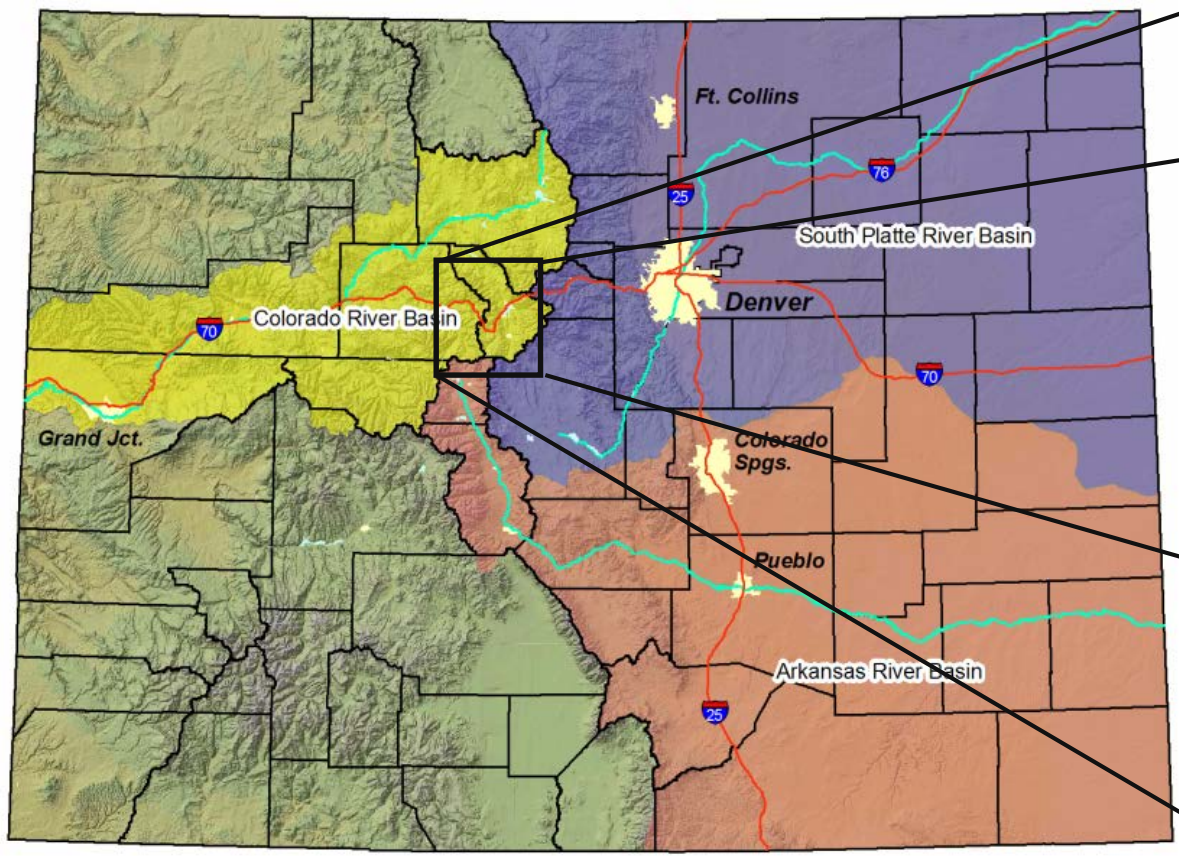


**MATURE SUBALPINE TREE &
SHRUB TRANSPLANTING AT THE
CLIMAX MINE, CLIMAX, CO**

**Robin Bay & Ken Carlson – Habitat Management, Inc.
Aaron Hilshorst – Climax Molybdenum Company**

Climax Molybdenum Mine: Geographic Setting



Climax Mine

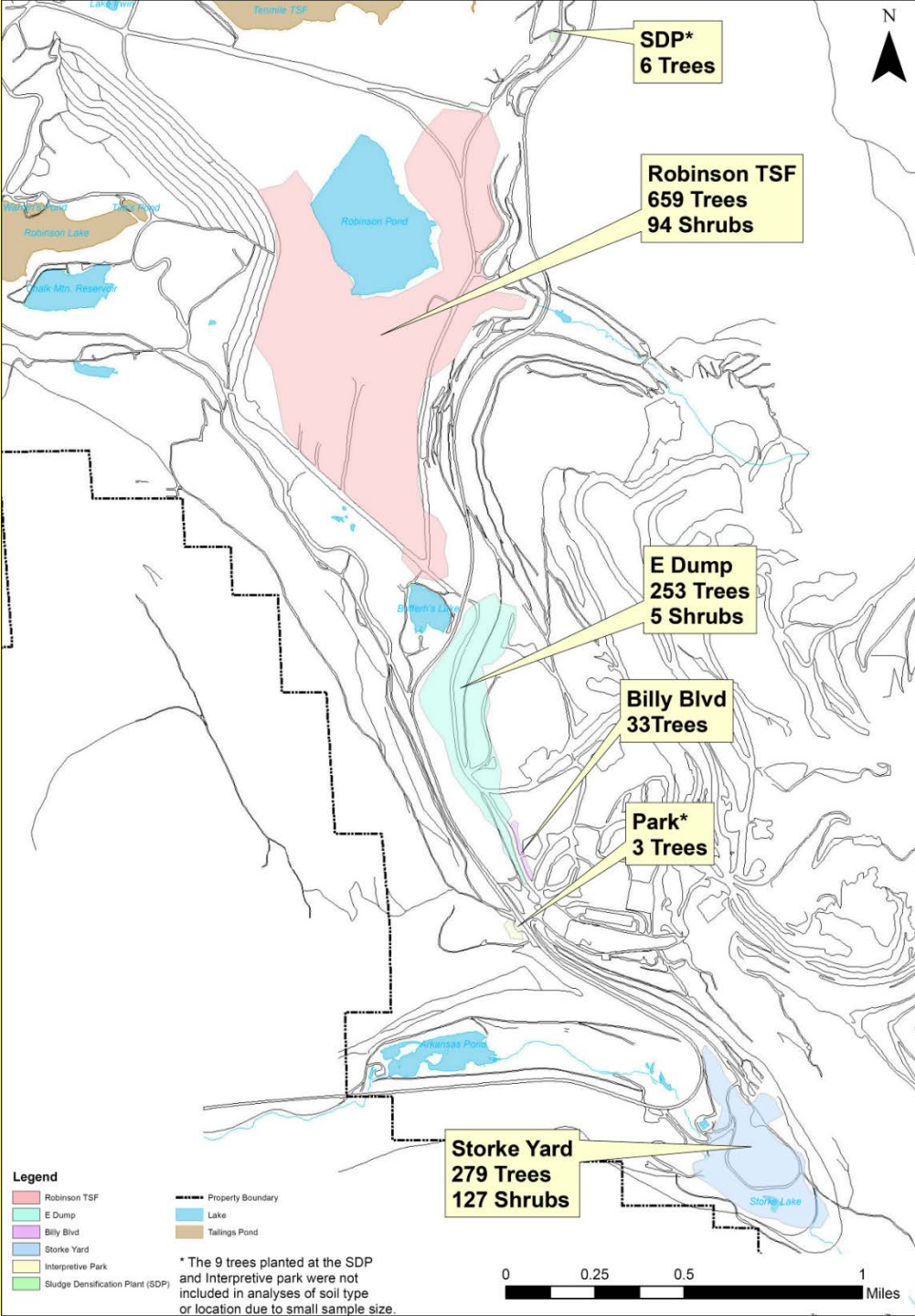
Operation: 1918 - 1995 & 2012 - present
Reclamation: 1980s - present



Elevation: 11,150 – 11,300 ft
Growing Season: 6 – 10 weeks
Average Snowpack: 280 inches

Tree & Shrub Transplanting Project

- 2005 – 2007
- Mature plants transplanted into reclamation
 - 1233 Trees
 - 226 Shrubs
- Most harvested from Climax's permitted affected area



Project Goals

- Use Trees From On-site Construction
- Visually Enhance Reclamation
- Seed Island Source
- Wildlife Cover
- Landscape Diversity
- 50% survival after 1 growing season



Project Constraints

- Steep, Shallow and Rocky Soils in Source
- Acid Rock Cover in Planting Area
- No Topsoil
- No Mycorrhizae in Soil
- High Altitude Exposed Location
- Heavy Snow and Sun Scald
- Wet Soil in Spring, Dry Soil in Summer
- Strong Winter Winds



Transplant Species & Quantities

Common Name	Species	2005	2006	2007	Total
Engelmann Spruce	Picea engelmannii	410	435	295	1,140
Subalpine Fir	Abies lasiocarpa	65	11	14	90
Lodgepole Pine	Pinus contorta	2	1		3
Total Trees		477	447	309	1,233
Willow	Salix spp.	91		100	191
Cinquefoil	Dasiphora fruticosa		2	14	16
Dwarf Birch	Betula nana	2		12	14
Currant	Ribes spp.	4		1	5
Total Shrubs		97	2	127	226
Total Transplants		574	449	436	1,459



Tree Spade Mounted on Tracked Skid-loader



Tree lifted from ground





Tree Balled and Burlapped

Trees Transported to Planting Sites



Tree Placed in Hole





Tree Backfilled

- Topsoil
- Old Woodchips
- Compost
- Additives
 - Terrasorb
 - Mycorrhiza

Trees Mulched, Staked, & Irrigated



Tree Monitoring

- At Planting
 - GPS each location
 - Species, height, diameter, & health
- Monitored 2006, 2007, 2008, 2010, & 2012
 - Survival and health
- 2012 data presented here

Reclamation & Soils

- Reclaimed 1996-2008
- Variety of cap/soil materials
- With and without Class A composted biosolids
- Seeded with approved seed mixture



Reclamation Soils

Location	Soil Type	Geologic Description	Rock Content	Surface Texture	Lime Required* (tons/acre)
Robinson TSF E Dump	Pit Run	Decomposed granite	High	Sandy Loam	30
Robinson TSF	Cirque	Decomposed granite	High	Sandy Loam	10
	Maroon	Conglomeratic sandstone	Low	Sandy Loam	0
	Brown	Mosquito Fault	Low	Sandy Clay Loam	0
	Dark Brown	Mosquito Fault	Low	Sandy Loam	0
Robinson TSF Billy Blvd	Dark Grey	Mosquito Fault	Low	Sandy Loam	0
Storke	Fill	Variable	Moderate	Sandy Loam	0

Reclamation & Soils – Robinson Tailings Pond

- Reclaimed 1980s – Present
- Tailing with 12- 36” of cap material
 - Pit Run, Cirque Pit Rock, Mosquito Fault Rock (Brown & Grey), Maroon Formation
 - 0 – 30 tons/acre lime requirement
- With and without Class A composted biosolids



Reclamation & Soils – Storke Yard

- Reclaimed 1996 & 2007
- Soil is development rock and construction debris
 - Sandy loam
 - Moderate rock content
 - No lime required
- With and without Class A composted biosolids



Reclamation & Soils – E Dump & Billy Blvd

E Dump

- Reclaimed 1997
- Soil is pit run
 - Sandy loam
 - High rock content
 - 30 tons/acre lime required
- No Class A composted biosolids

Billy Blvd

- Reclaimed 2005
- Soil is from Mosquito Fault
 - Sandy loam
 - Moderate rock content
 - No lime required
- Class A composted biosolids on surface

Results – Shrub Transplants

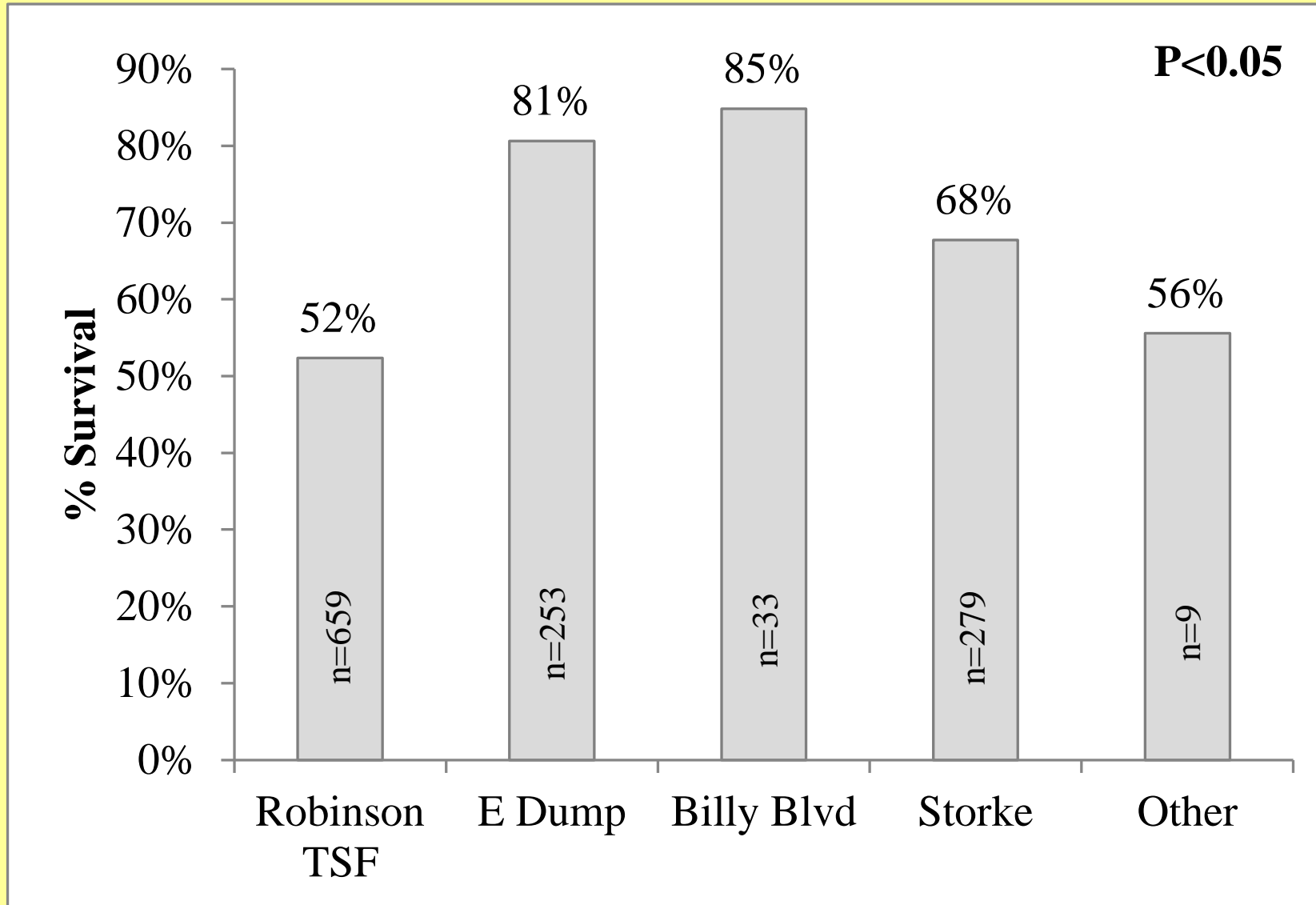
- 226 planted
- 218 (96%) alive in 2012
 - 97% Willows
 - 100% Birch
 - 100% Cinquefoil
 - 60% Currants
- All mortality on Robinson TSF likely due to drying



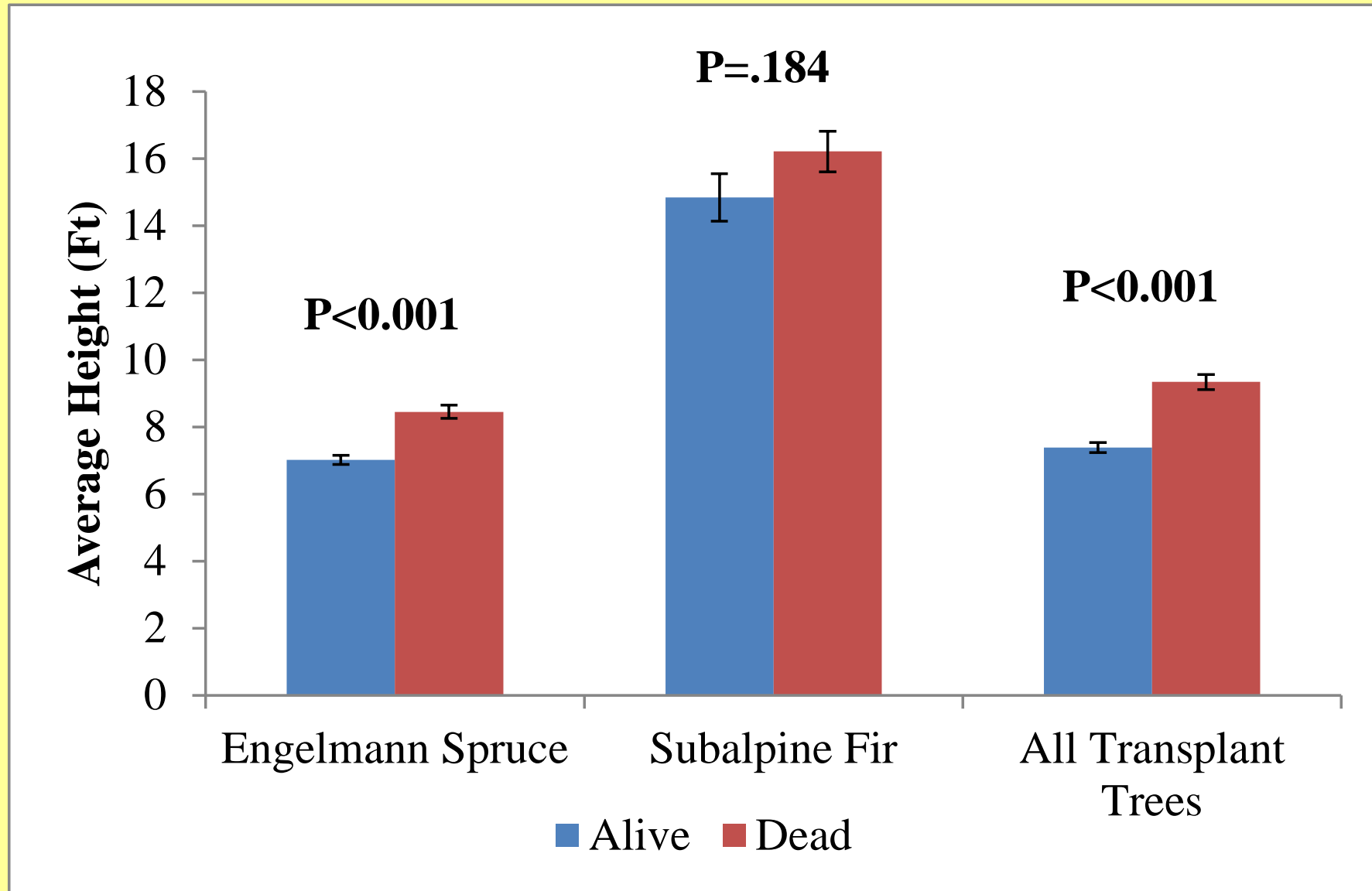
Results – Tree Transplants

	Transplanted 2005		Transplanted 2006		Transplanted 2007		All Transplants	
Transplant Species	Alive	% Survival	Alive	% Survival	Alive	% Survival	Alive	% Survival
Engelmann Spruce	222	54%	316	73%	195	66%	733	64%
Subalpine Fir	22	34%	10	91%	5	36%	37	41%
Lodgepole Pine	1	50%		0%			1	33%
Tree Total	245	51%	326	73%	200	65%	771	63%

Results – Tree Transplants by Location



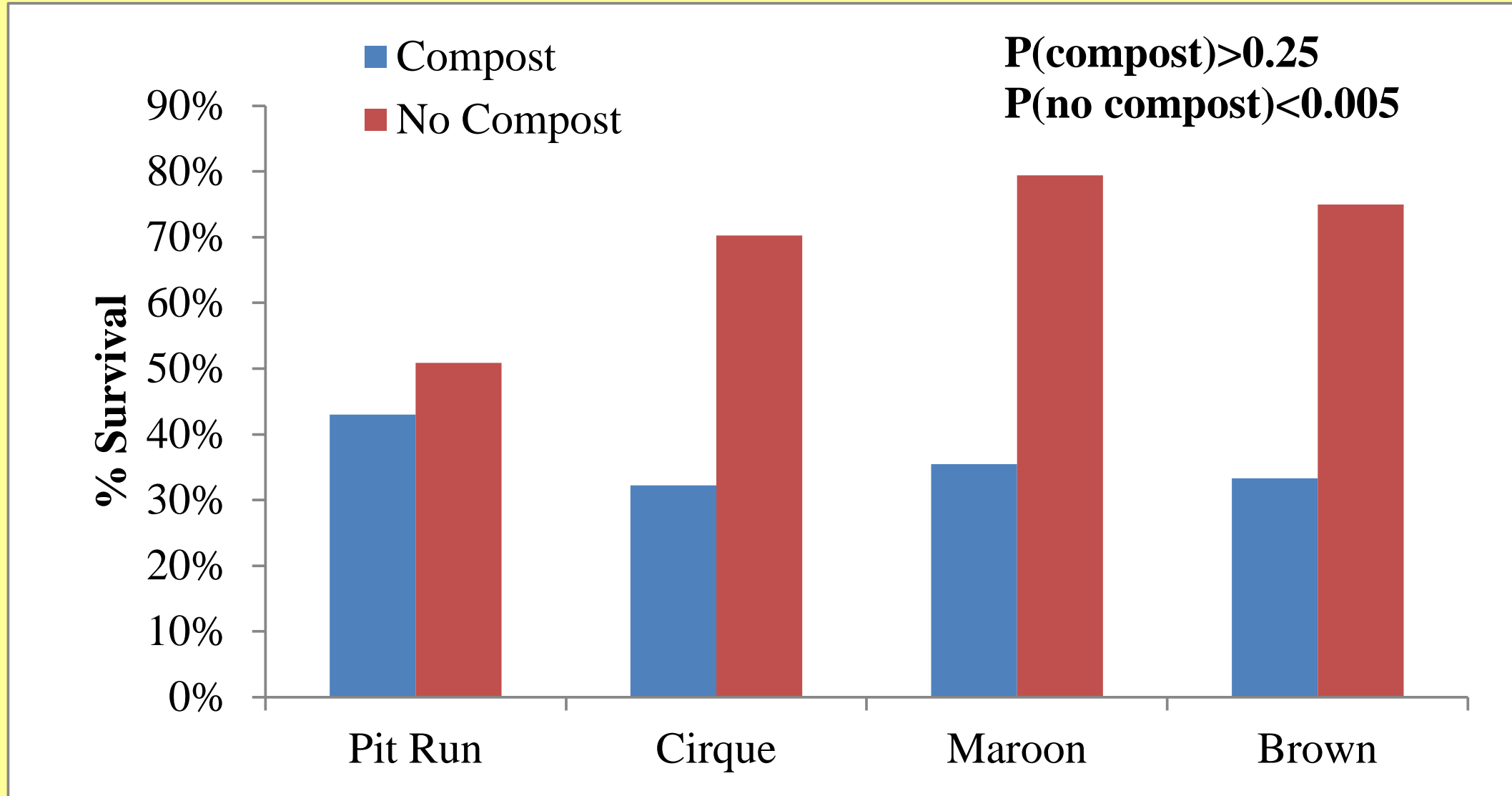
Results – Tree Transplants by Height



Results – Tree Transplants by Soil Type

Location	Soil Type	Spruce		Fir		Total	
		Alive	% Survival	Alive	% Survival	Alive	% Survival
E Dump	Pit Run	198	80%	6	100%	204	81%
Robinson TSF	Pit Run	154	46%			154	46%
	Cirque	39	49%	6	38%	46	47%
	Maroon	113	72%	14	64%	127	71%
	Brown	10	77%	5	42%	15	60%
	Dark Brown	5	71%			5	71%
	Dark Grey	1	100%	1	11%	2	20%
Billy Blvd	Dark Grey	28	85%			28	85%
Storke	Fill	184	69%	5	36%	189	68%
Native	Topsoil	1	33%			1	33%
Total		551	71%	37	47%	589	69%

Results – Tree Transplants by Soil Type



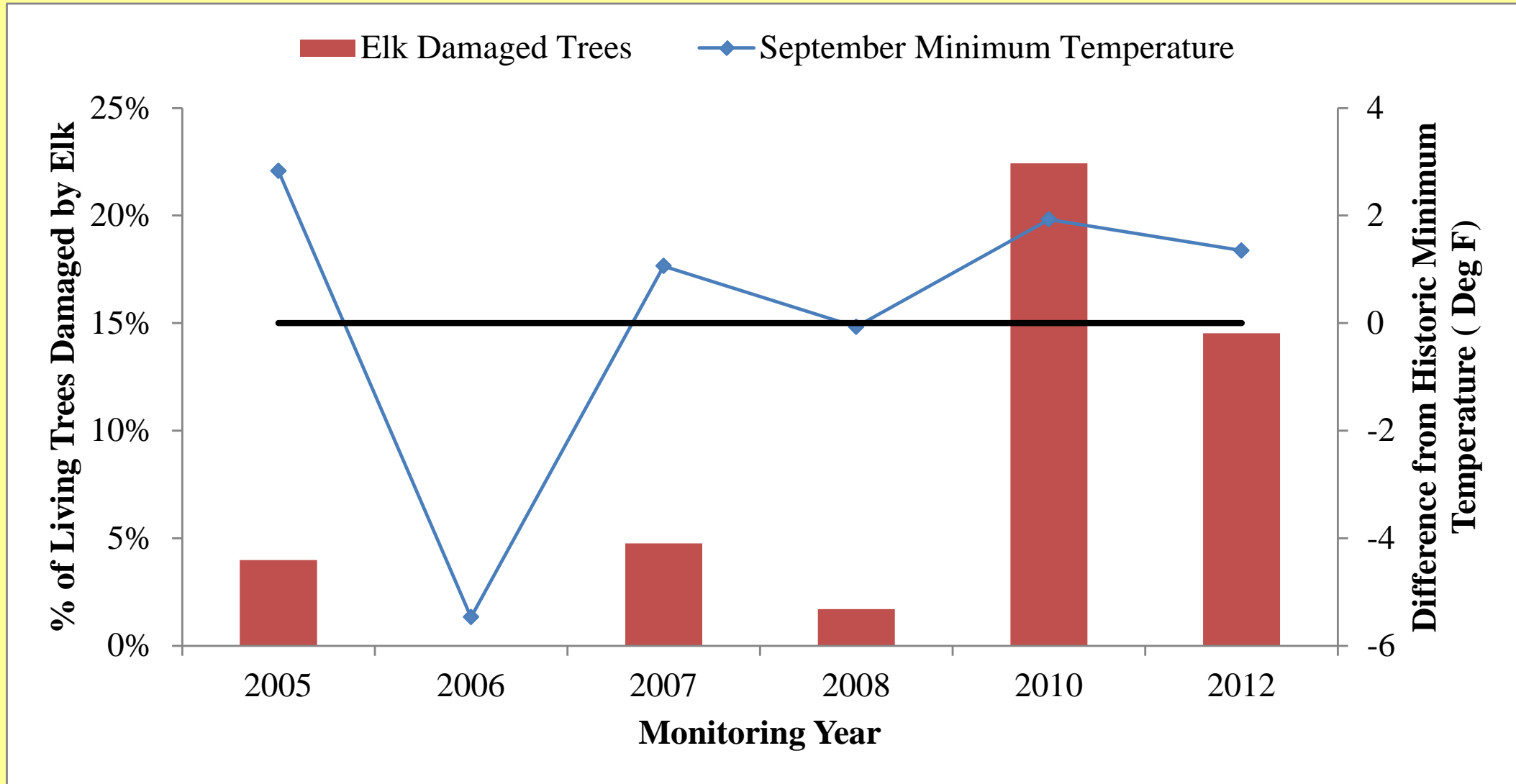
Results – Tree Transplants & Elk Damage



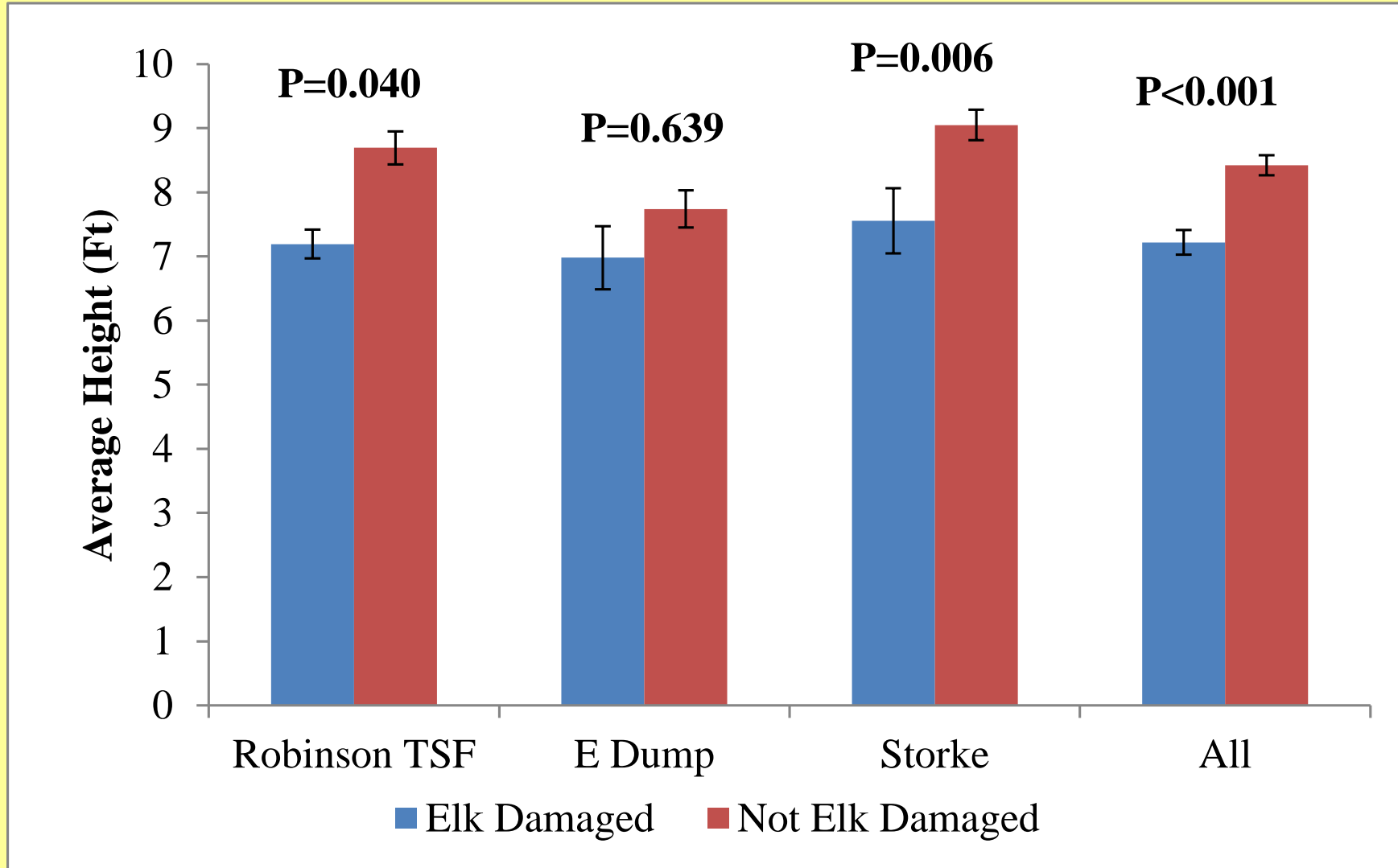
Results – Tree Transplants & Elk Damage

Location Planted	Trees Damaged By Elk	% of Planted Trees Damaged	Dead Elk Damaged Trees in 2012	% of Elk Damaged Trees Killed
Robinson TSF	220	33%	73	33%
E Dump	44	17%	0	0%
Storke	48	17%	7	15%
Total	312	25%	80	26%

Results – Tree Transplants & Elk Damage



Results – Tree Transplants & Elk Damage



Project Costs

- Project Cost \$650,000

Root Ball Size	Height Range	2005-2006*	2007*	2013 Estimated Retail **
32"	2 – 6 ft	\$ 275	\$ 330	\$ 330 – \$ 490
44"	6 – 10 ft	\$ 425	\$ 510	\$ 550 – \$ 1,010
60"	10 – 16 ft	\$ 550	\$ 660	\$ 1,070 – \$ 1,560
72"	> 16 ft	\$ 695	n/a	Variable

* includes labor, equipment, and materials

** range depends on tree height and includes a 2x factor on retail purchase price for delivery and planting



Conclusions

- 68% of all individuals transplanted still living in 2012
 - 96% of shrubs
 - 63% of trees
- Goal of 50% first year survival surpassed

Conclusions

- Locally harvested trees more successful than those trees imported from Wyoming
- Shorter trees were more successful than tall trees
- Trees planted into locally stripped subsoil materials were more successful than those transplanted into rocky pit run material
- Trees planted in areas reclaimed without compost were more successful than those planted into compost
- 6% loss to elk damage represents a preventable loss of \$20,000 to \$50,000 in trees
- Spring watering before the monsoons start may have been beneficial

Conclusions

- Mature trees and shrubs provide...
 - Vegetation Structure
 - Visual cover for bird and mammal populations
 - Hunting perches for raptors
 - Seed island effect
 - Willows provide wetland community establishment and soil stabilization
 - Aesthetic view from the public highway.



Questions?

