# Utilizing Paste Technology for Reclamation of the Ute-Ulay

tailings impound ments

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#### Site Background

- Mill Tailings from Ute-Ule Mine and Mill
- 5 constructed ponds on 6 acres of BLM managed land
- Problems with the site included air born dust that contained high levels of metals (Pb, As, Cu, Cd, Zn).
- Human health concern due to heavy site use by ATV, other recreation
- Ponds collected water during rain and snowmelt, which leached through tailings into groundwater
- Lowest tailings pond spilled into Henson Creek
- Wastes from Hanna, Risorgimento, and Hidden Treasure trucked to site





# Project Design

- Problems with standard repository
  - Shallow bedrock
  - Narrow site
  - Proximity to creek
- Paste Repository design
  - MSD Report and "recipe"
  - Layered design
- Excavation based on XRF
- Multiple Drainage Channels
- Regrade the site, revegetate



SOUTHWESTERN COLORADO NTS

BUCKHORN ii, Structural & Geot

MC COLLUM EXCAVATING UTE ULAY REPOSITORY TOPORNAMC SUMEY

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#### GENERAL MOTES

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#### SURVEYOR'S CERTIFICATE

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DATED THIS \_\_\_\_ DAY OF \_\_\_\_\_ A.D. 20\_\_\_

# Paste Technology

- Paste is a non-segregating substance
- Created by mixing fine grained tailings with water and (in this case) cement
- Cement has high pH which immobilizes metals, neutralizes tailings
- Does not bleed water during placement
- Dries to an impermeable, concrete like substance
- Provides strength to low strength materials





# **Paste Specifications**





- 3 bin batch plant with continuous auger mixer
- 95% of waste to pass 3/8" screen, no particles larger than ½"
- Water provided on-site
- 5% by weight cement –will provide minimum 100kPa compressive strength
- Paste to have 6" slump
- 3' lifts, cure 3 days
- Cure 1 week prior to placing coarse wastes or soil
- Pump 350 yds<sup>3</sup> per day

# **Construction Summary**

1000 - 1000

June 1, 2009

Tailings excavated to bedrock or native soil
XRF verification
Cover material separated

# Excavation



#### Cover Material

1" or less screened wastes

### **Paste Pumping**

### **Actual Paste Placement**

- First day 12yds<sup>3</sup>
- Two weeks to achieve specification
- Not enough aggregate to pump
- Initial cement 8.5% due to error-corrected to 5%. Paste did not set up well at 5%-too soft. Final paste at 6.5%
- Pumped approximately 12,000 yds<sup>3</sup> of paste
- Used 20,000 gallons of water per day

# **Coarse Waste Placement**

## Sealing the coarse waste Final two lifts of paste

#### Borrow Soil????

1" screened gravel

1/2 " screened sand

# **Geocomposite Drainage Layer**

# Henson Creek Tie-In

# **Revegetation Specifications**

- Spread existing topsoil approximately 12" thick
- Rip compacted areas using excavator
- ½" Gunnison WTP compost, mixed into top 4" of soil
- Biosol (6-1-1) 300 lb/acre
- Hand broadcast seed
- 2 tons/acre CWF straw, crimped with excavator



# **Ute-Ulay Seed Mix**

#### Seed Mix/Rates for Ute-Ulay (lbs PLS/acre) **Total Pounds** Growth **Species % of Mix** Scientific name **Common Name** Form PLS 9 Pascopyrum smithii 'Arriba' Western wheatgrass Grass 3 Elymus trachycaulus ssp 17 Slender wheatgrass Grass 4 trachycaulus 'San Luis' Poa alpina Alpine bluegrass 13 .5 Grass Bromus marginatus 'Garnet' Mountain brome Grass 6 2.5 Phleum alpinum Alpine timothy Grass 15 .5 Festuca ovina Sheep fescue 18 Grass 1 Deschampsia cespitosa Tufted hairgrass Grass 9 .25 Rocky Mountain Penstemon strictus 3 .25 Forb penstemon Western Yarrow Achillea millefolium Forb 9 .1 *Lupinus alpestris* Mountain Lupine Forb 1 2.0

100\*

Total

14.1

# Final Grade and Revegetation

October 2011

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October 2011

# Monitoring and Maintenance

- Groundwater monitoring began in spring 2010-testing for metals and pH
- Maintenance in 2011
  - Drilled 6 new wells, abandoned older wells
  - Ripped/re-seeded areas that are compacted and where vegetation has not established
- Continue monitoring vegetation growth, tree growth, and erosion (none so far)

## **Vegetation Monitoring**



- Most areas took vegetation well
- Wood chip issues with compost
- High winds and little rain in spring 2010
- Poor tree survival

# 2011 Vegetation Maintenance

- 2 acres
- Areas of poor growth and disturbed by drill rig
- Same amendments
- Mixed straw/ compost/ fertilizer into to top 12"
- Accomplished using tracked excavator
- Completed in October 2011



#### Groundwater Monitoring

	Total Meta	Total Metals Concentration (µg/l)									
		Sample									1
	Date	Event	Al	As	Cd	Cu	Mn	Ni	Pb	2.	
$\leq$	3/31/2010	1	59600	31.6	3.7	207	9550	44.1	113	478	$\mathbf{P}$
	5/10/2010	2	8490	4.0	0.9	32.1	811	2.9	23.2	228	
	8/5/2010	3	20900	11.8	1.3	65	2210	<4.0	34.8	228	
$\triangleleft$	10/28/2010	4	8220	6.6	0.5	36.2	828	<4.0	13.0	113	$\mathbf{P}$
	10/21/2011*	5	6210	<2.0	0.2	7.42	127	<5.0	9.14	57.7	
	5/1/2012*	6	844	<2.0	0.2	2.73 <sup>j</sup>	20.6	<5.0	1.42	44.5	
	10/23/2012*	7	2260	<2.0	0.5 <sup>j</sup>	7.82	91.8	<5.0	12.6	67.8	$\mathbf{P}$
Total Metals UU-2 Total Metals Concentration (µg/l)											
		Sample									
		Sample									
	Date	Event	Al	As	Cd	Cu	Mn	Ni	Pb	Zn	
<	Date 3/31/2010	Event 1	Al 52900	As 46.6	Cd 9.1	Cu 194	Mn 9150	Ni 34.2	Pb 132	Zn 3020	
4	Date 3/31/2010 5/10/2010	Event 1 2	Al 52900 4270	As 46.6 <4.0	Cd 9.1 1.4	Cu 194 14.2	Mn 9150 469	Ni 34.2 2.7	Pb 132 12.7	Zn 3020 1260	
•	Date 3/31/2010 5/10/2010 8/5/2010	Event 1 2 3	Al 52900 4270 2630	As 46.6 <4.0 <4.0	Cd 9.1 1.4 0.7	Cu 194 14.2 11.8	Mn 9150 469 358	Ni 34.2 2.7 <4.0	Pb 132 12.7 5.8	Zp 3020 1260 514	
	Date 3/31/2010 5/10/2010 8/5/2010 10/28/2010	Event 1 2 3 4	Al 52900 4270 2630 6290	As 46.6 <4.0 <4.0 6.4	Cd 9.1 1.4 0.7 0.7	Cu 194 14.2 11.8 19.4	Mn 9150 469 358 860	Ni 34.2 2.7 <4.0 <4.0	Pb 132 12.7 5.8 13.4	Zp 3020 1260 514 425	
	Date 3/31/2010 5/10/2010 8/5/2010 10/28/2010 10/21/2011*	Event           1           2           3           4           5	Al 52900 4270 2630 6290 5720	As 46.6 <4.0 <4.0 6.4 2.62i	Cd 9.1 1.4 0.7 0.7 1.73	Cu 194 14.2 11.8 19.4 12.4	Mn 9150 469 358 860 1160	Ni 34.2 2.7 <4.0 <5.0	Pb 132 12.7 5.8 13.4 7.8	Zp 3020 1260 514 425 629	
	Date 3/31/2010 5/10/2010 8/5/2010 10/28/2010 10/21/2011* 5/1/2012*	Sample           Event           1           2           3           4           5           6	Al 52900 4270 2630 6290 5720 2170	As 46.6 <4.0 <4.0 6.4 2.62 <sup>j</sup> <10	Cd 9.1 1.4 0.7 0.7 1.73 0.95 <sup>j</sup>	Cu 194 14.2 11.8 19.4 12.4 5.59	Mn 9150 469 358 860 1160 299	Ni 34.2 2.7 <4.0 <4.0 <5.0 <5.0	Pb 132 12.7 5.8 13.4 7.8 2.72	Zn 3020 1260 514 425 629 630	
	Date 3/31/2010 5/10/2010 8/5/2010 10/28/2010 10/21/2011* 5/1/2012*	Event 1 2 3 4 5 6	Al 52900 4270 2630 6290 5720 2170	As 46.6 <4.0 6.4 2.62 <sup>j</sup> <10	Cd 9.1 1.4 0.7 0.7 1.73 0.95 <sup>j</sup>	Cu 194 14.2 11.8 19.4 12.4 5.59	Mn 9150 469 358 860 1160 299	Ni 34.2 2.7 <4.0 <5.0 <5.0	Pb 132 12.7 5.8 13.4 7.8 2.72	Zp 3020 1260 514 425 629 630	

\* Samples collected in well offsets

<sup>j</sup> Data estimated qualifier, applied to data less than the reporting limit, greater than method

#### Groundwater Monitoring

Dissolved Metals UU-1 Metals Concentration (µg/l)												
Date	Sample Event	pН	Al	As	Cd	Cu	Mn	Ni	Pb	Zn		
3/31/2010	1	6.78	<100	<4.0	0.30	<10.0	133	<4.0	<1.0	56.1		
5/10/2010	2	6.73	<100	<4.0	0.40	7.4	104	<4.0	<1.0	148		
8/5/2010	3	7.20	<100	<4.0	0.10	<5.0	<2.0	<4.0	<1.0	47.9		
10/28/2010	4	6.59	<100	<4.0	0.10	<5.0	3.5	<4.0	<1.0	41.5		
10/21/2011*	5	6.75	<155	1.05 <sup>j</sup>	0.85	3.2	59.7	<1.0	1.82	42.1		
5/1/2012*	6	6.97	<50	0.99 <sup>j</sup>	0.20	<1.0	<5.0	<1.0	< 0.2	34.1		
10/23/2012*	7	6.85	<50	0.54 <sup>j</sup>	0.20	<1.0	<5.0	<1.0	0.64	37.5		
Dissolved Metals UU-2 Metals Concentration (µg/l)												
Date	Sample Event	pН	Al	As	Cd	Cu	Mn	Ni	Pb	Zn		
3/31/2010	1	6.13	109	<4.0	3.2	<10.0	280	2.2	<1.0	1820		
5/10/2010	2	6.17	<100	<4.0	1.4	7.4	41.6	<4.0	<1.0	1260		
8/5/2010	3	6.62	<100	<4.0	0.5	<5.0	2.8	<4.0	<1.0	533		
10/28/2010	4	6.59	<100	<4.0	0.3	<5.0	<2.0	<4.0	<1.0	348		
10/21/2011*	5	7.08	444	2.09	1.32	6.99	435	<1	2.21	623		
5/1/2012*	6	6.99	29.8	1.15 <sup>j</sup>	0.61	<1	<5.0	<1	<.2	588		
10/23/2012*	7	6.6	<50	0.74 <sup>j</sup>	0.31	<1.0	<5.0	<1	<.2	323		

\* Samples collected in well offsets

<sup>j</sup> Data estimated qualifier, applied to data less than the reporting limit, greater than method

# **Details and Future**

- Final cost: about 1.2 mil, 5 months to complete
- Funds from BLM Central Hazmat fund (CERCLA), and DRMS severance tax
- Partnership between DRMS and BLM
- McCollum's Excavating Primary Contractor
- Grasses/forbs growing well
- Trees and shrubs are coming along
- Fence will stay until site is stable and able to be open to the public for beneficial use

# Thank You















