Agronomic Assessment and Growth Media Management Practices for Reclamation Cover Systems

American Society for Reclamation Sciences

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CEDAR CREEK ASSOCIATES, INC.

Who is this guy? And what does he care about?

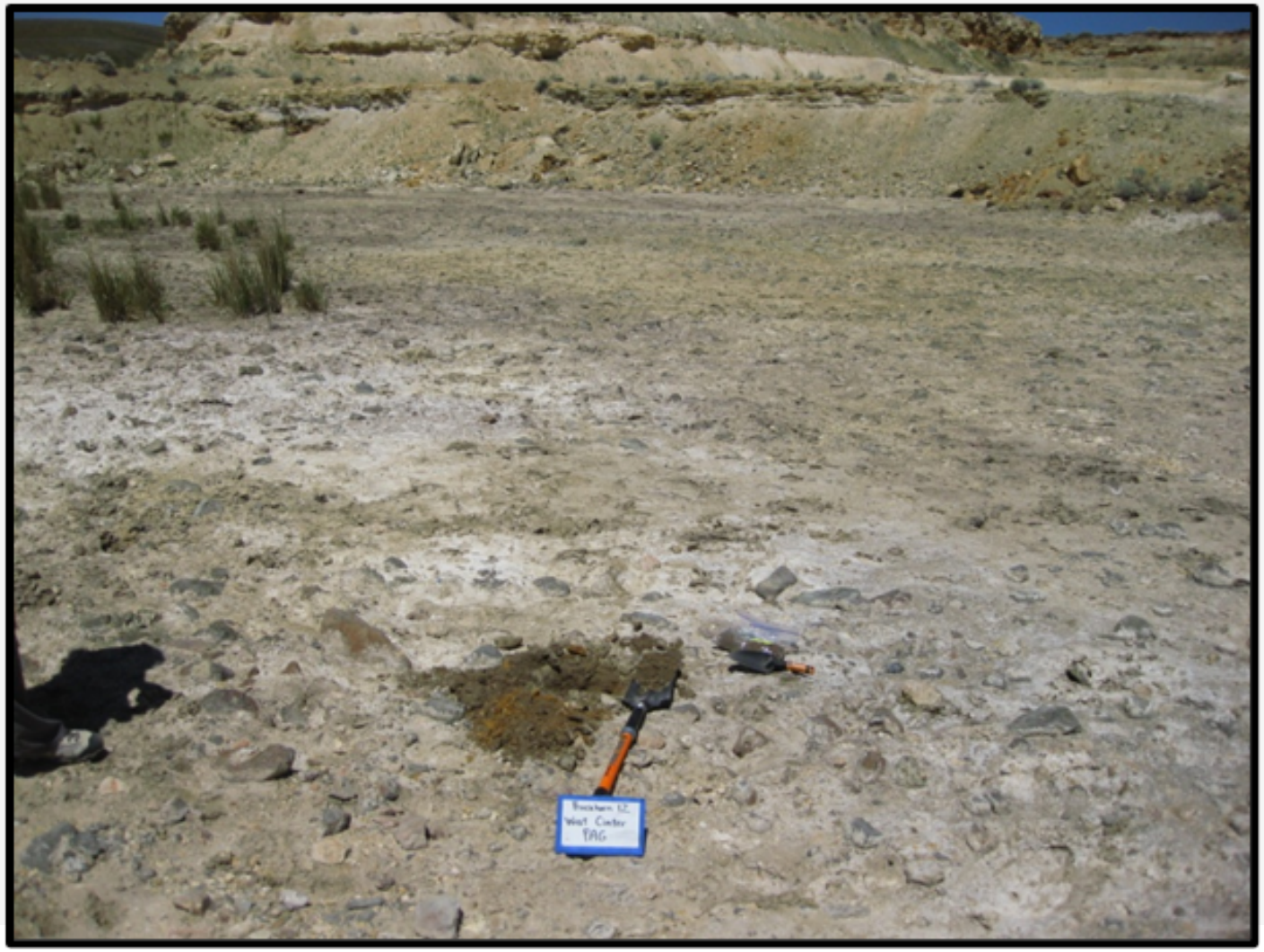
What have I seen?

Western Australia

Salvaged growth media contained elevated sodium which created a dispersive soil

Erosion features were prominent and frequent

What have I seen?



Nevada

Growth media was too clayey which contributed to upward migration of generated acid

Resulting soil chemistry has precluded revegetation

What have I seen?

Nevada

Growth media had elevated nitrogen and cheatgrass dominant seed bank

Cheatgrass outcompetes desirable vegetation establishment

What have I seen?

California

Salvaged growth media was exhausted, so run of mine material was used for reclamation

No fines available to make precipitation available to plants

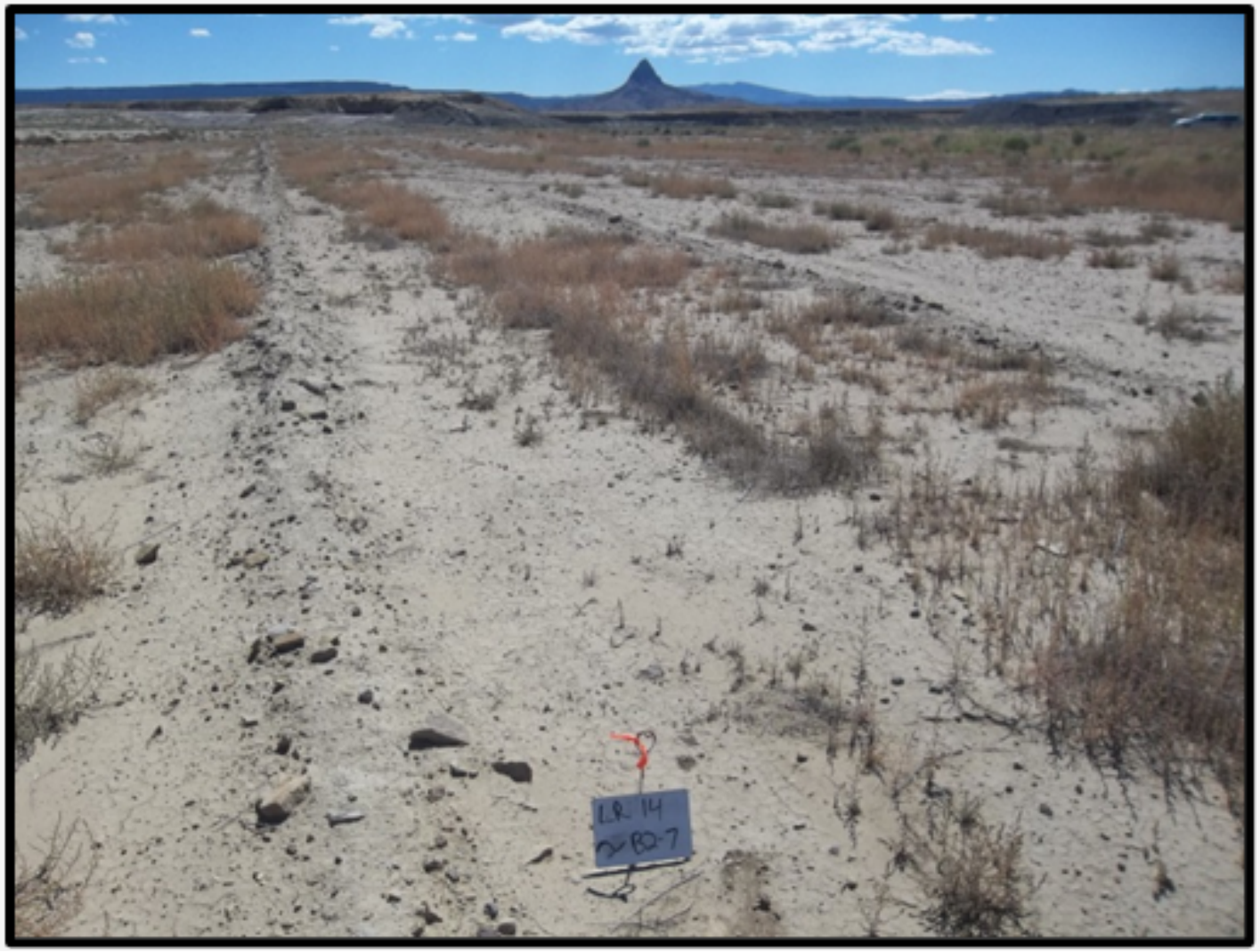
What have I seen?

Nevada

Borrowed growth media was salvaged from an alluvial area where salt lenses accumulated

Lysimeter test failed because desirable vegetation would not establish in adverse soil chemical conditions

What have I seen?



New Mexico

Rather than salvaging topsoil, deep alluvial material was salvaged

Sandy soils with elevated salt content exacerbate drought impacts, making establishing desirable vegetation difficult

Mistakes Were Made

What has changed in the past 20 years?

- Reclamation science has evolved

What can we do moving forward to improve outcomes?

1. Salvage the right topsoil / growth media materials
2. Set reasonable expectations of reclamation potential

Salvage the right topsoil / growth media materials

We need to identify and plan salvage of suitable materials for closure activities:

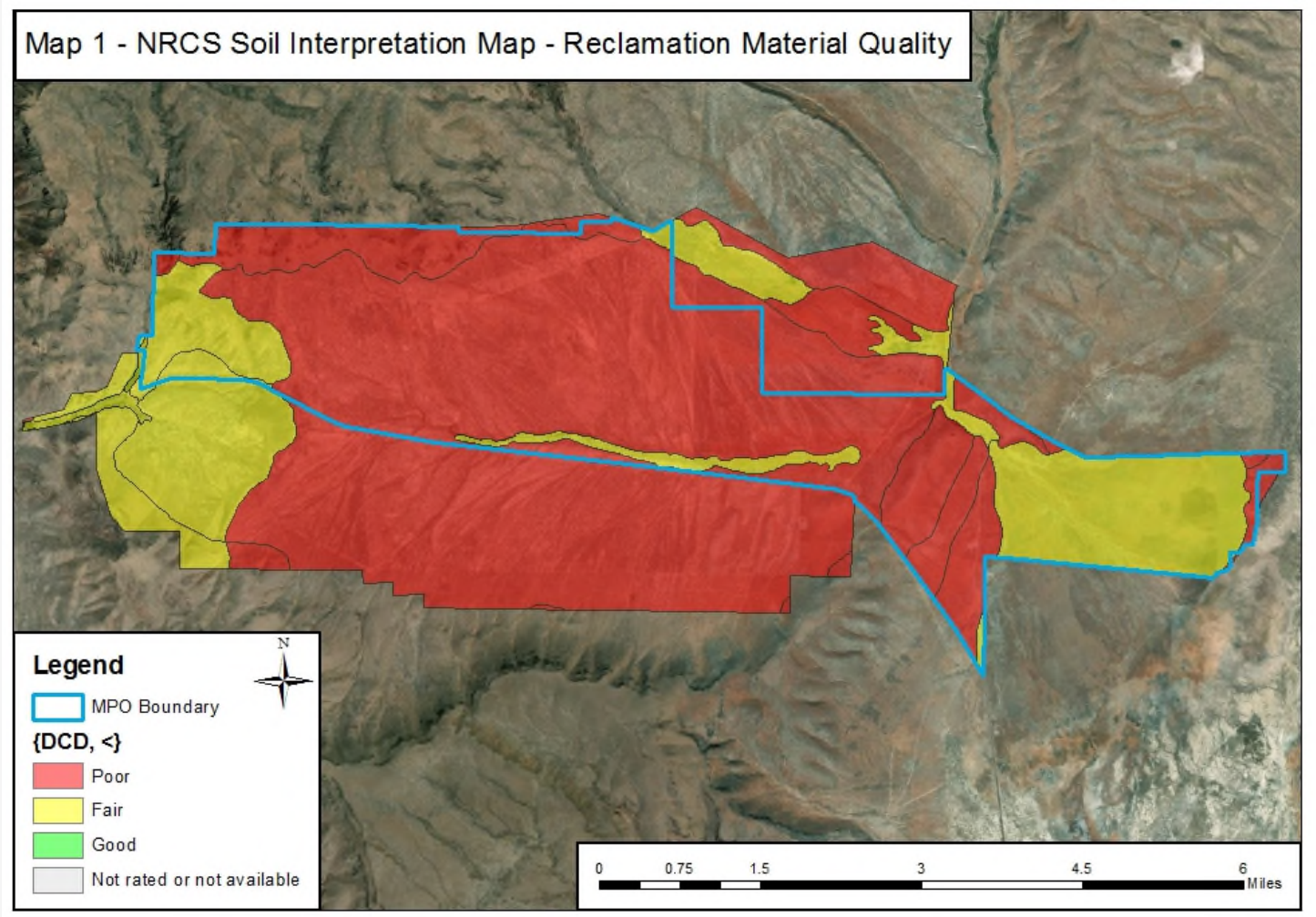
- Should consider special use cases, like ET covers, liners, mitigation requirements, etc.

We also need to identify deleterious materials and exclude them from salvage.

- Need to understand what physical or chemical parameters may be problematic.

Salvage the right topsoil / growth media materials

We should evaluate suitability of materials to support plant growth early in any project.



Salvage the right topsoil / growth media materials

Understand which adverse conditions may be problematic for reclamation.

Tables — Source of Reclamation Material — Summary By Map Unit

Summary by Map Unit — Owyhee County Area, Idaho (ID675)

Summary by Map Unit — Owyhee County Area, Idaho (ID675)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
44	Dehana-Nagitsy association, 2 to 50 percent slopes	Fair	Dehana (45%)	Too acid (0.95)	157.0	11.6%
			Nagitsy (30%)	Droughty (0.26)		
				Low content of organic matter (0.88)		
				Depth to bedrock (0.90)		
50	Doodlelink-Snell-Parkay complex, 5 to 40 percent slopes	Fair	Doodlelink (40%)	Droughty (1.00)	3.3	0.2%
			Snell (20%)	Droughty (0.19)		
				Too clayey (0.84)		
				Low content of organic matter (0.88)		
				Depth to bedrock (1.00)		
			Parkay (15%)	Droughty (0.86)		
62	Gaib-Wareagle-Rock outcrop association, 2 to 50 percent slopes	Poor	Gaib (35%)	Droughty (0.00)	227.5	16.8%
				Depth to bedrock (0.00)		
				Stone content (0.84)		
				Too acid (0.95)		
110	Nagitsy-Rock outcrop-Parkay complex, 3 to 30 percent slopes	Fair	Nagitsy (35%)	Droughty (0.13)	56.6	4.2%
				Depth to bedrock (0.97)		
			Parkay (15%)	Droughty (0.86)		

Salvage the right topsoil / growth media materials

Develop a growth media suitability table.

Soil Laboratory Results - Suitability Criteria			
Paramater	**Method**	**Acceptable Average Values**	**Units**
pH (paste)	1:1 Saturated Paste	6 - 8.3	N/A (unitless)
Electrical Conductivity	1:1 Saturated Paste	< 6	mmhos/cm
Organic Matter	Walkley-Black	< 10	% of Total Soil
NO_3-N	KCL Extraction	> 0.1+	ppm
Phosphorus (P)	DTPA Extraction	> 1+	ppm
Potassium (K)	DTPA Extraction	> 20+	ppm
Zinc (Zn)	DTPA Extraction	> 0.25+	ppm
Iron (Fe)	DTPA Extraction	> 1.0+	ppm
Manganese (Mn)	DTPA Extraction	> 0.1+	ppm
Copper (Cu)	DTPA Extraction	> 0.1+	ppm
Texture	By Hydrometer	No Textural Extremes	% Size Fraction
Calcium (Ca)	EPA Method 3050B	Addressed as SAR	meq/L
Magnesium (Mg)	EPA Method 3050B	Addressed as SAR	meq/L
Sodium (Na)	EPA Method 3050B	Addressed as SAR	meq/L
Sodium Adsorption Ratio	EPA Method 3050B	< 15	N/A (unitless)

+ Values Can Be Increased Through OM Additions

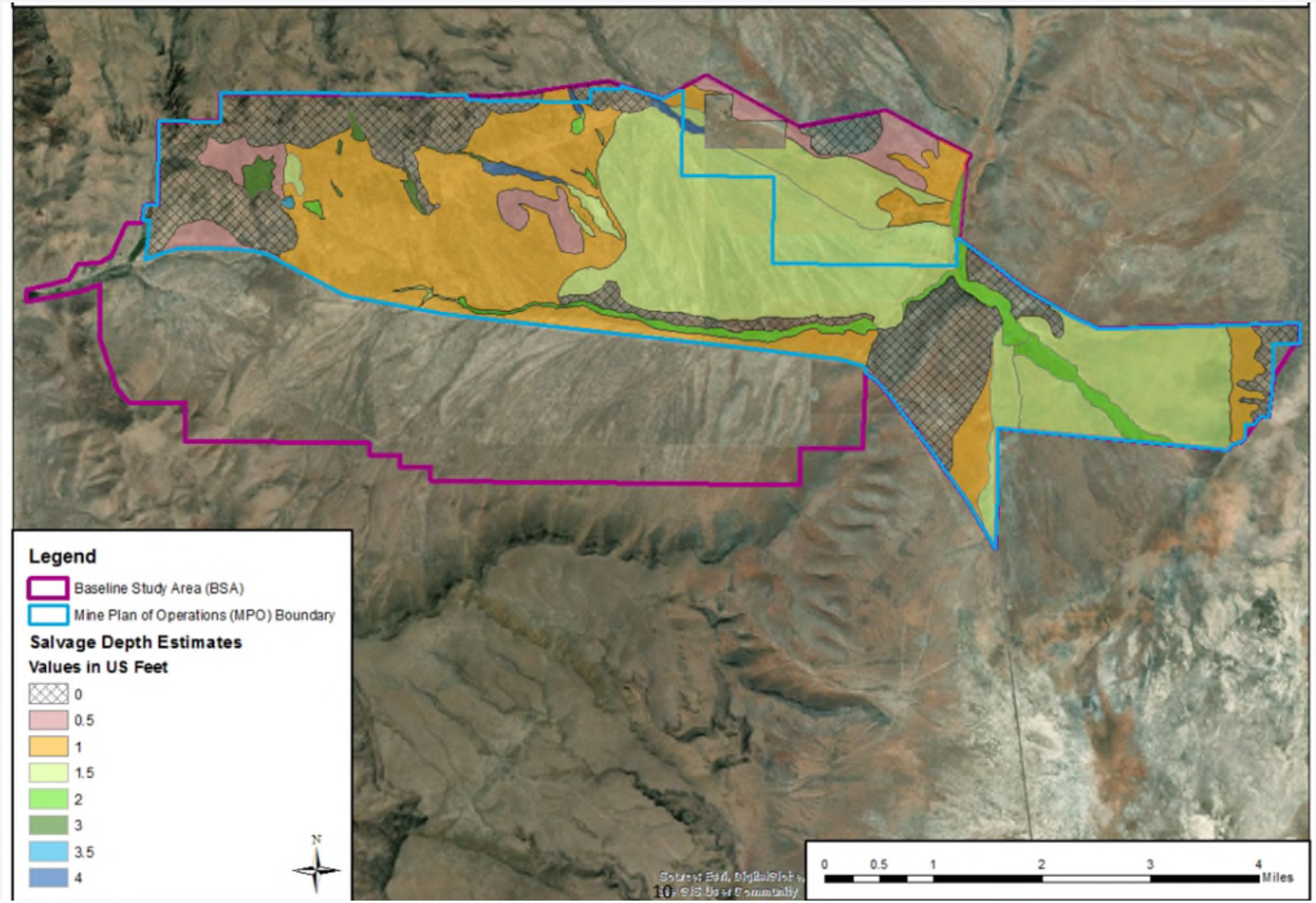
Salvage the right topsoil / growth media materials

Collect samples and observational data during baseline assessment and conduct analytical testing.

		paste			%				ppm							meq/L			
Sample ID	Depth (Inches)	pH	EC mmhos/cm	% Organic Matter	Sand	Silt	Clay	Texture	NO_3-N	P	K	Zn	Fe	Mn	Cu	Ca	Mg	Na	SAR
TP1-A	0-10	8.66	0.8	3.3	25	33	42	clay	13.2	2.8	179.7	0.1	2.5	1.0	1.6	0.8	0.1	8.0	12.0
TP1-B	10-60	8.84	0.9	3.2	30	27	43	clay	3.1	2.4	129.0	0.1	2.0	1.0	1.3	1.2	0.2	9.2	11.3
TP1-C	60-100	9.11	0.7	0.9	32	25	43	clay	0.1	5.2	48.4	0.0	2.0	0.1	0.5	0.6	0.1	7.2	11.6
TP2-A	0-9	8.04	0.9	5.7	33	13	54	clay	11.7	3.9	384.7	0.4	5.4	1.5	2.4	3.0	0.8	3.0	2.2
TP2-B	9-19	7.91	1.4	5.5	26	19	55	clay	13.7	3.3	304.5	0.5	4.8	1.7	2.4	7.0	2.7	8.2	3.7
TP2-C	19-96	8.65	0.2	0.8	28	18	54	clay	0.1	2.7	18.9	0.0	1.4	0.1	0.2	0.8	0.2	1.2	1.7
TP2-D	96-110	8.57	0.3	1.3	38	5	57	clay	0.1	3.5	31.5	0.0	1.4	0.1	0.4	1.1	0.3	2.4	2.9
TP3-A	0-6	7.76	1.8	3.8	40	24	36	clay loam	0.1	3.6	21.6	0.0	1.6	0.9	0.4	21.7	5.5	3.1	0.8
TP3-B	6-48	8.40	1.3	1.1	41	22	37	clay loam	13.1	1.5	31.7.5	0.1	1.2	0.2	0.6	1.7	0.9	15.3	13.3
TP3-C	48-84	9.56	1.6	3.3	43	22	35	clay loam	0.1	2.1	61.9	0.0	2.9	0.1	0.3	1.3	2.9	22.8	15.6
TP3-D	84-132	10.01	0.8	0.7	42	22	36	clay loam	0.1	2.5	271.2	0.1	1.6	0.5	1.4	0.4	0.1	18.2	35.7
TP4-A	0-7	8.29	0.2	1.8	55	17	28	sandy clay loam	0.1	2.9	195.0	0.1	3.0	0.4	1.1	1.2	0.2	0.7	0.8
TP4-B	7-14	8.23	0.2	2.1	53	17	30	sandy clay loam	0.1	9.0	126.6	0.1	3.1	0.6	1.1	1.4	0.3	0.5	0.5
TP4-C	14-48	8.26	0.3	2.1	53	18	29	sandy clay loam	0.1	6.1	58.1	0.1	2.1	0.5	0.7	1.4	0.4	0.8	0.9
TP4-D	48-84	8.86	0.5	0.9	54	15	31	sandy clay loam	0.1	6.8	38.6	0.1	1.1	0.2	0.3	0.4	0.2	5.2	9.5
TP5-A	0-6	8.06	2.6	4.7	40	18	42	clay	38.0	7.5	461.0	0.3	3.3	2.1	1.6	16.1	3.6	17.8	5.7
TP5-B	6-32	8.20	2.1	4.3	36	21	43	clay	11.9	7.0	241.1	0.2	2.9	1.5	1.4	8.6	2.0	26.6	11.5
TP5-D	32-72	8.08	3.3	3.4	35	21	44	clay	0.1	8.3	127.2	0.1	3.1	0.6	1.2	14.9	3.3	35.0	11.6
Average		**8.53**	**1.1**	**2.7**	**39**	**20**	**41**	**clay**	**5.9**	**4.5**	**167.6**	**0.1**	**2.5**	**0.7**	**1.1**	**4.7**	**1.3**	**10.3**	**8.4**

Salvage the right topsoil / growth media materials

Develop a growth media salvage map and growth media balance.



Set reasonable expectations for revegetation potential

Historically, we have looked to native communities adjacent to mine disturbances as our target for reclamation.

Essentially.

"We will make it look like it used to here"

Set reasonable expectations for revegetation potential

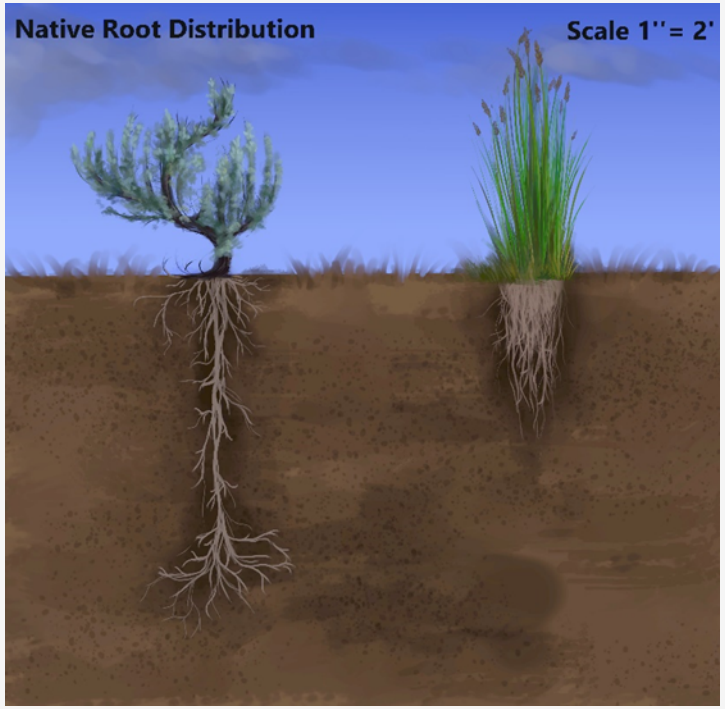
On reclaimed sites, we are engineering a novel soil profile.

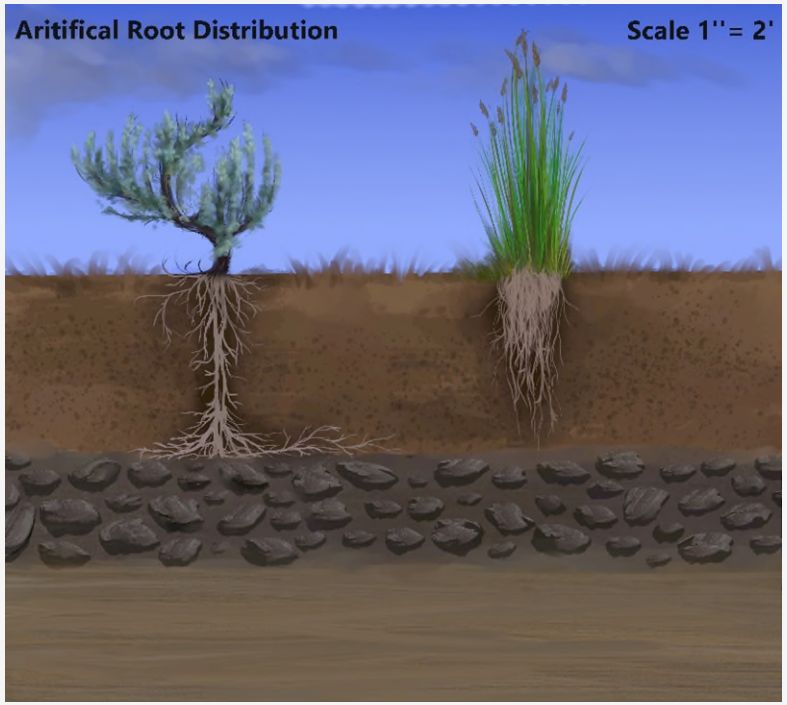
- It is often some nominal depth of growth media over some waste materials.

We need to be realistic about the revegetation potential of reclamation during permitting.

Set reasonable expectations for revegetation potential

Plant rooting profiles are vastly different than native ecosystems and that often impacts the plant community assemblages found on reclaimed sites.





Our goal should be to create functional self-sustaining ecosystems which are set on a trajectory of ecological succession.

Constructing Cover Systems

- Important considerations for borrow sites:
  - Balancing depth versus surface disturbance
  - Hauling distances matter
  - Understanding sequencing of materials
  - Potential for special handling
  - Need solid BMPs

Thank You