



IN-SITU SOIL RECLAMATION

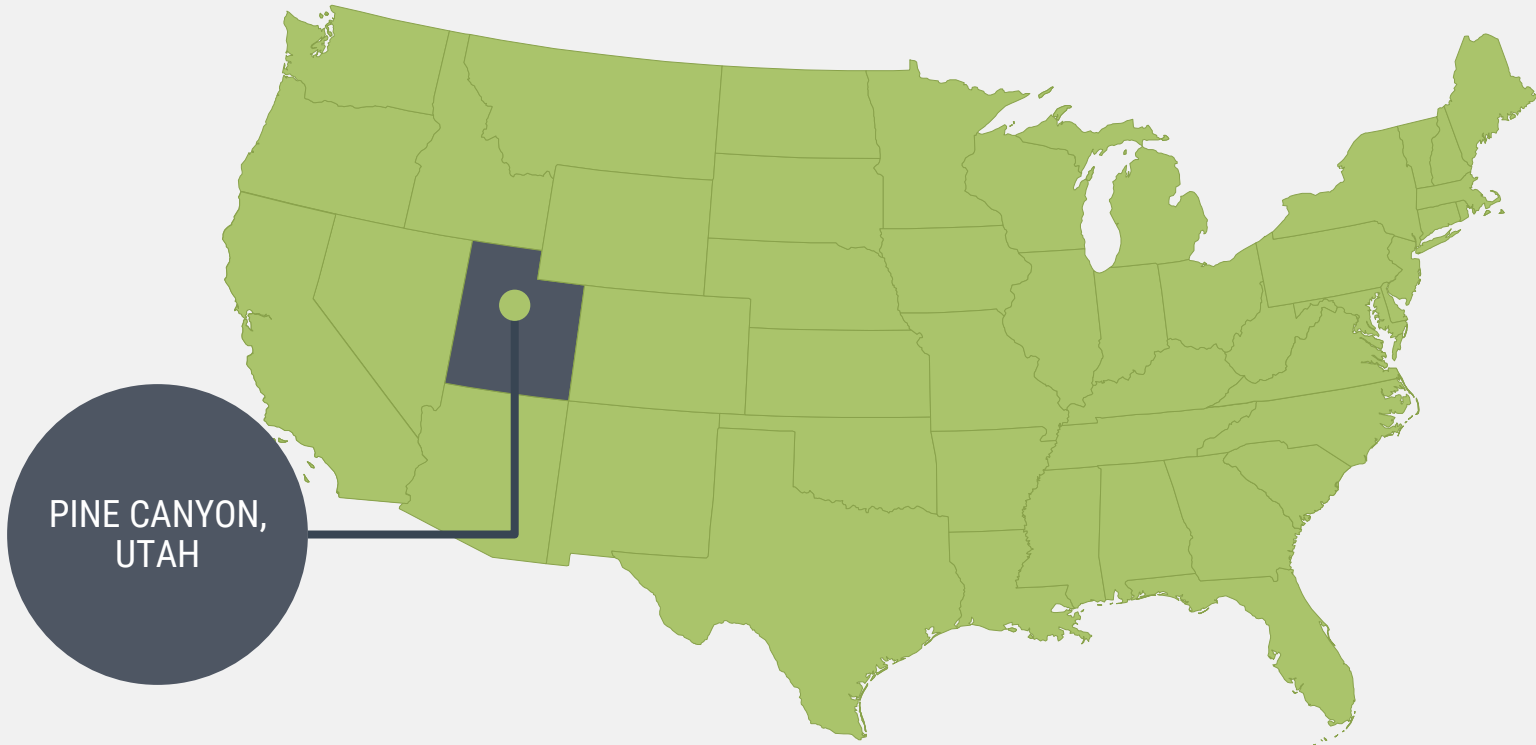
DEEP TILLING METHOD

PRESENTED BY: Erna Waterman, US Environmental Protection Agency (EPA)



PROJECT LOCATION

Pine Canyon, Utah



Operated 1908-1974



Treated 750,000 Tons of Ore



Produced

- 72,000 Tons of Lead Bullion
- 10,000 Tons of Blister Copper
- 9,000,000 Ounces of Silver
- Numerous by products



1986: 3,000 Acre Smelter Site Reclaimed



2007: Pine Canyon Conservation Area for Wildlife Conservation Established

HISTORY

International Smelter and Refining Company
formed by the Anaconda Copper Company

NIX FIELD



- Nix Field is 96 acre area located along the western border of a smelter and refinery site
- Originally characterized during Remedial Investigation as and Agriculture Land Use
- Recently Re-Zoned for ranchette type residential (5 ac lots)
- Future residential development will require mitigation of risk from lead and arsenic to match new Land Use



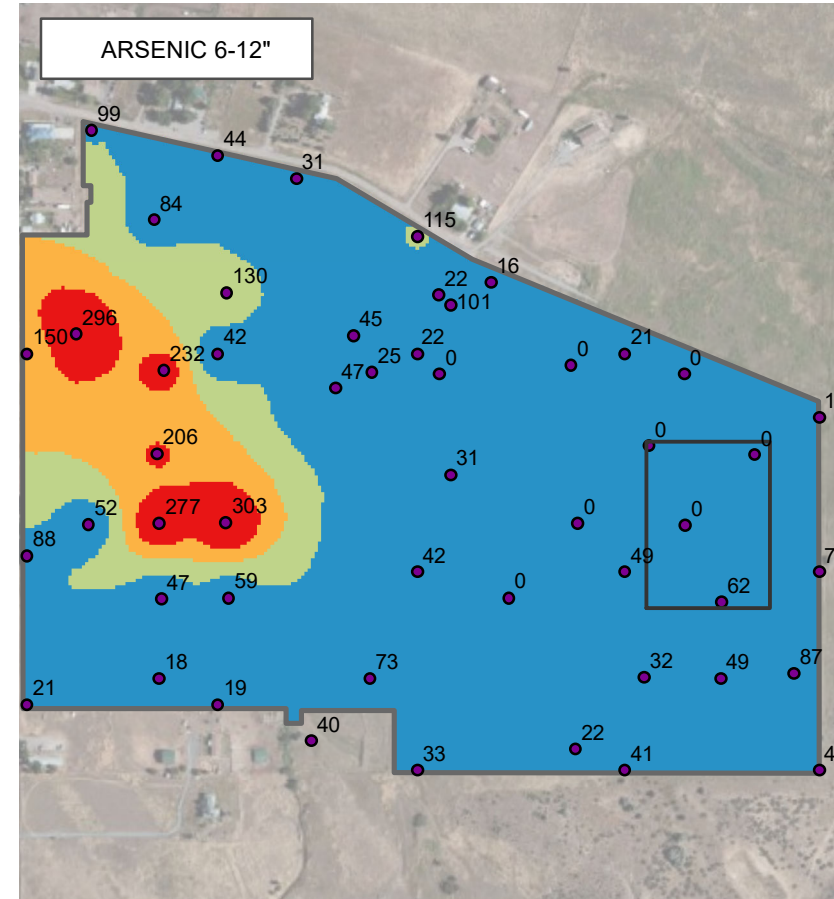
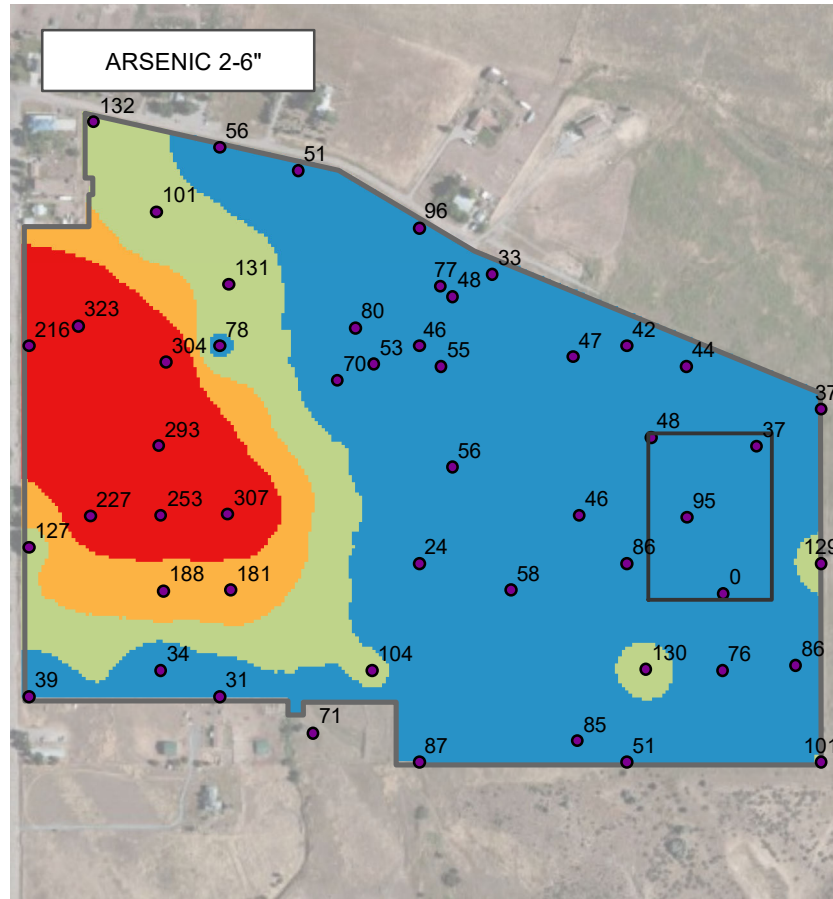
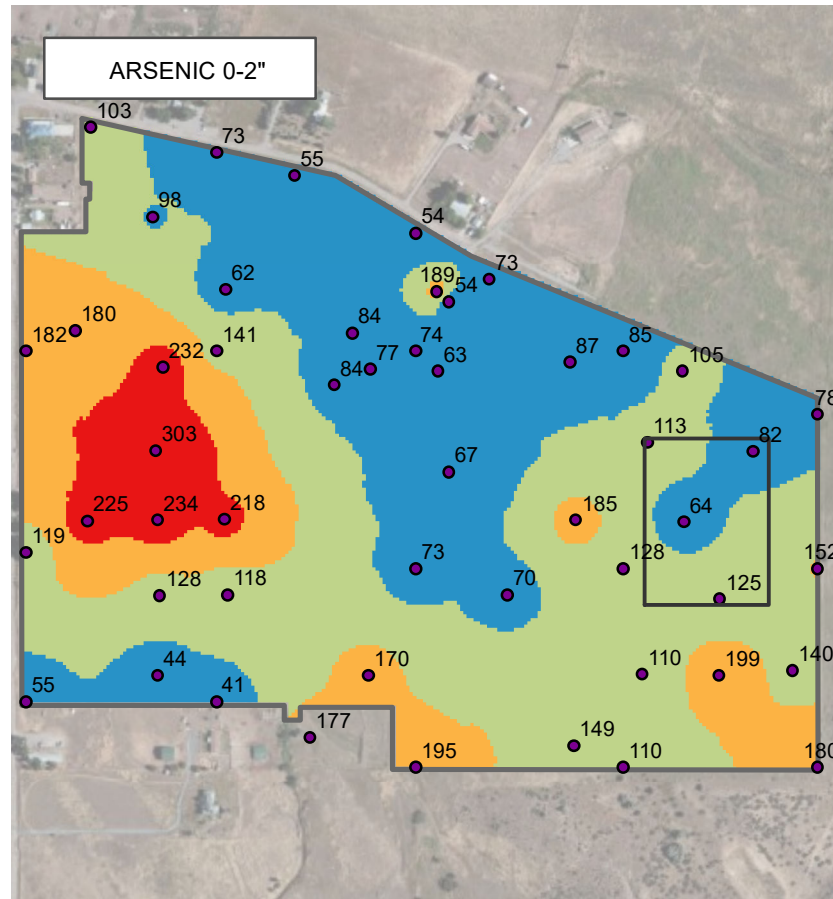
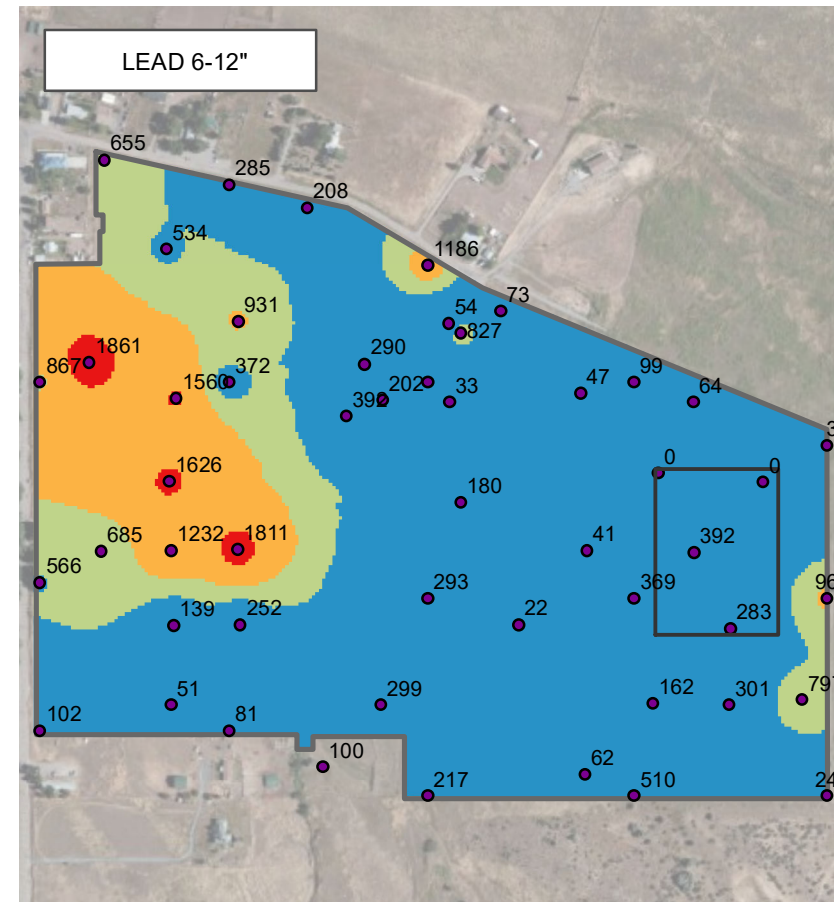
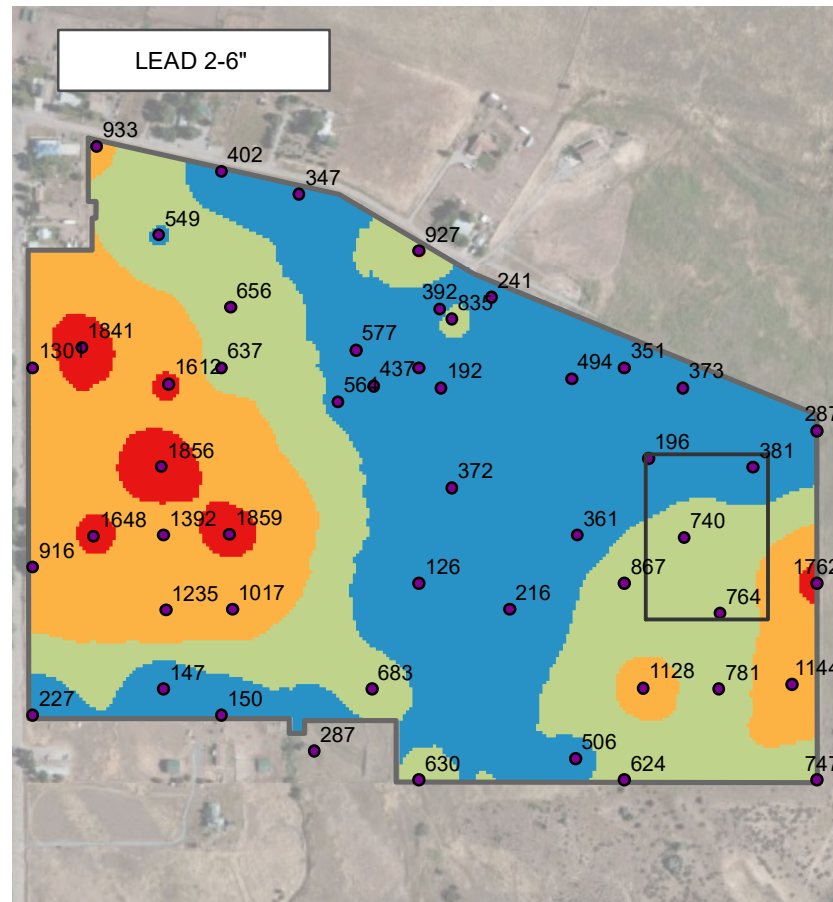
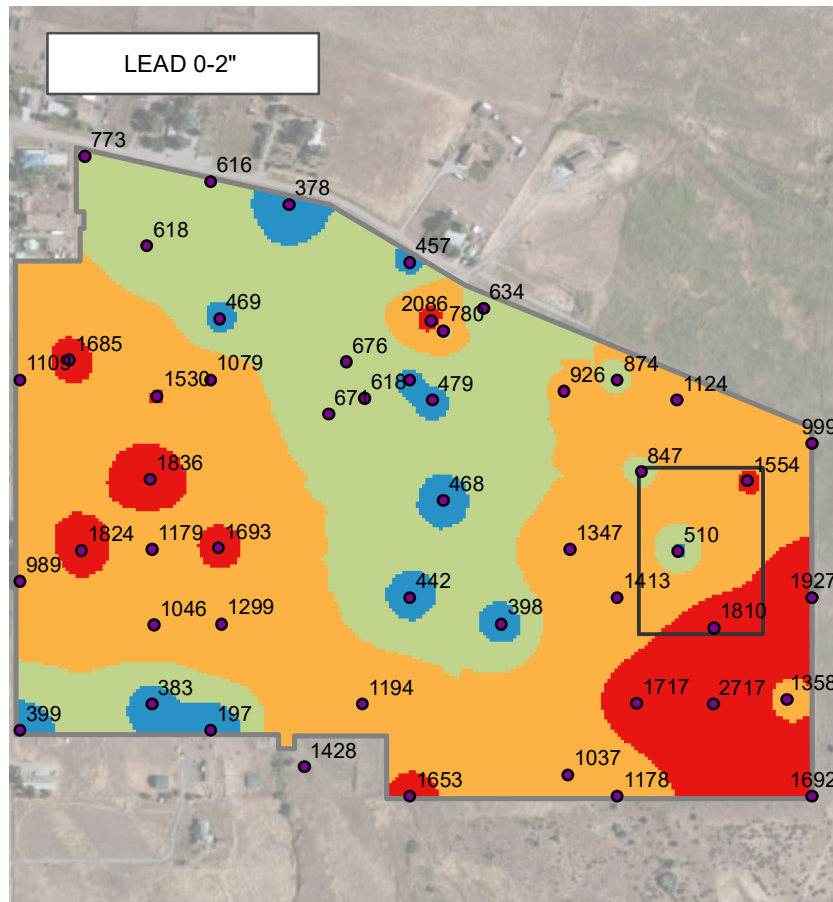
NIX FIELD



FORMER SMELTER
LOCATION

NIX FIELD PROPERTY
BOUNDARY





General Notes

- TILLING TEST PLOT
- COMBINED AECI AND BYU INTERPOLATED DATA
- SITE BOUNDARIES

ARSENIC VALUES

PPM

- 0 - 100
- 101 - 150
- 151 - 200
- 201 - 300

LEAD VALUES

PPM

- 202 - 580
- 581 - 900
- 901 - 1,500
- 1,501 - 3,000

Feet

0 310 620

ATLANTIC RICHFIELD COMPANY



NIX FIELD
COMBINED AECI DATA AND
INTERPOLATED BYU DATA

TOOELE COUNTY, UTAH

DRAWN BY:	MSH
ENGINEER:	
APPROVED:	

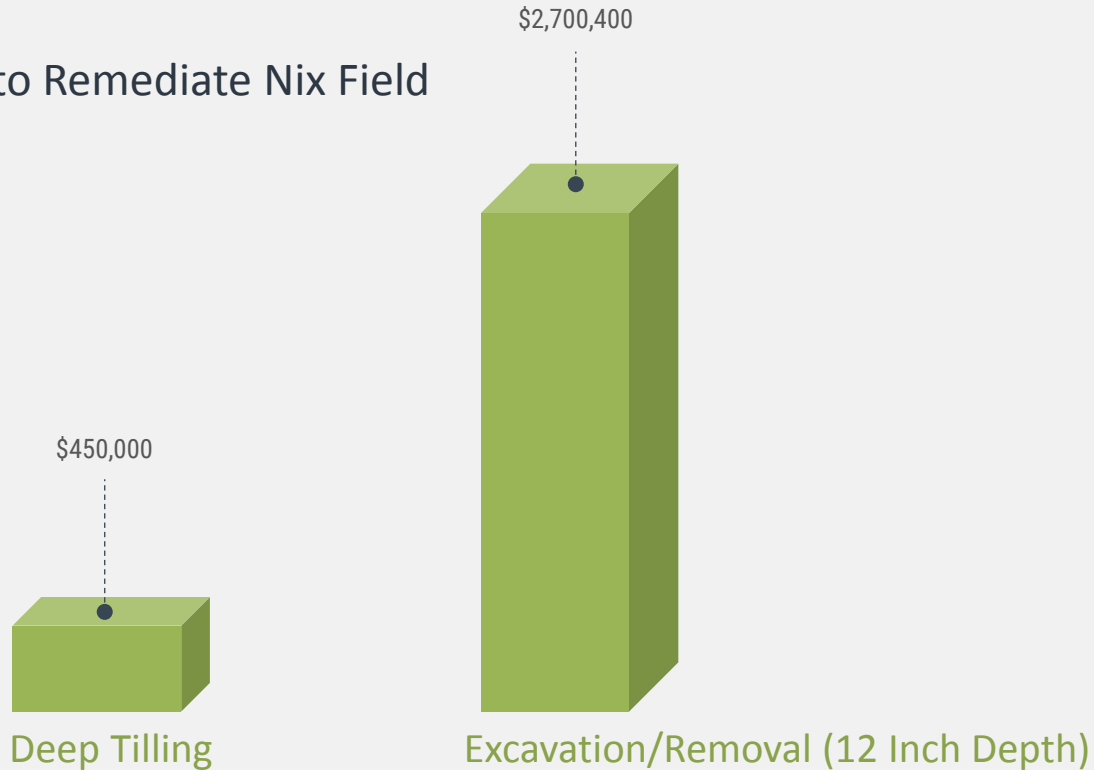
Project	Figure
Date	08 - JUL - 2015
Scale	1"=1,600'

XX

FORECASTED REMEDIAL COST



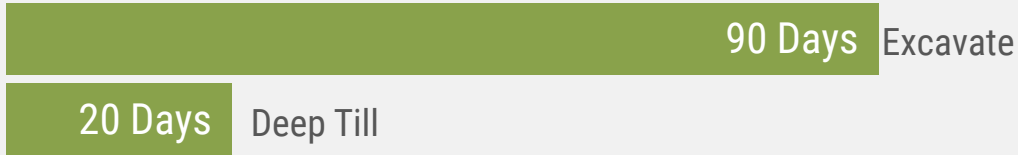
Estimated Costs to Remediate Nix Field



FORECASTED CONSTRUCTION DAYS



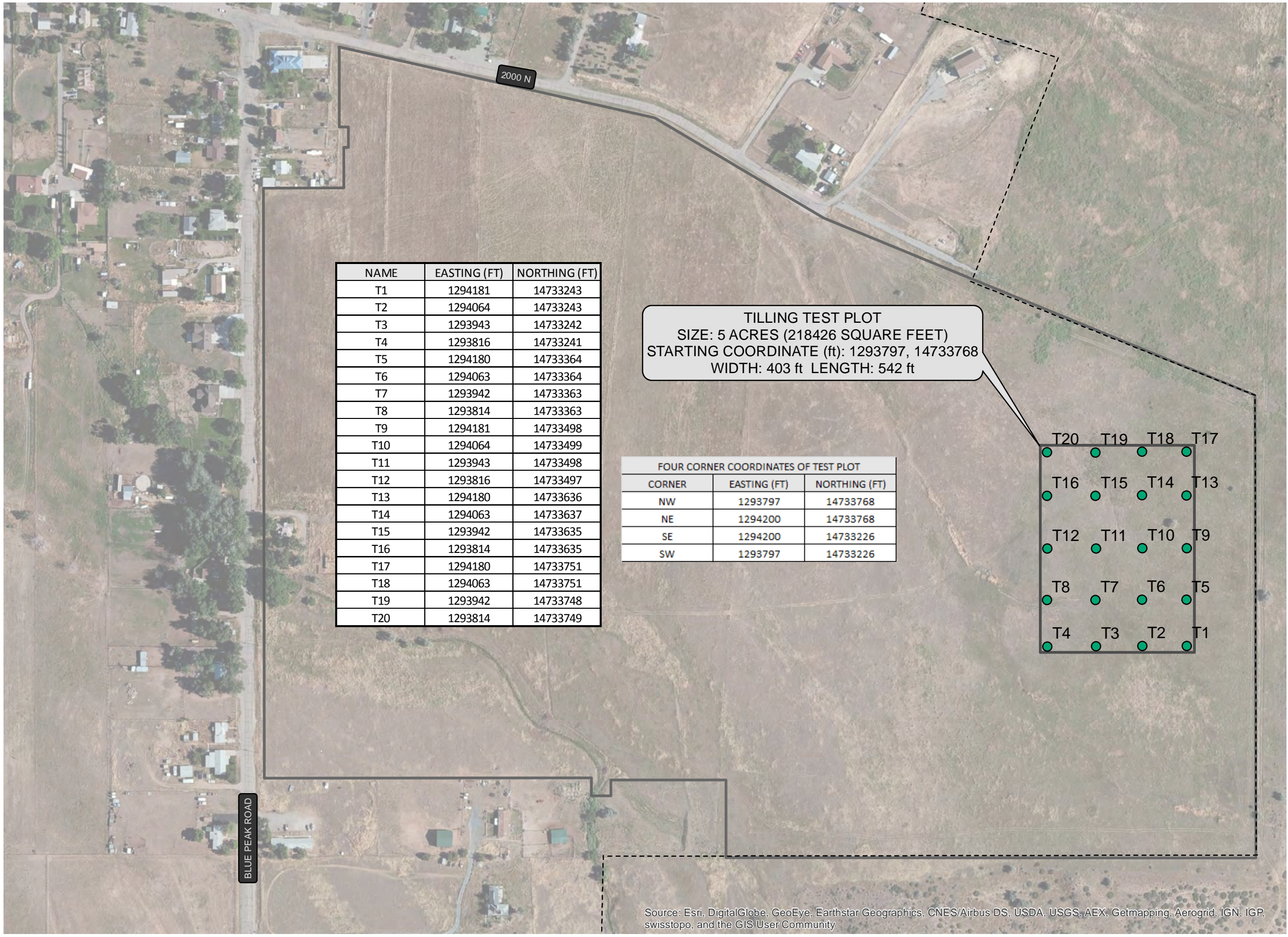
Estimated Time to Remediate Nix Field



TEST PLOT LOCATION SELECTION



- A 403 feet X 542 feet (~5-acre) test plot location was chosen based on previous sampling results
 - Plot has a wide range of lead and arsenic concentrations:
 - Low: Pb 510 mg/kg, As 64 mg/kg (Surface)
 - High: Pb 1810 mg/kg, As 125 mg/kg (Surface)



NAME	EASTING (FT)	NORTHING (FT)
T1	1294181	14733243
T2	1294064	14733243
T3	1293943	14733242
T4	1293816	14733241
T5	1294180	14733364
T6	1294063	14733364
T7	1293942	14733363
T8	1293814	14733363
T9	1294181	14733498
T10	1294064	14733499
T11	1293943	14733498
T12	1293816	14733497
T13	1294180	14733636
T14	1294063	14733637
T15	1293942	14733635
T16	1293814	14733635
T17	1294180	14733751
T18	1294063	14733751
T19	1293942	14733748
T20	1293814	14733749

TILLING TEST PLOT
 SIZE: 5 ACRES (218426 SQUARE FEET)
 STARTING COORDINATE (ft): 1293797, 14733768
 WIDTH: 403 ft LENGTH: 542 ft

FOUR CORNER COORDINATES OF TEST PLOT		
CORNER	EASTING (FT)	NORTHING (FT)
NW	1293797	14733768
NE	1294200	14733768
SE	1294200	14733226
SW	1293797	14733226



- General Notes
- POST&PRE TILLING SAMPLING
 - TILLING TEST PLOT
 - - - - IS&R BOUNDARY
 - SITE BOUNDARIES

**TOOELE COUNTY
HEALTH
DEPARTMENT**



NIX FIELD
SITE MAP

LEAD & ARSENIC
CLEANUP
TOOELE COUNTY, UTAH

DRAWN BY:	MSH
ENGINEER:	
APPROVED:	

Project	NIX & SCOUT CLEANUP	Figure	03
Date	01 - JUL - 2015		
Scale	1"=1,600'		

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Z:\BP\0-t\ah\IS&R EPA Lincoln Sampling\Drawings\150706 Nix Cleanup Options

DEMONSTRATION OBJECTIVE



- Reduce lead and arsenic concentrations in impacted soil to acceptable thresholds:
 - 580 mg/kg lead
 - 100 mg/kg arsenic.
- Provide site-specific information concerning the effectiveness of soil tilling/blending
- Deep Till to a 18 Inch Depth

METHOD SELECTION



Two remedial action methods were considered

- **Excavation**
 - Effectively removes impacted material from site
- **Deep Tilling**
 - Because previous uses of tilling mixed only the top few inches of the soil profile
 - For this demonstration a recycler was selected with 18 inch mixing depth capability

OBJECTIVE



- What initial concentrations of metals in the soil have a high potential to obtain project risk criteria (CUL's)?
- What level of mechanical effort is required to effectively blend the soil?
- What depths can the mechanical equipment effectively blend soil?
- What are the effects of blending on the distributions of metals in the soil?
- What are the effects of blending on the physical characteristics of the soil?

SOIL MIXING



BOMAG 454 Recycler

Ability to mix soil up to 18" deep

Cost to use BOMAG Recycler:

\$4,300 (\$1,350 per day)



SOIL MIXING



FIELD PROCEDURES



- BOMAG Recycler made 1-3 passes over 5-acre test area
 - Used handheld Niton XRF unit in field to guide mixing
- All areas were passed over once
 - Areas that exceeded CUL's after first pass were passed over again
- Mixing depth was measured during and post mixing operation

DEEP TILLING



- Mostly level surface
- Small rise on the west end
 - Not powerful enough to mix while going up hill
 - Worked well going down hill
- Hard surface with a silty sand soil



SAMPLING PROTOCOL

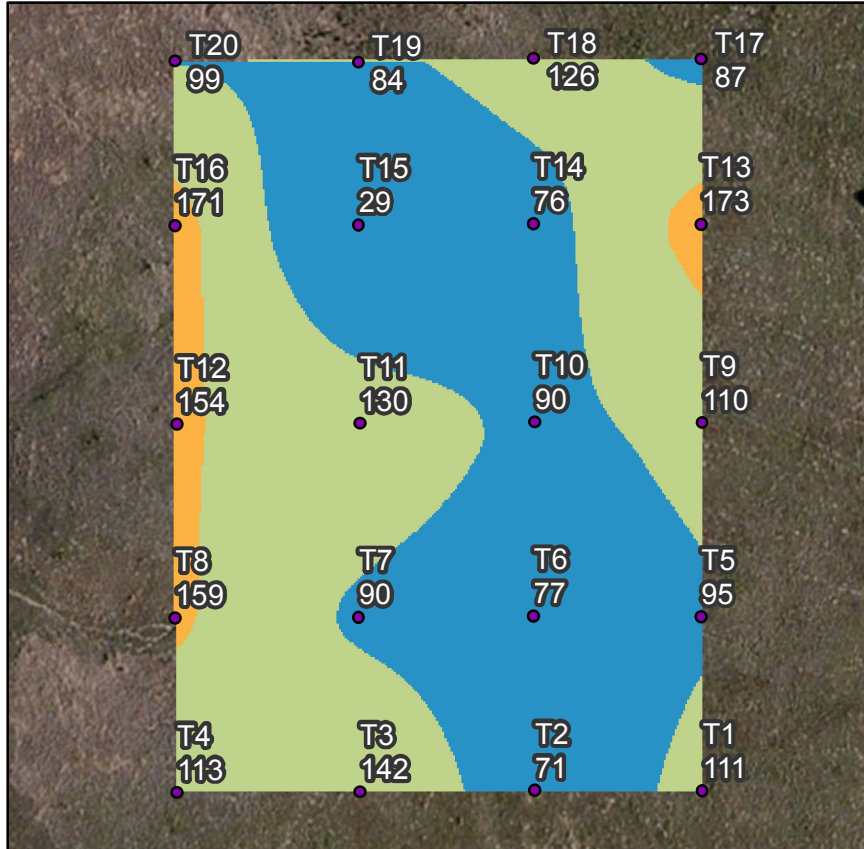


- Pre/post mixing sampling
 - Samples from 20 locations collected at three depths
 - 0-2 inches
 - 2-6 inches
 - 6-12 inches
 - Split Samples collected by BYU and Anderson Engineering
 - Duplicate samples were collected at a rate of 10%, (sent to third party lab for analysis)
 - Analysis completed on the < #60 sieve portion of sample
 - Field analysis completed with a handheld Niton XRF unit
 - Each sample was read three times and results averaged



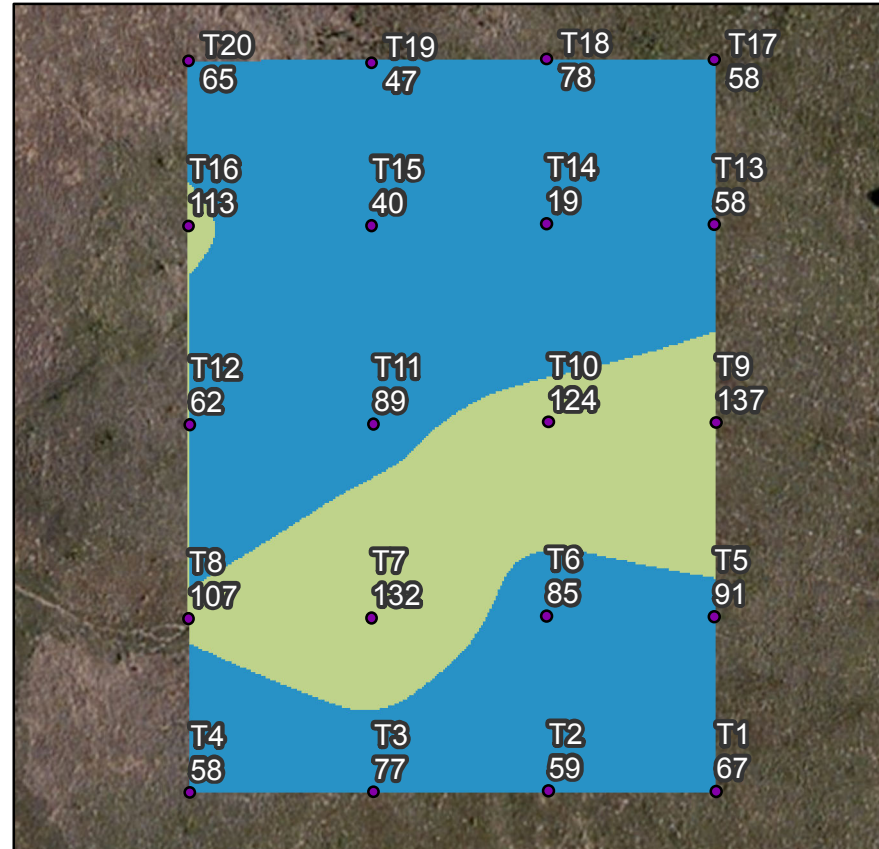
**ARSENIC PRE TILLING
VALUES 0-2"**

Average:
109 ppm



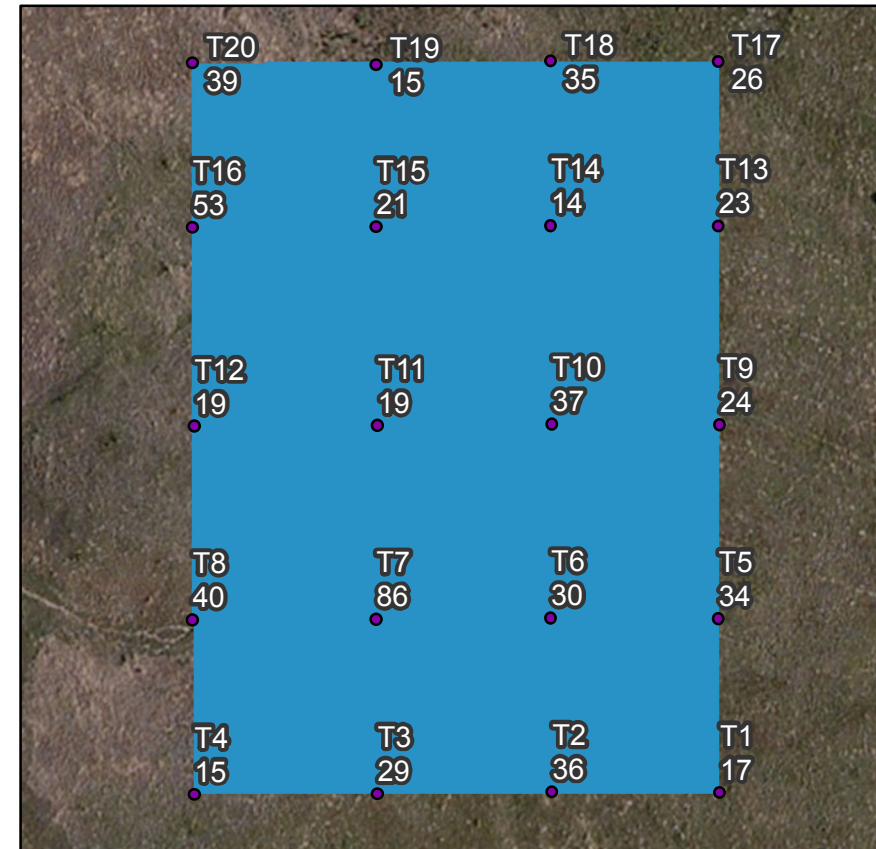
**ARSENIC PRE TILLING
VALUES 2-6"**

Average:
78 ppm



**ARSENIC PRE TILLING
VALUES 6-12"**

Average:
30 ppm



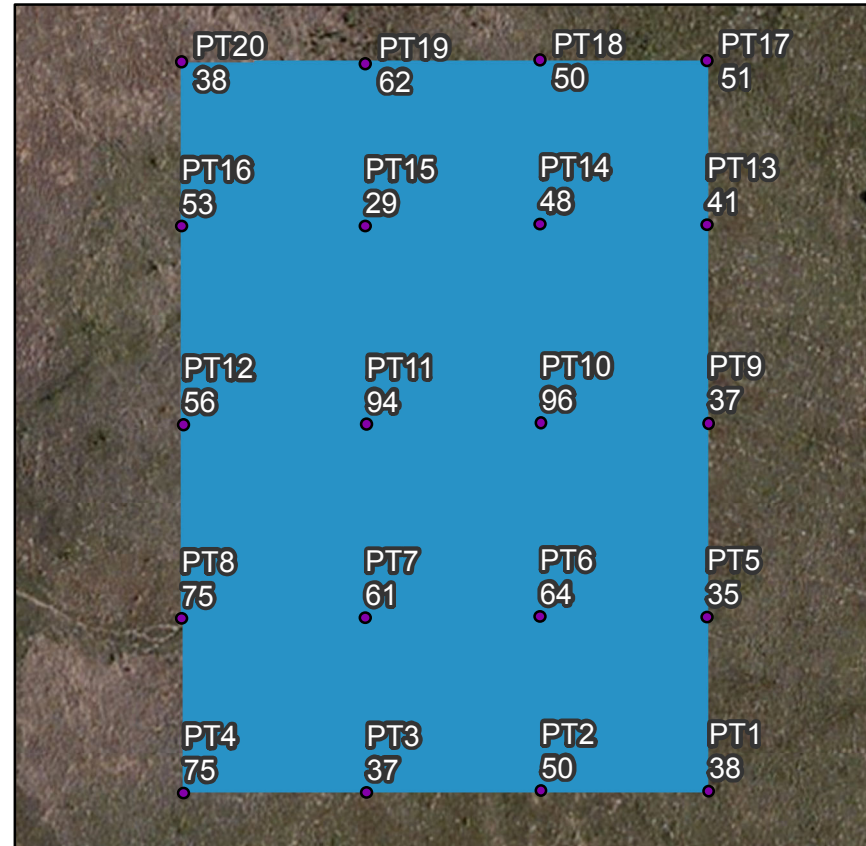
**ARSENIC POST TILLING
VALUES 0-2"**

Average:
55 ppm



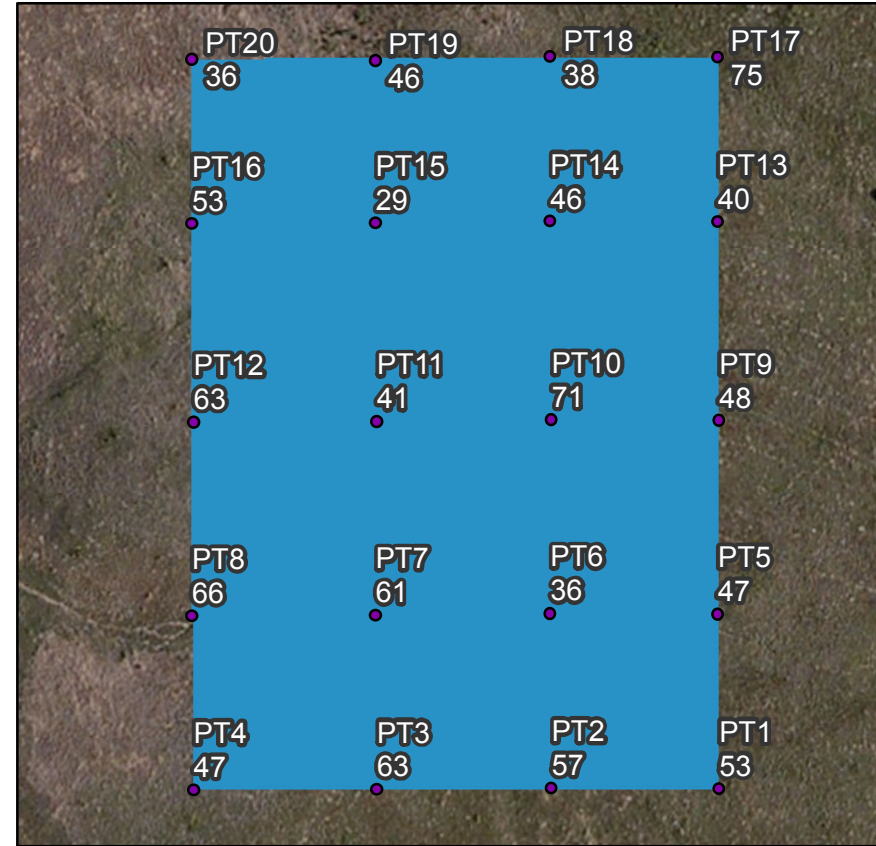
**ARSENIC POST TILLING
VALUES 2-6"**

Average:
55 ppm



**ARSENIC POST TILLING
VALUES 6-12"**

Average:
51 ppm



General Notes

- TEST PITS

ARSENIC VALUES
PPM

- 0 - 100
- 101 - 150
- 151 - 200
- 201 - 300

SCALE IN FEET
0 60 120

**ATLANTIC
RICHFIELD
COMPANY**



**NIX FIELD
PRE & POST TILLING
ARSENIC SAMPLING DATA**

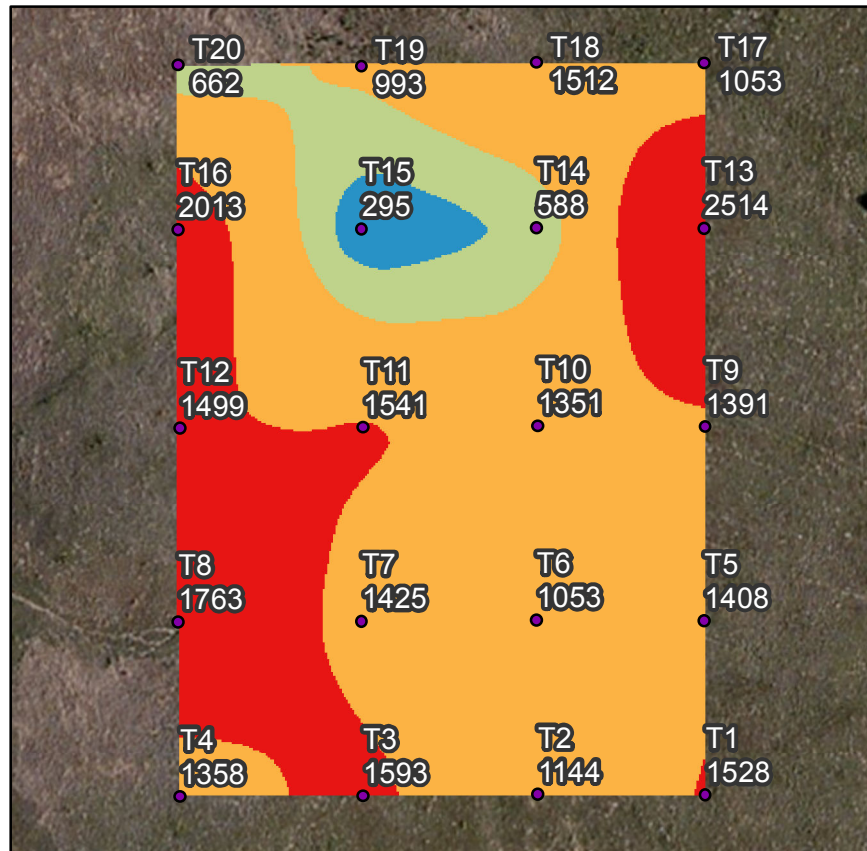
TOOELE COUNTY, UTAH

DRAWN BY:	AS
ENGINEER:	AS
APPROVED:	RA

Project text	Sheet 3
Date 20-NOV-2015	
Scale 1" = 133'	

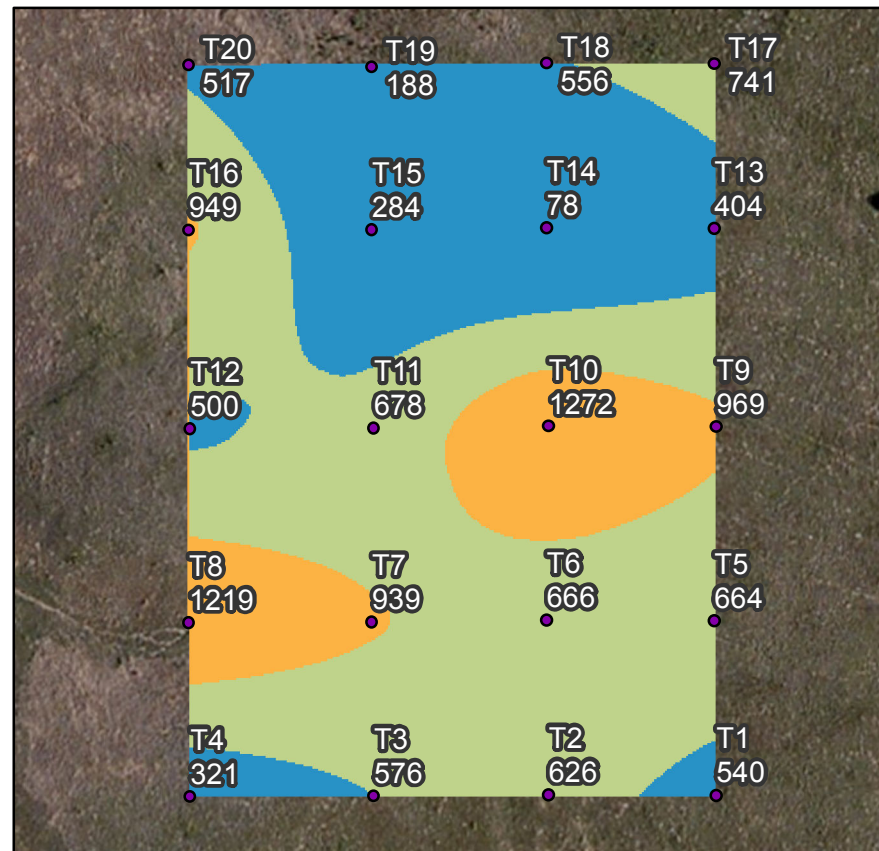
**LEAD PRE TILLING
VALUES 0-2"**

Average:
1334 ppm



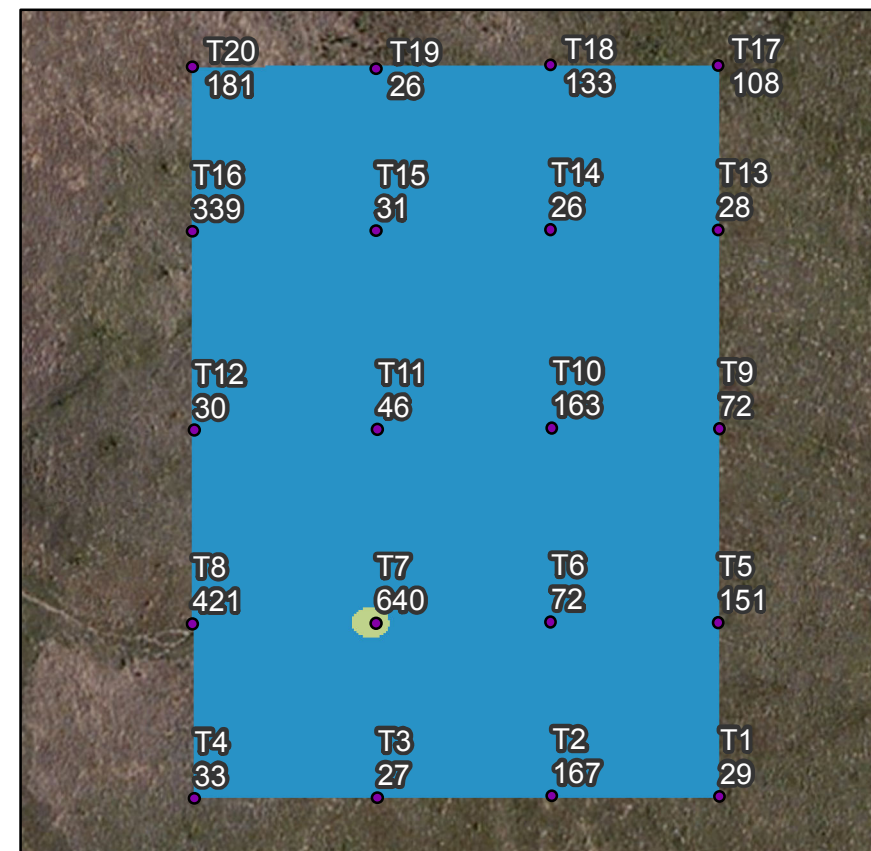
**LEAD PRE TILLING
VALUES 2-6"**

Average:
634 ppm



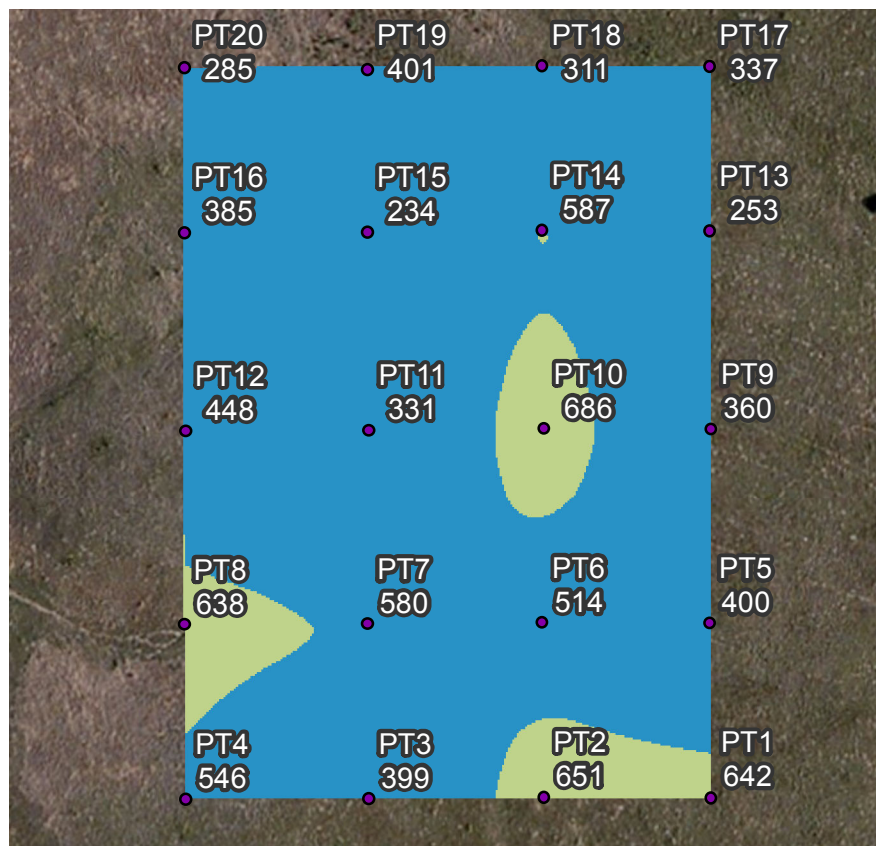
**LEAD PRE TILLING
VALUES 6-12"**

Average:
136 ppm



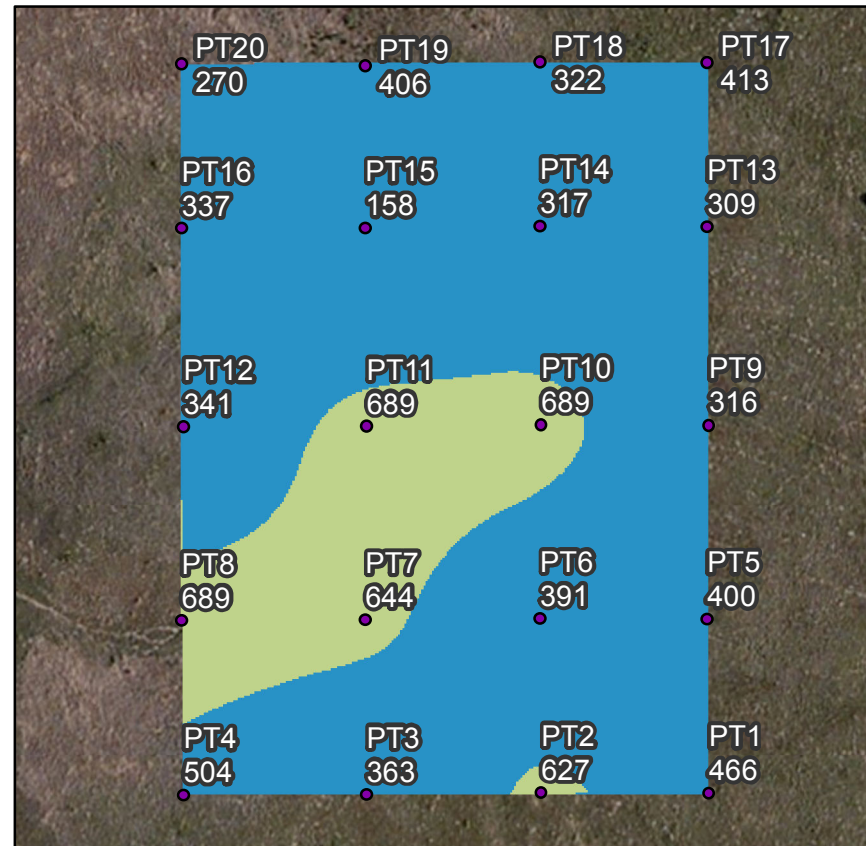
**LEAD POST TILLING
VALUES 0-2"**

Average:
449 ppm



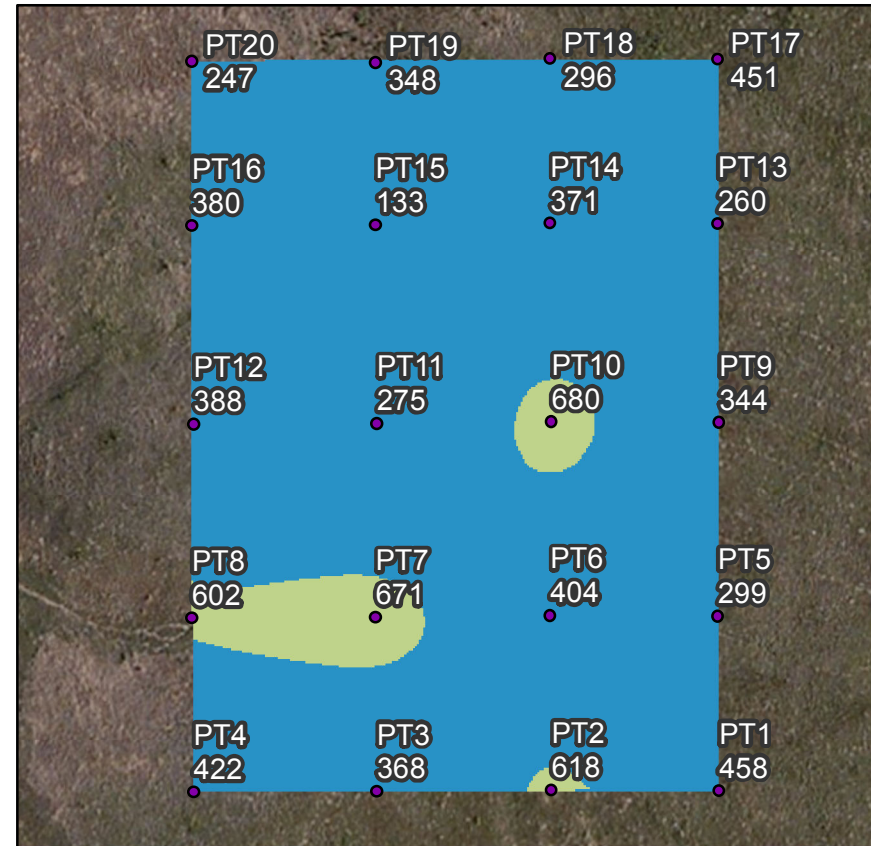
**LEAD POST TILLING
VALUES 2-6"**

Average:
433 ppm



**LEAD POST TILLING
VALUES 6-12"**

Average:
334 ppm



General Notes

- TEST PITS
- LEAD VALUES
PPM**
- 202 - 580
 - 581 - 900
 - 901 - 1,500
 - 1,501 - 3,000



ATLANTIC
RICHFIELD
COMPANY



NIX FIELD
PRE & POST TILLING
LEAD SAMPLING DATA

TOOELE COUNTY, UTAH

DRAWN BY:	AS
ENGINEER:	AS
APPROVED:	RA

Project text	Sheet
Date 20-NOV-2015	2
Scale 1" = 133'	

RESULTS (CONT'D)



- Duplicate sample results from XRF and American West Analytical Labs

Pre-Tilling

Location ID	Arsenic mg/kg (XRF)			Arsenic mg/kg (AWAL)		
	0-2 in.	2-6 in.	6-12 in.	0-2 in.	2-6 in.	6-12 in.
T4	113	58	15	167	78.8	19.8
T12	154	62	19	191	75.5	16.6

Location ID	Lead mg/kg (XRF)			Lead mg/kg (AWAL)		
	0-2 in.	2-6 in.	6-12 in.	0-2 in.	2-6 in.	6-12 in.
T4	1358	321	33	1630	531	32.7
T12	1499	500	30	1630	618	20.4

Post-Tilling

Location ID	Arsenic mg/kg (XRF)			Arsenic mg/kg (AWAL)		
	0-2 in.	2-6 in.	6-12 in.	0-2 in.	2-6 in.	6-12 in.
T3	61	37	63	47.6	47.6	46.5
T18	49	50	38	48	45.4	50.3

Location ID	Lead mg/kg (XRF)			Lead mg/kg (AWAL)		
	0-2 in.	2-6 in.	6-12 in.	0-2 in.	2-6 in.	6-12 in.
T3	399	363	368	386	388	362
T18	311	322	296	339	331	381

CONCLUSIONS



- Over 50% reduction in lead and arsenic levels at 0-2" and 2-6" depths
- Increase in concentrations at 6-12 inches, however remained below CULs.
- Arsenic reduced to below CULs at all locations
- Lead Reduced below CULs at most locations
- 5-acre average now below CULs



Thank You