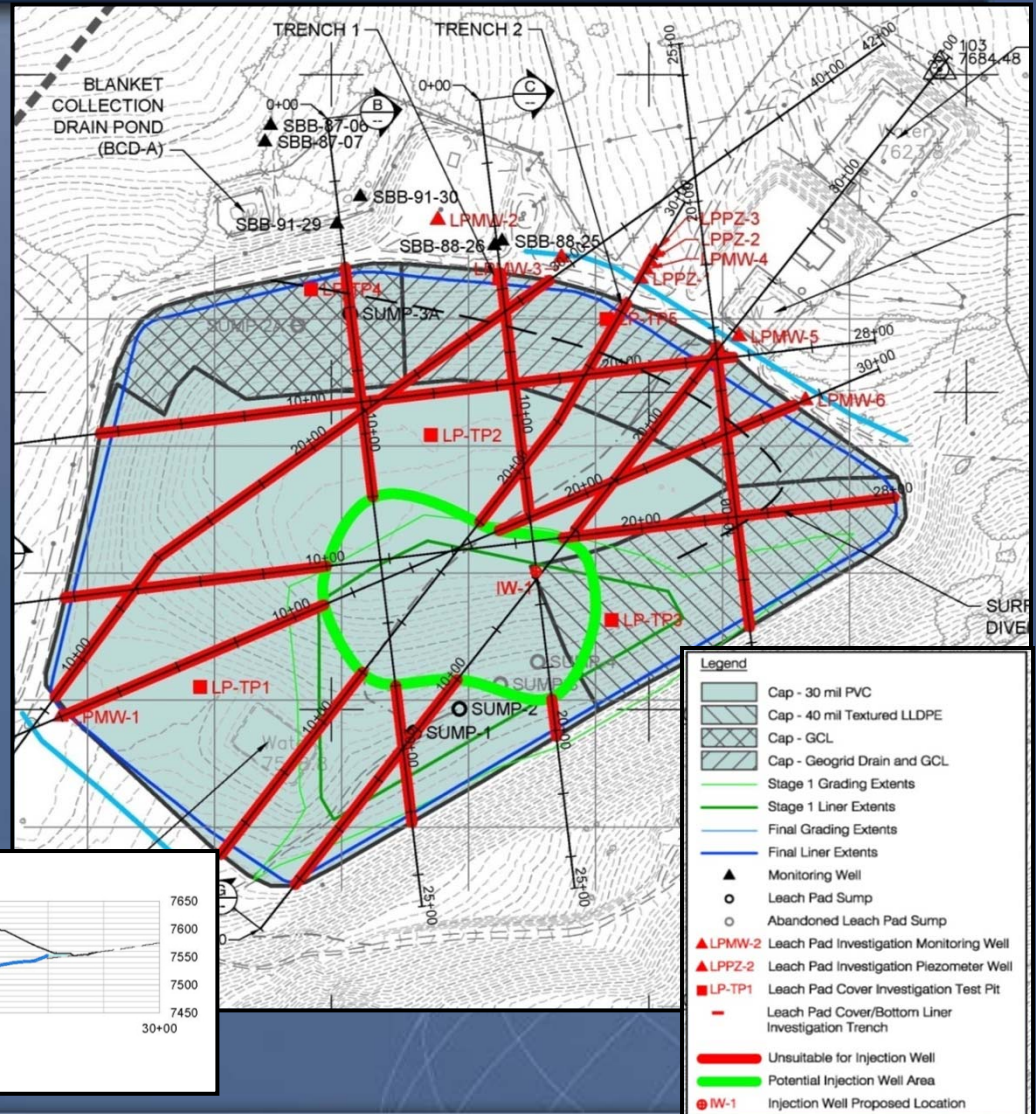


Eliminate the potential for treatment system reject solution from exiting the leach pad base-liner containment.

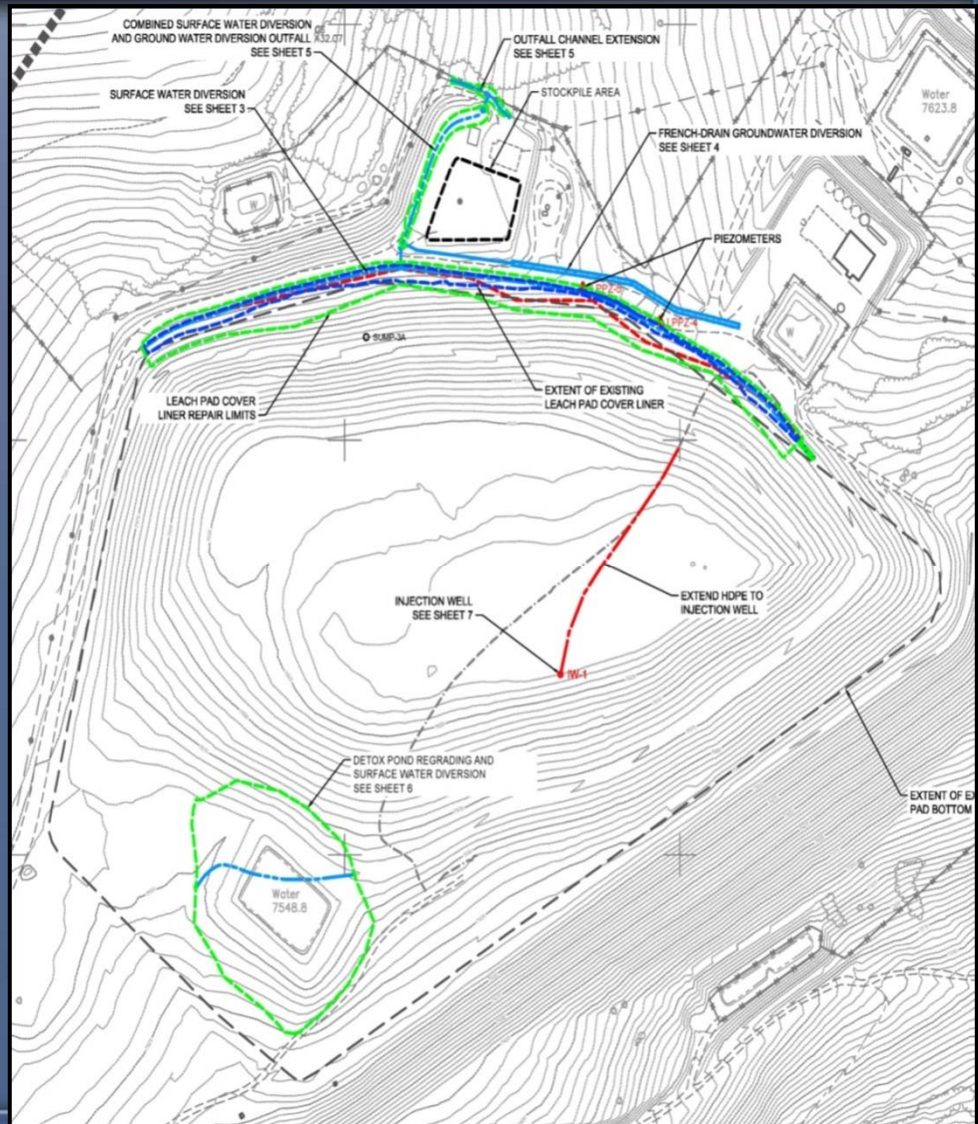
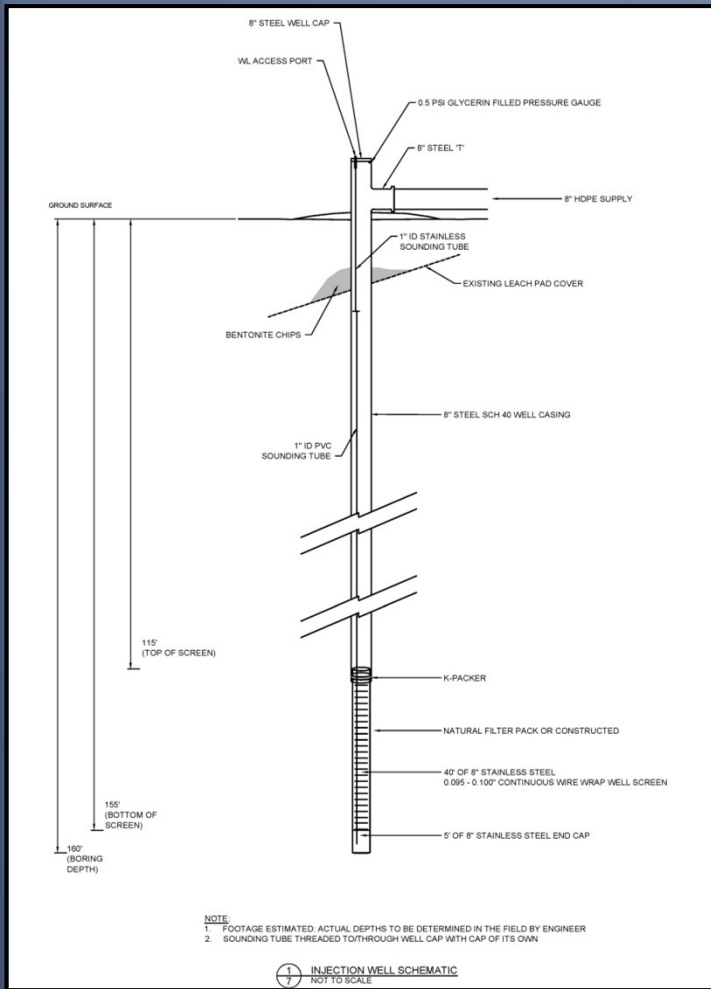


# Injection Well Placement Objectives

- Bottom of screen to be within previously saturated waste rock.
- Bottom of proposed well to be approximately 20 feet above bottom liner.
- Maximize distance to Leach Pad perimeter.
- Maximize distance Sump-1.



# Injection Well Location and Construction



# Beal Mountain Mine Design-Build Cost Estimate

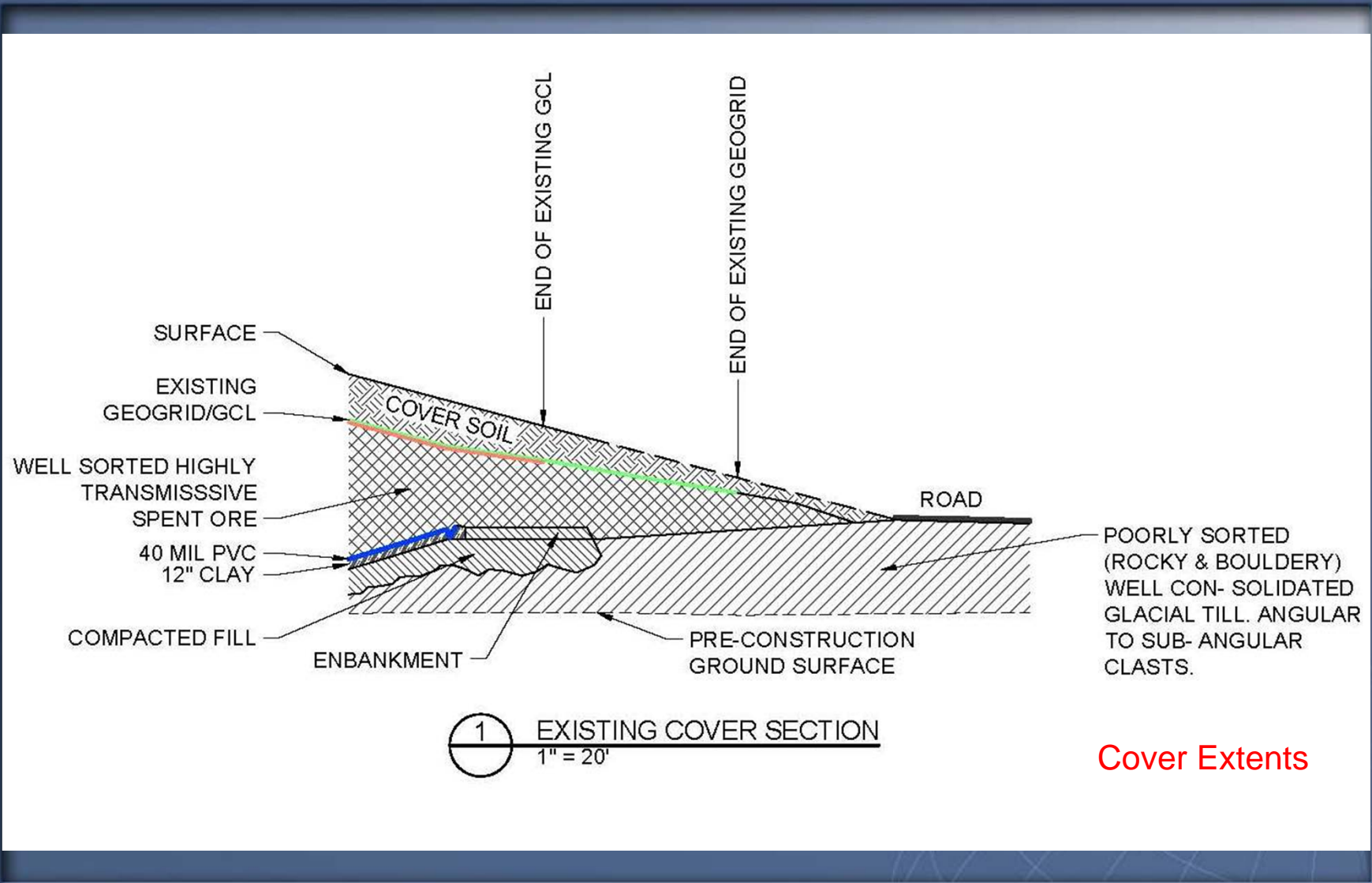
Estimate is \$1,114,000



# Questions?



# Leach Pad - the Problem



Cover Extents



## Cover Extents



# Surface Water Diversion and Outflow Channel

